D2.2 Strategy blueprints for Urban ReLeaf city pilots

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Authors	Temmerman Laura (VUB), Veeckman Carina (VUB)
Contributors	Ilia Christantoni (DAEM), Dimitra Tsakanika (DAEM), Vanessa Boas (IIASA), Gerid Hager (IIASA)

Short description	This document delivers a Blueprint for Inclusive Engagement Strategies, which identifies step-by-step guidance for ensuring inclusive engagement in Urban ReLeaf cities. The deliverable also provides the collective visions for inclusive citizen observation campaigns to complement authoritative and official measurements, based on the results of the multistakeholder workshops carried out in and by the Urban ReLeaf pilot cities.
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Project Partners

Table of Contents

Acronyms and definitions

CS	Citizen Science	An initiative that "involves scientific research conducted in whole or in part by non-scientists (citizens), often in collaboration with, or under the guidance of professional scientists." (Veeckman et al., 2021)
-	Citizen	A member of a broadly construed community, independent of their legal status (Eitzel et al., 2017).
-	Participation (in the scope of CS)	Intentional collaborations in which members of the public take part in the process of research to generate new science-based knowledge (Shirk et al., 2012). The type of participation can differ depending on the level of contribution offered to, or required from, participants.
-	Engagement (in the scope of CS)	Emotional, behavioural, cognitive, and social contributions of participants to a CS project (Phillips et al., 2019)
-	Campaign (in the scope of Urban ReLeaf)	A coherent, timebound set of activities (in a specific geographic area) to engage citizens in observation and data collection activities. A city can run several distinct campaigns, if suitable and economical. Each campaign is also targeted at a special focus audiences, but not exclusively.
-	Vulnerable	Being vulnerable is a position of relative disadvantage and will depend on the scope of each CS project or campaign.
SE	Socio-economic	Refers to socio-economic characteristics (e.g., employment status, education level, financial situation).
SD	Socio-demographic	Refers to socio-demographic characteristics (e.g., age, gender).

List of Figures

List of Tables

Executive Summary

Marginalized and vulnerable groups experience profound environmental and climate injustices, being disproportionately affected by these issues despite their minimal responsibility and coping resources. This disparity extends not just between countries but also within communities of the Global North. Additionally, these communities lack representative data and are excluded from Citizen Science (CS) initiatives, intensifying their injustices. Despite the potential benefits of CS, these initiatives often involve predominantly privileged individuals, excluding the very communities most impacted. This exclusion highlights the urgent need for inclusive practices in CS to address these injustices.

In response to these challenges, this report presents a Blueprint for Inclusive CS Engagement Strategies. This blueprint, developed for the Urban ReLeaf project's six pilot cities, addresses the critical issue of inclusive engagement. Divided into four phases (Preparing, Planning, Interacting, and Monitoring for inclusion) and eight steps (Explore, Understand, Organise, Design, Recruit, Communicate, Engage, and Assess), the blueprint guides the cities through the process of engaging non-traditional citizens, especially those from vulnerable and marginalized groups, in CS activities. The blueprint is a comprehensive guide, detailing considerations and guidelines for each step.

Additionally, this report shares the outcomes of Phase I of the blueprint: Preparing for inclusion. It provides insights from multistakeholder workshops held in each pilot city, offering visual summaries for personas associated with prioritized target groups and co-created campaign ideas. These tools empower the pilot cities in subsequent stages of the development of their observation and monitoring campaigns (T4.1) by facilitating informed decision-making and community engagement.

1 Introduction: the need for inclusive Citizen Science

Marginalised and vulnerable groups suffer from a number of injustices in society, especially in regard to environmental degradation and climate change. **These groups have been reported to suffer from a double environmental and climate injustice:** they are the most likely to be harmed by climate change and environmental issues are also least responsible for causing it, and least equipped to cope with the consequences (Gough, 2011, 2019). While this injustice is the most apparent between countries of the Global North and the Global South, it also applies *within* countries of the Global North (Hvinden & Schoyen, 2022). A stark example comes from air quality, where households living in poverty have the highest levels of exposure to air pollution, while simultaneously contributing significantly less and having a more limited capacity to alter their situation, e.g., by moving to a less polluted area (Barnes et al., 2019). Parallel to this, **marginalised and vulnerable groups of society are also the least likely to have data representative of them or their situation**, which in turn affects their ability to take action or be taken into consideration by governments' resource allocation or policy formulation, as information about them is missing (Renner et al., 2018). Against this backdrop, Citizen Science (hereafter: CS) has been championed as a way to collect rich and detailed information about their experience and needs (West & Pateman, 2017).

Engaging a diverse public in CS offers additional benefits: it not only amplifies data collection and analysis but also diversifies perspectives, enhances the societal relevance of science by bridging local knowledge with research, improves the quality and legitimacy of knowledge by rectifying skewed representation, boosts scientific literacy through participatory learning opportunities, and fosters public acceptance of scientific outcomes by building trust between research teams and local communities (Brouwer & Hessels, 2019; Varga et al., 2023). This engagement leads to **epistemic improvements** (i.e., enhancement or advancement of knowledge) as diverse public involvement challenges biased assumptions and betters the accuracy and representativeness of research. Additionally, **ethical enhancements** occur as the values reflected in scientific results align more closely with societal concerns such as fairness and justice, thanks to the input from individuals with relevant personal experiences. Lastly, **political legitimacy** is reinforced as diverse public participation ensures that scientific findings are rooted in acceptable values for public decision-making, strengthening public trust and support for science and contributing to democracy, civic engagement, and community cohesion (Schroeder, 2022; Varga et al., 2023).

Of course, **these benefits rest on the critical assumption that a diverse and representative sample of society will take part in the research activities** (Brouwer & Hessels, 2019). Unfortunately, real-life practices do not correspond to this assumption since the same exclusionary processes that are present on a wider societal level are also reflected within CS initiatives (Varga et al., 2023). CS initiatives generally fail to engage diverse citizens and most often deal with an overrepresentation of the same profile: white middle-aged men from a higher educational and higher socioeconomic background (Cooper et al., 2021; Haklay, 2015; National Academies of Sciences, Engineering, and Medicine, 2018; Pateman et al., 2021; Vasiliades et al., 2021). Overall, CS is not accessible to all, and is currently "leaving some behind"'.

This lead marginalised and vulnerable groups of society to suffer from a double data injustice where they are least likely to have representative data while also being least likely

to take part in monitoring activities. Another example comes from air quality monitoring, where areas made up of higher percentages of minority and lower-income households experience worse air pollution exposures along with decreased sensors per capita, and therefore limited access to relevant, potentially protective air pollution exposure information (Mullen et al., 2022).

The disparities and injustices faced by marginalized and vulnerable groups, especially in the face of environmental degradation and climate change, are clear and pressing issues. In this context, the importance of inclusion in CS cannot be overstated. This deliverable is dedicated to addressing this critical issue by focusing on inclusive engagement strategies to ensure that CS becomes a more inclusive and equitable endeavour.

- **Chapter 2** delivers a review of the literature on the concept of vulnerability and engagement of vulnerable and marginalised groups in CS.
- **Chapter 3** offers a **Blueprint for Inclusive CS Engagement Strategies** at destination of the six pilot cities of the Urban ReLeaf project.
- **Chapter 4** details the results of analysis of the insights and inputs collected during the multistakeholder workshops carried out in and by the cities and completes the first phase 'Preparing for inclusion' of the Blueprint.

"Citizen" in Citizen Science: addressing current debates

As this report focuses on the inclusion of marginalised and vulnerable groups in CS, we deem important to address the debate surrounding the use of the term "Citizen Science", and more specifically the place of "citizen" within it. Debate around the use of "citizen" in CS has gained traction, pleading that people born from currently or historically oppressed groups could perceive the term as a source of power as these groups have struggled to gain the rights of citizenship. Other terms such as "community science" have been proposed instead (see Cooper et al. (2021) for a full discussion on the subject). Recently, there has also been a call to rename CS "Tracking Science" as an alternative for those excluded, as it would better translate the objective of most projects (Liebenberg et al., 2021).

As reported by Eitzel et al. (2017) the word "citizen" can indeed appear problematic as the notion of "a legally recognised subject or national of a state" is considered, especially as legal citizenship is not relevant for many CS projects. On the other hand, the authors also point out that "citizen" can also refer to "an inhabitant of a city or a town", which considers citizenship in a broader light. For the sake of consistency with existing literature, we use in the remaining of this report and project, the term "citizen science", and align with Eitzel et al. (2017) in defining citizen as a member of a broadly construed community, independent of their legal status.

It is to be noted that the goal of this Blueprint is to foster increased engagement of “non-traditional”, “left behind” citizens such as people from vulnerable and marginalised groups within CS activities. We recognise that the discussion around Inclusive Citizen Science is much broader and encompasses themes such as Open Access Data, the recognition of historic injustices, or a reflection on global justice to name just a few other considerations (Fiske et al., 2019), which we do not address in detail here. Instead, the Blueprint details a set of considerations and guidelines that ought to be taken into consideration for a more inclusive engagement of citizens within CS.

2 Literature

2.1 Participation and engagement in Citizen Science

Before we begin with this deliverable, it is important to differentiate between participation and engagement. **Participation** within CS refers to the intentional collaborations in which members of the public take part in the process of research to generate new science-based knowledge (Shirk et al., 2012), i.e., the "CS tasks" as named in the remaining of this deliverable. **In this sense, participation can take different forms, and will differ depending on the level of contribution** offered to, or required from, participants. One of the most widespread classifications comes from Bonney et al. (2009) and contains three levels: **contributory** projects, where citizens contribute as collectors of data; **collaborative** projects, where citizens contribute as collaborators in the collection, analysis, and dissemination of the data and results; and **co-created** projects, where citizens contribute as co-creators in the earliest stage of the research process, e.g., problem definition.

Engagement within CS refers to the emotional, behavioural, cognitive, and social contributions participants make to a CS project (Phillips et al., 2019). By engagement, we therefore mean the involvement of citizens within any activities related to the Urban ReLeaf project, including trainings and events (e.g., pop-up community and culture labs), and not restricted to the process of research. The engagement of citizens is seen as supportive of their participation, and inversely, higher level of contributions within their participation will require higher level of engagement from the participants.

2.2 Vulnerability

Vulnerability is considered a **position of relative disadvantage** and possesses two facets: an external aspect involving risks, shocks, and stressors an individual faces, and an internal aspect denoting defenselessness, meaning a lack of means to cope without damaging loss (Chambers, 1989). The degree of vulnerability is influenced by several factors: the most important are income, education and language skills, gender, age, physical and mental capacity, access to resources and political power, and social capital (Eizenberg & Jabareen, 2017). In citizen science projects, a common trait of groups or communities who are considered vulnerable is that they fall under the label of being hard to reach or engage. However, whether an individual belongs to a vulnerable community or not depends on the scope of each project or campaign (Varga et al., 2023).

UNDP has highlighted that those who are most vulnerable and marginalized in society are also **at risk of "being left behind"** (Renner et al., 2018). Individuals tend to be "left behind" when they lack the choices or the capabilities to participate or benefit from human development. This can be a result of *absolute deprivation*, i.e., living below accepted standards of security, income, public services, infrastructure, or wellbeing; or a result of *relative disadvantage*, i.e., facing exclusion, discrimination, and/or inequalities, being less able to gain influence, get educated, survive setbacks, acquire wealth, access job markets or technologies, have shorter, riskier lives, or ranking below median in SDG outcomes.

There are different mechanisms through which individuals can be excluded from participating in society. UNDP has developed a framework enabling the identification of individuals at-risk of being excluded, comprising of five exclusionary processes: **discrimination, geography,**

governance, socio-economic status, and vulnerability to shocks (Renner et al., 2018). To explore issues of inclusion and exclusion in citizen science comprehensively, these processes must be considered across three dimensions: during the initiative's creation (in terms of participation level, such as contributory, collaborative, or co-created), during the initiative's practice (involving tasks like sensing, analyzing, computing, self-reporting, and making), and within the initiative's purpose (focused on objectives such as action, conservation, investigation, virtual experiences, and education) (Montanari et al., 2021). By crossanalysing the five exclusionary processes defined by UNDP with the three aforementioned dimensions of CS, Montanari et al. (2021) preliminarily describe what these exclusionary processes can look like within CS initiatives. **We build further upon their preliminary endeavour to investigate how these exclusionary processes could apply to CS initatives**:

Discrimination: individuals may be excluded due to their ascribed or assumed identity, including "gender, age, income, ethnicity, caste, religion, disability, sexual orientation, nationality, indigenous, refugee, displaced or migratory status, amongst others".

- Within the creation of the initiative, discrimination can influence the selection of participants in CS projects, leading to underrepresentation of certain groups. For example, if a project is only able to recruit participants from privileged backgrounds because they have a pre-existing affinity with the scientific discipline, or have had access to science education, it excludes individuals from marginalized communities.
- Within the practice of the initiative, discrimination can affect the treatment and involvement of participants in CS projects. For instance, if certain participants are not given adequate opportunities and access to contribute or are not given proper recognition for their contributions due to discriminatory biases, it hinders inclusivity.
- Within the purpose of the initiative, discrimination may lead to biased data collection and analysis in CS projects. If marginalized communities are neglected or their perspectives are not considered, it can perpetuate existing inequalities. An example would be a CS project on air quality that focuses only on affluent neighbourhoods, ignoring areas with low-income communities.

Geography: individuals may be excluded due to their place of residence, as it can hinders the access to economic and social opportunities, public services, or security.

- Within the creation of the initiative, geographic factors can influence the project's scope and target areas. If CS initiatives are primarily established in urban or accessible regions, it excludes remote or marginalized geographies from participating. This can lead to unequal representation in data collection efforts.
- Within the practice of the initiative, geographical constraints can impact the involvement and accessibility of participants in CS projects. For instance, individuals living in rural or geographically isolated areas may face challenges in accessing project resources, such as internet connectivity or transportation.
- Within the purpose of the initiative, geographical disparities may result in biased findings and limited understanding of certain regions or ecosystems. For example, if a CS project focuses on biodiversity monitoring but only includes data from easily accessible locations, it fails to capture the diversity in remote or underrepresented areas.

Governance: individuals may be excluded due to the institutions, laws, policies, or budget of its government, as it affects their autonomy to make decision.

- Within the creation of the initiative, governance factors can influence the decision-making processes and power dynamics within CS initiatives. If project leadership and governance structures are centralised and exclude diverse perspectives or forms of knowledge, it can limit participation and representation.
- Within the practice of the initiative, governance practices can impact the level of engagement and influence given to participants in CS projects. If decision-making and data ownership are controlled solely by project leaders, it undermines the collaborative nature of CS and limits the agency of participants.
- Within the purpose of the initiative, governance practices can shape the goals and outcomes of CS projects. For instance, if the research questions and objectives are driven solely by the interests of scientists or governing institutions without considering the needs and priorities of the participating community, it may not address relevant local concerns.

Socio-economic status: individuals may be excluded due to their inability to accumulate wealth or earn an adequate income, as it impacts their capacity to fully participate within their economy and society.

- Within the creation of the initiative, socio-economic status can influence the recruitment and access of participants in CS projects. If projects require expensive equipment or extensive time commitments, it may exclude individuals with limited financial resources or flexibility.
- Within the practice of the initiative, socio-economic disparities can affect the meaningful engagement and contribution of participants in CS projects. For example, individuals with lower socio-economic profiles may face barriers in attending project meetings or workshops due to financial constraints, language barriers, work obligations or other responsibilities.
- Within the purpose of the initiative, socio-economic factors can impact the relevance and applicability of CS findings. If the research questions and outcomes only reflect the perspectives and interests of more privileged participants, it may not address the concerns and priorities of marginalized communities.

Shocks and fragility: individuals may be excluded due to their accentuated vulnerability to environmental, social, political, and economic risks.

- Within the creation of the initiative, the vulnerability to shocks, such as environmental disasters or socio-political crises, may influence the initiation and planning of CS projects. For example, if a community is affected by a natural disaster, the project may need to be postponed or modified to address the immediate needs of the affected population.
- Within the practice of the initiative, vulnerability to shocks can disrupt the continuity and participation of citizens in ongoing projects. If individuals are dealing with the aftermath of a crisis, they may have limited capacity to actively contribute to CS activities.

- Within the purpose of the initiative, vulnerability to shocks may require CS initiatives to focus on immediate response and recovery efforts rather than long-term monitoring and research. For instance, after a major environmental incident, a CS project might prioritize assessing the short-term impacts and collaborating with affected communities to address their immediate needs.

2.3 Engaging vulnerable groups in Citizen Science

2.3.1 General challenges and considerations of doing citizen science with vulnerable groups

The data is unequivocal: to date, CS initiatives are not successful in engaging a diverse and representative proportion of the population. While the “white middle-aged man from a higher educational and higher socioeconomic background” has been largely reported as the predominant profile within CS initiatives (Cooper et al., 2021; Haklay, 2015; National Academies of Sciences, Engineering, and Medicine, 2018; Pateman et al., 2021; Vasiliades et al., 2021), a recent study (Pateman et al., 2021)gives more insights regarding who participate in CS:

- There is a significant correlation between age and ethnicity. The participation rate of individuals identifying as belonging to ethnic minority groups is higher for those aged between 16-24 years whereas the participation rate of individuals identifying as white is higher for the 35+ age group. **That means that white individuals are more likely to take part in CS initiatives at a later age than individuals from ethnic minority groups**.
- Women were found to be less likely to participate than men of all ethnic groups, but the disparity was even greater for individuals belonging to ethnic minority groups. **This means that a non-white woman is even less likely to take part in CS activities than a white woman**.
- While there is a positive correlation between the participation rate of individuals identifying as white and their social class, participation of individuals identifying as belonging to ethnic minority groups is the highest for the social class corresponding to the ‘middle-high’ (i.e., C1) social grade. **This means that for non-white individuals, those belonging to the middle-high social grade are most likely to take part in CS, whereas for white individuals, it is the highest social class which is the most active**.

There are significant barriers to the engagement of vulnerable groups in CS. Based on a discussion with 15 CS coordinators working with marginalized or Indigenous communities, Benyei et al. (2023) have identified a set of external and internal challenges, together with strategies used to overcome them, which are reported in Table I. **Internal challenges** are associated with the **technologies** used in activities, including difficulties in accessing and using technology. These challenges can be mitigated by designing technologies and methods tailored to the local context and by actively seeking continuous feedback. Issues related to **data use**, such as sensitivity and privacy concerns, as well as problems with data ownership and accessibility, are also common. To navigate these challenges, projects can implement community-owned data practices and adopt a Free Prior Informed Consent (FPIC) process,

ensuring explicit participant consent for any new project activities. Finally, **participation-related** challenges encompass low technical and textual literacy, language barriers, lack of motivation, trust issues, and time constraints. Addressing these challenges requires projects to identify community needs and adjust schedules accordingly. A bottom-up approach, adaptive and context-specific technologies, and transparent communication are essential for building trust and enhancing participation.

The challenges faced in citizen science projects are diverse and are outlined in Table I. **External challenges** often stem from the local **political context**, where government support might be lacking, and concerns about security and safety may arise. Projects have addressed these challenges by focusing on human rights and advocacy work. **Economic constraints** within the community, such as insufficient funding or low incomes, pose another obstacle. Overcoming this challenge involves seeking alternative funding sources and providing economic incentives to participants. Additionally, **poor digital infrastructure**, like limited internet connectivity or lack of electricity access, can hinder projects. To address this, strategies such as adopting a "co-researcher" approach, where participants operate independently, or using low-tech methods have proven effective.

Internal challenges are associated with the **technologies** used in activities, including difficulties in accessing and using technology. These challenges can be mitigated by designing technologies and methods tailored to the local context and by actively seeking continuous feedback. Issues related to **data use**, such as sensitivity and privacy concerns, as well as problems with data ownership and accessibility, are also common. To navigate these challenges, projects can implement community-owned data practices and adopt a Free Prior Informed Consent (FPIC) process, ensuring explicit participant consent for any new project activities. Finally, **participation**-related challenges encompass low technical and textual literacy, language barriers, lack of motivation, trust issues, and time constraints. Addressing these challenges requires projects to identify community needs and adjust schedules accordingly. A bottom-up approach, adaptive and context-specific technologies, and transparent communication are essential for building trust and enhancing participation.

Table I: Challenges and strategies of doing citizen science with marginalized and indigenous communities, as reported in Benyei et al. (2023)

Theme	Challenges	Strategies
Political	Lack of government support Safety and security issues	Promote human-rights based approach Promote advocacy work
Economic	Low income Lack of funding	Non-research funding sources Pay for all + financial compensation Open up grant proposal for writing
Infrastructure	Lack of internet connectivity Lack of electricity access	Low-tech solutions and tools Local co-researcher takes full control
Technology	Issues in accessing and using technology	Design technologies to fit the local context Co-design technologies and continuous feedback
Data	Data privacy and sensitivity issues Data ownership and accessibility issues	Free Prior Informed Consent (FPIC) and community protocols Data sovereignty

Participation	Low technical and textual literacy Low participant engagement and motivation Low outreach Language barrier Time constraints	Identify needs and adapt timing Implement a bottom-up approach Adaptative and contextualised technologies Open contact and transparency
Epistemology	Type of knowledge (Western vs. indigenous)	Listening spaces, locally-fitted methods

To counter the divide with regard to community engagement with research, Chesser et al. (2020) propose to follow five ethical considerations when conducting Citizen Science with marginalised populations: inclusivity, adaptability, sensitivity, safety, and reciprocity.

Inclusivity consideration ensures that all individuals have the opportunity to contribute with their diverse knowledge. Particularly, the authors point to the communication strategies used to promote CS initiatives, emphasising the importance of diversifying the mediums to reach different members of the public. This stems from the fact that the reliance on one method only could result in an unintentional exclusion of some groups of individuals.

Adaptability considerations refer to the modification of the project to provide greater opportunities for varied participation. This includes appropriate training of the citizen scientist which considers language, culture, and literacy levels; flexibility within the engagement process itself by providing different means and stages of participation. The project should also reflect on adapting their process to the special needs of some individuals, e.g., with a physical disability.

Sensitivity consideration ensures the project takes into account and respects cultural traditions and beliefs. This consideration is especially important for groups that have experienced historical trauma or exploitation within the subject of research. Approaching the project as a partnership has the potential to provide this sensitivity.

Safety considerations refer to the protection of the physical and psychological safety of citizen scientists through a research protocol design. CS projects can present unique safety issues, in large part because citizen scientists may be contributing to projects without supervision. Further, projects should ensure that citizen scientists are not overburdened by research labour, or asked to complete tasks that they are unwilling or unable to do.

Finally, **reciprocity** **considerations imply a reflection on the benefits that the project can provide to the participants and should be examined before the start of the research work**. This avoids a certain exploitation of citizen scientists. Tangible benefits can be considered, but benefits can also be less tangible, such as experience of empowerment and self-efficacy, or opportunities for individuals to become more engaged within their communities. Ideally, citizen science projects should seek feedback from citizen scientists throughout the research process to maximize the tangible and less tangible benefits that project involvement could provide.

The tension between social inclusivity and scientific efficiency

It should also be addressed that there can exist a trade-off between social inclusivity and scientific efficiency: there might be "instances where a project is more scientifically efficient if it is more exclusive, therefore, the scientific efficiency of a citizen science project may occasionally directly conflict with the aim of social inclusivity" (Spiers et al., 2019, p. 21). This can reinforce exclusionary processes in situations where involving vulnerable groups of society in CS activities might be of particular importance (e.g., because they are specifically vulnerable in regard to the subject, they lack power in that respect, etc.), but at the same time these profiles are harder to reach (e.g., because they might not have the required level of skills, time, or physical and mental capacity to participate). This can create a dilemma between CS that is either too demanding, and therefore unfeasible, or too un-inclusive, and therefore unfair (Jongsma & Friesen, 2019).

2.3.2 Determinants of initial and continued participation

To understand the reasons for the lack of participation among certain citizen profiles in CS activities, and therefore the lack of inclusivity in CS, it can be helpful to investigate the reasons as to why and how citizen scientists start and continue their engagement with such initiatives. The literature on volunteers' participation offers different insights in that respect. **Volunteers' decision to participate is influenced by three factors: the awareness of the opportunity's existence; the person's motivation; and the compatibility between the opportunity and the person** (Hobbs & White, 2012). This decision to participate then leads to initial participation and evolves into sustained participation, which are all influenced by different factors, as represented in Figure 1 (West & Pateman, 2016).

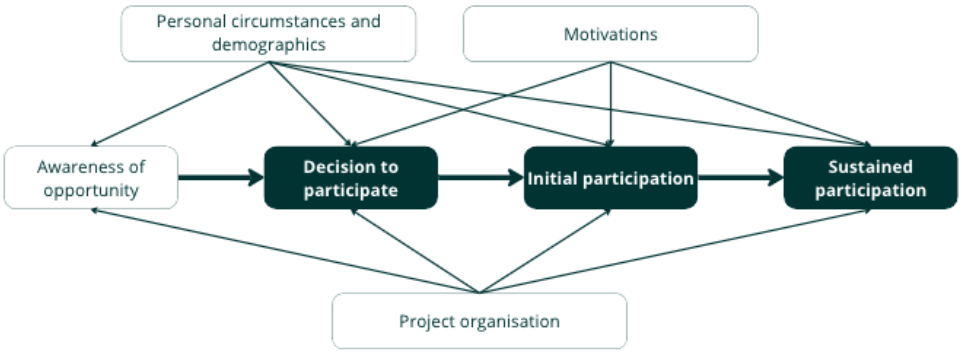

Figure 1: Model of influences on participation in citizen science (from West and Pateman (2015) as described in Geoghegan et al. (2016))

2.3.2.1 Awareness of the opportunity

A first reason why some profiles might be less represented in CS activities than others could therefore stem from a **lack of awareness concerning the existence of a participation opportunity**. Poor advertisement and marketing have been associated with a lack of awareness of opportunities to participate by younger participants who declared that searching for opportunities online was overwhelming particularly when advertisements did not effectively communicate the role, purpose, requirements, and benefits of the scheme (Constant & Hughes, 2023). Linked to this, the lack of social or family network to be made aware of opportunities, and the lack of opportunity in local areas were identified as barriers by younger participants (i.e., 18-29 years old) (Constant & Hughes, 2023).

This lack of awareness can result from the advertising strategies used to promote the project, where an overreliance on only one method of promotion could result in projects unintentionally excluding the very individuals they are trying to include (Chesser et al., 2020).

2.3.2.2 Personal circumstances and demographics

A second reason some profiles might be less represented in CS activities may stem from a lack of compatibility between the citizens and the opportunity of participation. Individuals might be motivated to participate, but for them to decide and start their initial involvement in a specific project, the opportunity needs to fit with the rest of their lives, including personality traits, beliefs and values, and demographic characteristics (West & Pateman, 2016). A lack of compatibility might arise from various elements.

An important aspect of this compatibility is the level of **demandingness** of the CS tasks: members of marginalised and vulnerable communities often do not have the time nor wealth to dedicate to such hobby (Wiggins & Crowston, 2012). The balance between existing responsibilities and access to leisure time might be particularly unstable, and as CS is often an extra-curricular activity, individuals from lower socio-economic groups might not be able, or allow themselves, to participate (Montanari et al., 2021). Overall, a **lack of time** is a frequently reported barrier to participation for all participants, regardless of their ethnic profiles or age (Davis et al., 2020; Vasiliades et al., 2021). Interest, enjoyment, challenge, and other

initial motivators are not sufficient to overcome excessive demands in time, and this is exacerbated when individuals have the feeling that scientists are not considerate of the complexity and duration of the task they require (Rotman et al., 2014).

Other specific barriers per groups have been identified: **younger participants** have specifically been found to fear lone working, have safety concerns, and express boredom associated with the activities and lack of interest in the topic, not seeing peers from similar socio-economic backgrounds, lack of opportunity in local areas, and are held back by the perception that CS is for older people (Constant & Hughes, 2023).

Although not specific to citizen science, a systematic review of the engagement of 'hard to reach' **older adults** (i.e., >50 years old as reported in the article) in research on health promotion (Liljas et al., 2017a) has found that barriers to their participation included deteriorating health, having other priorities, and a lack of transport/inaccessibility. Feeling too tired and lacking support from family members were additional barriers for the oldest old (i.e., >80 years old). Similarly, feeling too tired and too old to participate in research on health promotion were reported by Black and Minority Ethnic (BME) groups. Barriers for BME groups included lack of motivation and self-confidence, and cultural and language differences. Barriers identified in deprived areas included use of written recruitment materials since low literacy rates or limited local language skills are prevalent here.

Other groups express discomfort or difficulties in accessing natural environments. Others might not possess a formal educational background, therefore lacking familiarity and comfort with science altogether (Chesser et al., 2020).

2.3.2.3 Motivations

Motivations to participate in a CS project can be classified into five general categories: values, personal development, career and recognition, social, and recreation (Robinson et al., 2021).

'Values' relates to a feeling of civic responsibility and the will to contribute to science, society, and/or the environment (Robinson et al., 2021). This was found as a motivation for young participants (i.e., 18-29 years old) who listed 'having an observable and positive impact on a cause' as the reason for their participation (Constant & Hughes, 2023). An interesting way to tap into this motivation is through the 'sense of place', or affective connections individuals might have with their local environment, e.g., by involving local groups such as "Friends of …" (Hart et al., 2022).

'Personal development' relates to the learning opportunities offered by projects, e.g., gaining knowledge about the scientific subject of the project, data collection and analysis, etc. (Robinson et al., 2021). New interest and knowledge appear to be a strong motivation with young people (i.e., 18-29 years old) who participate because they have an interest in the particular cause, to assert that interest, to learn something new, and to put their own knowledge and skills into practice (Constant & Hughes, 2023). Older adults also appear to be highly motivated by the idea of learning something new (Skorupska et al., 2021a). A comparative study found that the motivation to acquire new knowledge was indeed not related to age group (Brouwer & Hessels, 2019). However, it appears that there are variations in this motivation between other groups of individuals: a study of non-traditional participants (i.e., non-white, low-income, and/or participants without a four-year college degree) has found that

the motivation of "contributing to science" as well as "learning for the sake of learning" may apply disproportionately to white, college educated, and non-low-income participants. Participants from communities of colour were more likely to be motivated by addressing a relevant problem (i.e., a potential risk such as water contamination), suggesting that the relevance of the study content may be an important motivator for engaging diverse CS participants (Davis et al., 2020). This interest in a particular topic has also been found more salient for older participants than for younger participants (Brouwer & Hessels, 2019). However, it was also observed that participants with a low level of education (primary school only) report CS as a learning opportunity more often than others (Brouwer & Hessels, 2019).

'Career and recognition' relates to the relevant experience that can be gained and one's career interest, or to other personal benefits that arise from one's input (Robinson et al., 2021). Career development is a strong motivation to participate for young people (i.e., 18-29 years old), e.g., through gaining a diversity of skills and because they consider volunteering as a pre-requisite to secure work in the conservation sector (Constant & Hughes, 2023).

'Social' related to the social interaction and belonging to a community of likeminded individuals (Robinson et al., 2021). Meeting new and likeminded people and learning about the local community were found to be motivational factors of young participants (i.e., 18-29 years old). The inclusivity aspect, in the form of a welcoming environment was also a motivation for young people (Constant & Hughes, 2023). A prior relationship with a community organisation and staff were found to be motivational factors of non-traditional participants, while personal interactions (rather than written material) was found to be a supportive factor for engaging diverse CS participants (Davis et al., 2020).

'Recreation' relates to the "fun" component of the activities which are equated with recreational activities (Robinson et al., 2021). This motivation was found to be more salient with younger participants (Brouwer & Hessels, 2019), who indicate 'physical activity' and 'going outside' as strong motivators (Constant & Hughes, 2023). This motivator was also found important for both participants from the lowest and highest education levels (Brouwer & Hessels, 2019).

2.3.2.4 Project organisation

The organisation of a CS project is crucial to individuals' participation, especially in their sustained engagement with the project (West & Pateman, 2016). **Design and implementation issues** have been identified as a main barrier to participation (Vasiliades et al., 2021). With younger participants, barriers to participation include **logistical constraints** such as the timing of CS opportunities, the access to transport or accommodation, the fact that it is unpaid, or the cost of participation (Constant & Hughes, 2023). Other **pragmatic and organisation issues** have also been mentioned as barrier to participation with younger participants, such as the competitive environment, the ineffective management of the project, or judgment from project organisers (Constant & Hughes, 2023).

A **lack of knowledge** and a lack of understanding of the role of CS, requirement of the project, and subsequent benefits have been mentioned by both younger and older participants as a barrier to their participation (Constant & Hughes, 2023; Skorupska et al., 2021a).

A **lack of recognition** for participant's contributions has also been reported as a barrier to participation in Nature-Based CS (Vasiliades et al., 2021).

On the other hand, non-traditional participants (i.e., non-white, low-income, and/or participants without a four-year college degree) have been found less likely to have a reliable **computer or internet access**, which they mention as a main barrier to their participation (Davis et al., 2020). Technological infrastructure is indeed pointed as one main demotivator to long-term participation (Rotman et al., 2014).

3 Inclusive CS Engagement Strategies: a Blueprint

This chapter presents a blueprint to set up **Inclusive Citizen Science Engagement Strategies**. This Blueprint is based on good practices and insights from the literature (such as those reported in Chapter 2 of this document), the Citizen Science Starter Kit developed by the Urban ReLeaf's Equality, Diversity, and Inclusivity manager Carina Veeckman for the Vrije Universiteit Brussel (Veeckman et al., 2022), the set of questions developed by Fiske et al. (2019), and the check-list developed by West and Pateman (2016).

This Blueprint supports inclusive citizen science practices, i.e., the engagement of underrepresented participants such as vulnerable and marginalised groups. As mentioned earlier in this document, social inclusivity and scientific efficiency can sometimes be conflictual if more demanding tasks are required to fulfil the scientific purpose of the project (Spiers et al., 2019). We adopt the stance of "**centring at the margins**" as proposed by different strands of literature focusing on diversity, equity, and inclusion: if the system is accessible to the people and communities who experience marginalisation, it will be accessible to all (Spiers et al., 2019; Varga et al., 2023; Westby et al., 2021).

In the following sections, we detail Urban ReLeaf's inclusive engagement strategy, structured around four main phases: (i) preparing for inclusion, (ii) planning for inclusion, (iii) interacting for inclusion, and (iv) monitoring for inclusion. Each phase is described, taking into consideration existing challenges to inclusion in CS, along with guidelines and recommendations. The strategy is synthesised in a Blueprint (Figure 3) at the end of this chapter.

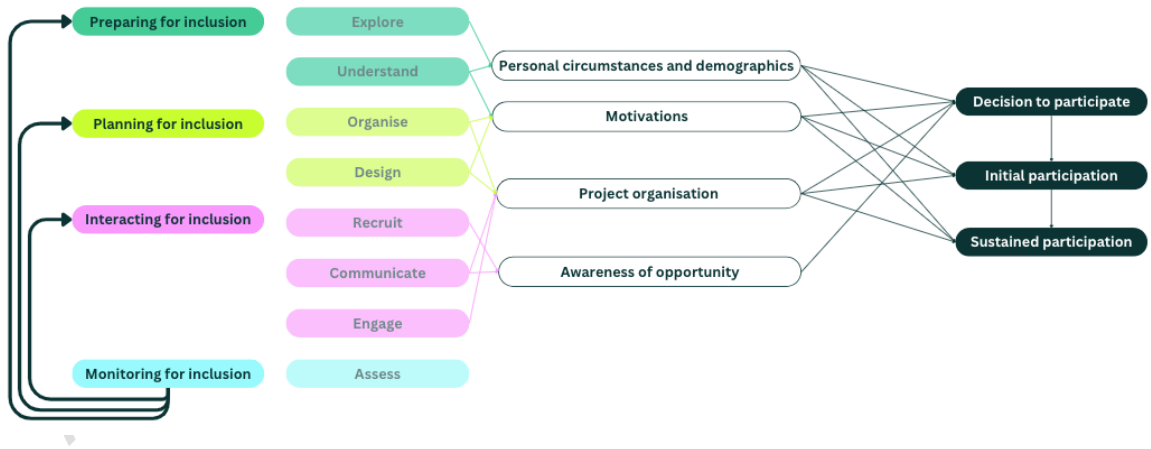

Figure 2: Urban ReLeaf's Blueprint structure in relation to the main determinants of participation in CS, and their correspondence with a participant's journey.

3.1 Phase I - Preparing for inclusion

Preconditions for phase I

Before starting with this phase, one should have identified CS as the best approach to answer their research question. From the research question, and as a starting point for any subsequent reflection, one should have **preliminary target group(s)** and/or a **preliminary subject of research** defined. This will generally stem from an observed data gap.

For more information consult the "Guide to Citizen Science" from Tweddle et al. (2012), or the second module of the Citizen Science starter kit 'Determine if citizen science is right for your research' (Veeckman et al., 2022).

3.1.1 Explore

Description: The preliminary target group(s) and subject of research are explored. To engage participants effectively, it is important to explore potential target groups. This will not only influence the interactions with the participants, such as the content of the message communicated, the frequency, the duration, the language, and the medium (Rüfenacht et al., 2021), but the overall scoping of the CS campaign.

Considerations:

- ***What is the preliminary subject of research? Who is impacted by it?***
- ***Or: Who is/are your target group(s)? What are they impacted by?***

If a preliminary subject of research has been identified (e.g., heat stress), the preliminary target group(s) impacted by it should be explored (e.g., older adults). If preliminary target group(s) have been identified (e.g., inhabitants of a neighbourhood), topic(s) that impact them should be preliminarily explored (e.g., air quality).

- ***Which target group(s) appear as particularly vulnerable?***

Once the preliminary subject of research and target group(s) have been identified, it is crucial to explore which groups are particularly vulnerable (e.g., everyone can be impacted by heat stress, but some groups are particularly vulnerable to it, such as older adults), together with their type and level of vulnerability.

In the interest of involving vulnerable and marginalised groups in CS, it is important to consider that, as the definition of vulnerability is a "**position of relative disadvantage**", vulnerability is not a strict concept but one that varies both across context and time. In CS projects, a common trait of groups or communities who are considered vulnerable is that they fall under the label of being hard to reach or engage. However, who belongs or not to a vulnerable community might depend on the focus of each project or initiative (Varga et al., 2023).

- ***What is their level and type of vulnerability?***

The **identification of the level of vulnerability** of the target groups can be done through the five exclusionary processes highlighted by UNDP – discrimination, geography, governance, socio-economic status, and vulnerability to shocks – and applied to CS projects (Renner et al., 2018) – see chapter 2.1.2. In the context of the Urban ReLeaf project, the pilot cities need to consider that climate change does not affect all citizens in the same way. In many European countries, there is a disproportionate exposure and uneven distribution of impacts of air pollution and extreme temperatures, which reflect the socio-demographic differences within our society. The reason why individuals may be more vulnerable to the impacts of environmental risks are related to the specific circumstances of the individual, such as their age, health condition, and particular behaviours. This specific type of vulnerability is labelled as '**social vulnerability'** (Breil et al., 2018). It is an integrated measures of exposure and susceptibility to harm, and the lack of capacity to avoid, cope with or adapt to environmental health hazards. The sensitivity is largely driven by age and health, while the ability to cope is linked to the socio-economic status, social support available or awareness of risks.

- ***Which stakeholders compose the ecosystem around this issue?***

Exploring and identifying the stakeholders of the ecosystem around the issue (preliminary research question and target group(s)) has numerous advantages (Skarlatidou, Suskevics, et al., 2019):

- Identifying relevant stakeholders and their roles and responsibilities ensures that the right stakeholders are involved in key decisions and activities, increasing the likelihood of **successful implementation**.
- Mapping the stakeholders provides a comprehensive understanding of the diverse perspectives and expertise within their stakeholder network. This knowledge can **provide valuable insights** to enhance project planning, decision-making, and innovation by incorporating multiple viewpoints and leveraging the diverse skills and knowledge of stakeholders.
- By mapping and understanding their interests and expertise, the contributions of different stakeholders can be optimised, and **greater impact** can be achieved for CS initiatives.
- Understanding their interests, needs, and concerns enables to communicate more effectively with them, leading to **better engagement and support**.
- Identifying stakeholders who can contribute to the co-creation process enables their engagement in collaborative activities that lead to **shared ownership of outcomes** and increased project effectiveness.

Guidelines: The exploration of the preliminary target group(s) and/or subject of research can be done through a formative study by e.g.: reviewing literature (scientific, policy texts, grey literature, etc.), conducting surveys, focus groups, and/or experts' interviews.

An ecosystem mapping (including stakeholders, related projects, and initiatives), such as performed in D2.1, should also be conducted.

Outcome: Preliminary target group(s) and research subject.

Potential challenge(s) to tackle:

- Overrepresentation of the same (biased) profile in CS.

3.1.2 Understand

Description: The preliminary target groups and subject of research are refined and characterised. After the preliminary idea of the scope of the CS campaign has been pinpointed, further investigations are carried out to clearly define what aspect(s) of the preliminary subject of research impact(s) the target group(s) and who exactly the people are from the preliminary target group(s). If necessary, a prioritisation is conducted to narrow down the scope of the future campaign.

Considerations:

- ***What are the socio-demographics (SD) and socio-economic (SE) characteristics of the target group(s)?***
- ***What is their level of literacy (language, digital, scientific, etc.)?***
- ***What are their preoccupations and aspirations in life?***
- ***How does the subject of research and overall CS concept relate and resonate with them?***
- ***What are the motivations and barriers to their participation?***

Understanding the social realities of the target groups and their needs is crucial to ensuring inclusiveness (Benyei et al., 2023; Paleco et al., 2021). Investigations should be carried out to understand how the subject of research, and which aspect of it could impact the target group(s) and/or their community. Regardless of the scope of the CS activities, inclusion is increased when a clear linkage is made between the subject of research and the outcome of the project and between the lives, livelihoods, values, preoccupation and aspirations of the target group(s).

This encompasses the identification of the socio-demographics (SD) and socio-economic (SE) characteristics of the target group(s), their level of literacy (digital, scientific, etc.), their preoccupations and aspirations in life, their potential motivations, and barriers to participation.

Guidelines: Ideally, a **co-creation approach** is implemented to centre the activities around the local communities' ways of knowing and participants' needs (Benyei et al., 2023). An approach such as Participatory Action Research (PAR), where non-professional and non-academic researchers, including citizens and representatives of civil society organisations, engage in the research process, enables the consideration of the needs and perspectives of the target group(s) (Senabre Hidalgo et al., 2021). This ensures that the CS activities address practical and relevant issues to the target groups, and through their involvement, increases their engagement through a feeling of co-ownership and control over the scientific process (Robinson et al., 2021; Senabre Hidalgo et al., 2021). A **PAR4P approach**, as implemented in the Urban ReLeaf project, applies a more pragmatic approach through an additional collaboration with policymakers, increasing the probability that outcomes of the CS activities will be effectively taken into consideration (see chapter 4.1).

Alternatively, information about the participants' profiles can be collected through a formative study by reviewing existing literature, conducting surveys, focus groups, and/or experts' interviews.

The results are crystallised into personas (i.e., preoccupations, aspirations, motivations, barriers) for each target group.

Outcome: Defined target group(s) and personas for each target group.

Potential challenges to tackle:

- Marginalised and vulnerable groups are the least likely to have data representative of their situation and profile and are hard(er)-to-reach.

3.2 Phase II - Planning for inclusion

Preconditions for phase II

For the successful implementation of this phase, the **scientific requirements** for the data collection should be defined, i.e., what should be collected, why, where, when and how?

The approach of the CS project is defined: contributory, collaborative, co-created.

Furthermore, "**inclusion by design**" principles should be applied for the design of the tasks and tools.

3.2.1 Organise

Description: Building upon the insights of the previous steps, the CS tasks to be conducted by the target group(s) are defined.

Considerations:

- ***What is the level of engagement required for each task?***

While common conceptualisations of participation have traditionally assumed that high-levels of involvement were better than low-levels (i.e., Arnstein's ladder of participation), citizens, with different daily lives, interests and responsibilities should have the opportunity to engage at different levels in CS projects (Haklay, 2018). As presented earlier, a trade-off exists between the demandingness of the task and its feasibility, especially when engaging marginalised and vulnerable groups and CS projects must be aware of the tension between social inclusivity and scientific efficiency. The level of engagement of each target group should therefore be carefully considered depending on the aim of the campaign.

The typology provided by Haklay helps to consider which levels of engagement might be suitable for which target group (see Table II).

Table II: Type of participation based on the levels of engagement and levels of knowledge of the participants, from Haklay (2018).

	High levels of engagement	Low levels engagement
High levels of knowledge	Target group has a high level of knowledge or familiarity with the subject of research and is willing and able to dedicate time (e.g., because of personal motivations). Harness highly valuable efforts. Requires significant investment in time from participants. Opportunities for deeper involvement (e.g., analysis, dissemination).	Target group has a high level of knowledge or familiarity with the subject of research but is not able or willing to dedicate time to it. Increase data quality. Requires less vulgarisation. Opportunities for lighter involvement to match time/effort disponibilities.
Low levels of knowledge	Target group has low levels of knowledge or familiarity with the subject or research but is willing and able to dedicate time (e.g., because of personal motivations). Opportunities for awareness raising, education, and skills learning. Requires support and facilitation. Opportunities for inclusivity in CS.	Target group has low levels of knowledge or familiarity with the subject or research and is not able or willing to dedicate time to it. Opportunities for involvement in science with limited effort, i.e., of marginalised groups. Potential for cross-generational engagement. Potential for large temporal and spatial coverage. Can represent a stepping-stone.

- ***What are potential barriers and motivations to the conduction of each task for each target group?***
- ***What are possible alternative tasks?***

Barriers to the participation of the target group(s) have to be considered. Specifically, the **accessibility** of the organised tasks and activities: access must be considered multidimensionally in terms of geography, language, skills, and time (Fiske et al., 2019).

On the other hand, certain aspect of the CS tasks and campaigns might appeal to different type of **motivations** (e.g., values; personal development; social; career and recognition; recreation), which will appeal to different target group(s) and should be reflected upon when organising the CS tasks.

To tackle this, projects can be composed of **modular activities**, simultaneously making participation accessible for those with limited time and resources and providing those with more time with the option to get more deeply involved (Davis et al., 2020; Varga et al., 2023). This can take different forms (Pateman et al., 2021; van Noordwijk et al., 2021):

- **Simple tasks** that require no prior knowledge enable the participation of the wider community;
- **One-off activities** can facilitate the participation of citizens with limited time to spare;
- Certain activities can be **incorporated into community events** or other widely shared interests such as gardening;
- Long-term projects can include **different tasks** that offer different learning opportunities.

Overall, offering various ways to participate with different levels of engagement, and various roles, are key to engaging a wide array of citizens (Constant & Hughes, 2023; Paleco et al., 2021).

- ***Is gamification relevant for your target group? If yes, what could it look like?***

To engage participants, **gamification features** can be considered during the organisation of the tasks. There is little data on the effect of **gamification** on inclusion in CS. It has been observed that gamification features are key to attracting the generation of "Millennials" (Bowser et al., 2013), which are already an age group with typically high participation in CS (Pateman et al., 2021). Further, gamification features have been shown to deter the reporting of low-scoring participants while sustaining the reporting of high-scoring participants (Neset et al., 2021). High-scoring participants enjoy the gamification features as it validates their efforts, helps them keep track of their personal progress, or simply because they enjoyed the competition and achievement of a certain status within the game. On the other hand, low-scoring participants find the competition features stressful and demotivating as they have the feeling they will never catch-up or cannot take a break; there may even be a feeling of distrust towards other participants who were thought to be cheating (Eveleigh et al., 2013). Some participants also mention that the gamification feature acted as a motivation in the beginning of their CS journey, but as time went on, the competition feature became demotivating due to the effort required to retain a certain status (Eveleigh et al., 2013). Overall, gamification has been found to maintain contribution from an existing community of participants (Robinson et al., 2021).

Generally, the literature on gamification is indecisive regarding the effectiveness of such features on the engagement of volunteers with CS. On the one hand, some studies, reported in Skarlatidou et al. (2019), indicate that gamification might not be a significant motivator to participation, with volunteers stating that contributing to science was their main motivation. Indeed, gamification poses the threat of introducing a shift from intrinsic to extrinsic motivations (Neset et al., 2021), and as such might lose its appeal for some target group(s) such as marginalised communities which have been found more likely to be motivated by addressing a relevant problem (Davis et al., 2020).

In this regard, "meaningful gamification" might provide an interesting avenue. **Meaningful gamification** is defined by six principles: **reflection** (using the game to explore past experiences), **exposition** (a connection to a real-world setting), **choice** (a sense of agency), **information** (helping participants learn about the world), **play** (a fun experience under an agreed set of rules), and **engagement** (enabling participation and collaboration) (Nicholson, 2015). The goal of this strategy is to motivate participants to first engage with the activities. As participants engaged with the gamification, they are also encouraged to interact with existing communities and information resources. As participants become more proficient, their reliance on the system decreases, and they engage more directly with the actual environment. The ultimate objective is to guide users towards discovering the meaningful aspects of the real world, gradually reducing the role of gamification until participants are fully immersed in and connected to their real-world surroundings (Nicholson, 2014).

Overall, the project's tasks should be 'cool' and 'fun' to use, while nurturing curiosity (Robinson et al., 2021). The gamification mechanisms should provide both competitive incentives (e.g., leader boards) and personal milestones (e.g., badges), and should provide finely graduated

stages of progression to make participants feel that their contributions are valued at all times (Eveleigh et al., 2013). It has been observed that while treasure hunts, leaderboards, and rating systems might improve the user experience of volunteers, gamification features could be more effective if they lead to tangible outcomes such as a gift voucher (Skarlatidou, Hamilton, et al., 2019). It is also strongly recommended to have the option to opt out of any gamification feature (Skarlatidou, Hamilton, et al., 2019).

- ***What are the relevant indicators of community participation?***

Last, it should already be reflected on how to **evaluate the processes and outcomes of participation**. Therefore, a set of community indicators can be considered and selected based on the scope and goal of the campaigns (cfr. MICS tool, Butterfoss, 2006; Wehn et al., 2021):

1. **Diversity of participants**: looking at demographic characteristics of participants such as gender, age, ethnicity, etc. In the Urban ReLeaf project, the aim is to engage 50% females in the campaigns, and 30 to 40% vulnerable groups.
2. **Recruitment and retention of participants** (e.g., 2 weeks, more than 6 months).
3. **Role in the activities**: the type of tasks and activities in which the participant is involved, as well as the degree of involvement in those tasks (e.g., collecting data, analysis, advocating for policy, etc.).
4. **Number and type of activities attended** (e.g., a participant attended 2 trainings).
5. **Amount of time spent in and out the activities** (e.g., number of hours).
6. **Benefits and challenges of participation** (e.g., insufficient credit).
7. **Satisfaction with the process of participation** (e.g., satisfaction rates).
8. **Balance of power and leadership** (e.g., influence in decision-making).

Guidelines

- The organisation of CS tasks is done in collaboration/co-creation with the target group(s) to ensure their accessibility (related to the 'barriers') and relevance (related to the 'motivations').
- A compatibility assessment between the target group(s) and each CS task is conducted. Hereby, the fit of each CS task for each target group is assessed. In this assessment, the level of engagement, barriers, and motivations for participation are taken into account.
- Community indicators that are of relevance for your CS campaign are selected. The selection of the community indicators can be done by the internal project stakeholders, and through a collaborative exercise with the participants. For the Urban ReLeaf project, the diversity indicator is a prerequisite to track.

Outcomes

- A compatibility assessment between the target group(s) and the foreseen CS tasks.
- Measures (KPIs) of community participation.

Potential challenge to tackle

- Tasks may be too demanding in terms of time and efforts.

- Tasks may not be interesting enough.
- Tasks may require the use of technology.
- Tasks may require moving around/travel.
- Overall, there can be a tension between the social inclusivity and the scientific efficiency.

3.2.2 Design

Description: The data collection tools that will be used by your target groups are defined.

Considerations:

- ***What are potential barriers and motivations to the use of each tool for each target group?***

As for the organisation of the tasks, consideration for potential barriers and motivations to using the CS tool(s) must be considered. Consideration should encompass how the tools are supposed to be used, e.g., inside/outside, requires interaction or not, etc., and how they are supposed to be accessed, e.g., electricity, smartphone, internet connection, etc. (Fiske et al., 2019).

Further, not every participant has the same level of digital literacy, and tools should be developed and explained appropriately (Rüfenacht et al., 2021). Indeed, it has been found that digital solutions in crowdsourced projects that are found to be inaccessible or difficult to use contribute to inequal participation and representation of different demographic groups (O'Keeffe & Walls, 2020).

Overall, some best practices should be followed to decrease barriers and increase user friendliness, as detailed in the table below.

Table III: Considerations for the inclusive design of CS data collection tools.

Feature	Description	Sources
Interface design to follow popular name and navigation convention	Project main page should contain: a project description; data collected; project outcomes; links to news and additional documentation; a help page.	Skarlatidou et al. (2019)
Registration	• Registration process should be simple. • Sign up with social media should not be the only option. • Participation can be increased without the obligation to sign up.	Constant and Hughes (2023); Skarlatidou et al. (2019)
Tutorials	Pop-up functionality with the option to skip and/or return to them at another time.	Skarlatidou et al. (2019)
Simple, easy, versatile and user-friendly tools	• Involving end-users in the development. Simple design: use of images, drop-down lists, and symbology. • Tools adapted to different user groups according to their skills, including adaptative and low-tech methods and tools.	Benyei et al. (2023); Hart et al. (2022); Robinson et al. (2021); Skarlatidou et al. (2019)
Communication functionality	A forum or a chat to support communication between volunteers, and/or between volunteers and scientists.	Constant and Hughes (2023); Robinson et al. (2021); Skarlatidou et al. (2019)

Offline data collection	Collecting data offline, storing them and uploading them automatically once a connection is established.	Skarlatidou et al. (2019)
Data visualisation	• Data sharing and viewing that displays data instantly. • Search function and filters. • Switch between map backgrounds. • Access data details while browsing (e.g., hover text). • Provide access to volunteers' contributions and the possibility to analyse and share them. • Enable volunteers to make discoveries.	Robinson et al. (2021); Skarlatidou et al. (2019)

- ***What are mitigation measures that can be offered for each tool?***

Measures to increase accessibility of the tools should be considered. Importantly, providing **trainings** to participants might decrease some barriers to the use of certain tools. Individuals unfamiliar with data collection technologies or devices, such as websites and apps, might require detailed training not only in using these tools (i.e., sensors) but also in handling the technological devices themselves, such as tablets or smartphones (Chesser et al., 2020).

Low-tech (or non-ICT-enabled) alternatives should be considered if appropriate, e.g., when there is unreliable access to technological infrastructure, and/or when offline participation can increase the inclusion of the target group(s) (Benyei et al., 2023). In that respect, low-tech alternatives such as record cards, paper-and-pencil-based diaries (Mazumdar et al., 2018) or low-tech air meter (Castell et al., 2021) can be implemented if relevant. A mix of high-tech and low-tech can present advantages in some cases (Hecker et al., 2018).

Extra features can also be coupled with the tools, such as in the "Our Voice" approach where a mobile app is used to document local environmental features through **geo-coded photographs, audio narratives, walking routes, together with visual ratings** that are assigned to each feature, represented by either a positive (green "smiley face"), negative (red "frown face"), or both, (King et al., 2020; Tuckett et al., 2018). Such technology was found to be user-friendly across all levels of education and technology literacy and has been operated successfully by participants ages 10 to 92 – successful training typically takes about five minutes (King et al., 2020; Tuckett et al., 2018). To date, the Our Voice method has been used in over 30 participatory research projects, with fourteen of these specifically involving older adults (King et al., 2020). The method has also been applied to target groups with a low socio-economic status (Bälter et al., 2020) and young adults, included from disadvantaged backgrounds (King et al., 2021; Montes et al., 2022).

Included in the Our Voice approach is the **PhotoVoice** technique. PhotoVoice is a participatory action method through which participants take pictures and accompany them with stories. The aim of the PhotoVoice method is generally to raise awareness about the participant's experience (Smith et al., 2022). The method has largely been applied to target groups with lower health profiles (Woolrych, 2004), young women (Moletsane, 2023), and within marginalised neighbourhoods (Carpenter, 2022). In this regard, photovoice and digital storytelling could accompany low-tech tools, such as described in the 'STORCIT-framework' (Veeckman et al. 2023).

Guidelines: A compatibility assessment between the target group(s) and each CS tool is conducted. Hereby, the fit of each CS tool with each target group is assessed. In this assessment, the barriers, motivations, and potential mitigation measures are taken into account.

Outcomes: A compatibility assessment between the target group(s) and the foreseen CS tools, with barriers and mitigation measures.

Potential challenges:

- Tools may require access to a laptop or smartphone.
- Tools may require digital skills.
- Tools may require specific technological skills with the device.
- Tools may require an internet access.

3.3 Phase III - Interacting for inclusion

Preconditions for phase III

In this phase, a recruitment, community, and engagement plan are prepared and rolled out. For the successful implementation of this phase, it should be ensured that participants sign a consent form and are aware of the (ethical) code of conduct of the CS project or campaign. Furthermore, a data management plan should be ready, listing all the different datasets and prerequisites of privacy and security.

3.3.1 Recruit

Description: To participate in a CS project or campaign, individuals need to be aware of an existing opportunity. Regarding this aspect, the recruitment strategy of the CS project is critical.

Considerations:

We can distinguish between four main recruitment techniques: (1) the generic, open call or "scattergun" technique; (2) the "gatekeeper" or community contact-point technique; (3) the "ambassadors" or word-of-mouth technique; (4) the targeted technique.

- ***Should the general population (also) participate?***

The **generic, open call or "scattergun" technique** entails the large-scale and undiscriminated advertisement of the project or campaign, through e.g., press releases (in newspapers, on the radio or on television), social media campaigns, or posters and flyers (Brouwer & Hessels, 2019; West & Pateman, 2016). However, it can be expected that this creates a bias towards groups of people that are particularly receptive to the type of media employed, e.g., younger people have been found to participate in projects that used social media as a recruitment strategy. This generic technique is also most likely to involve people already familiar with the scientific process (Brouwer & Hessels, 2019).

- ***Is the target group known to be present in certain places, affiliated with certain groups, associations, etc.?***

The **"gatekeeper" or community contact-point technique** uses third party organisations as a broker of participation opportunities. These include volunteering agencies, education institutions, community leaders, student unions, universities, local community groups and workplaces (Constant & Hughes, 2023; West & Pateman, 2016). This technique has been found particularly effective to reach people from ethnic minorities, young people, and unemployed people (West & Pateman, 2016). While fruitful as a recruitment strategy, gatekeepers or community contact points also serve as a long-term engagement technique as they help build long-lasting relationships with the local community (Hart et al., 2022).

- ***Is your target group particularly hard-to-reach?***

The "**ambassador**" technique, or word-of-mouth, is an effective way to recruit participants, with ambassador citizen-scientists representing passionate advocates for the project and mobilising their own communities (Dickinson & Bonney, 2012; West & Pateman, 2016). As this technique is most likely to reach and attract participants alike (West & Pateman, 2016) and this produces a bias in the profile of the participants involved, it is important to pay particular attention to the profile of the participants selected to be 'ambassadors'.

- ***Do you have an existing list of contact for your target group?***

The **targeted technique** consists of sending out personal invitations to a sample of the population (Brouwer & Hessels, 2019). It has to be noted that this technique presents a low response rate, generally below 10% (Brouwer & Hessels, 2019). Nevertheless, this technique is successful in reaching non-traditional participants, e.g., above the age of 24 years old and relatively more older adults, and with a relatively lower education level (Brouwer & Hessels, 2019).

Guidelines: The above-mentioned recruitment techniques are not mutually exclusive. Based on the scope and inclusivity level targeted by the project or campaign, a mix of techniques can, and should, be used to ensure that information reaches members of the public from different generations, socio-economic situations, technological abilities, and cultural traditions (Chesser et al., 2020). As such, a **4-step approach** can be implemented:

- **Step 1 - Definition of KPIs**: the project defines KPIs in terms of engagement, e.g., 50% females and 30 to 40% vulnerable groups.
- **Step 2 - Open call:** the project launches an open call regarding its activities towards the general audience through e.g., social media, press release, TV spot, etc.
- **Step 3- Assessment of KPIs**: the success of the open call in reaching the KPIs is assessed. If the KPIs are not met, the recruitment approach moves on to step 4.
- **Step 4 - Usage of other techniques**: depending on the KPI to be met, other techniques should be implemented.

Outcomes: A recruitment plan.

Potential challenges:

- Lack of awareness of the existence of an opportunity.
- Communication not clear about what and why.
- Recruitment method does not reach the target group.
- Personal values and gains are not clear.

3.3.2 Communicate

Description: The communication between the project and the target group(s) is established.

Considerations:

- ***What is the goal of the message, and does it align with your target group(s)' participant's journey?***

The **goal** of the communication may change during the project lifetime, going from recruiting participants, to motivating to participate, acknowledging efforts and input, and retaining participants (Rüfenacht et al., 2021). Likewise, the goal of the communication message should be aligned with the target group(s) participants journey. This will impact the content of the message.

- 'Decision to participate': convince them to engage with the project, increase their intention to participate in CS tasks, making clear why the scope of the project is relevant globally and locally, etc.
- 'Initial participation': help them to be engaged with the project and its tasks, show them how to take part, making clear how the project works, making expectation clear about their participation, and explaining how CS tasks contribute to a global and local matter, etc.
- 'Continued participation: keep them engaged with the project, show them why their efforts are still needed, provide feedback, etc.
- 'Finish participation': collect feedback from participants, collect information on predefined KPIs.

- ***What is the content of the message and is it relevant to your target group(s)?***

Precise information about the project's purpose, cause, expectations, support offered and the benefits of the initiative should be made available to participants (Constant & Hughes, 2023; Hart et al., 2022; Skorupska et al., 2021a). When advertising projects, it should be made clear what participating in the project involves, including the time commitment, nature of the activities, and whether any particular skills or abilities are required (West & Pateman, 2016).

Understanding the various motivations of the target group(s) and appealing to different ones in messaging can increase the number and diversity of participants. Communication messages can **capitalize on the different motivations of participants** and should evolve as the project unfolds. A study on the influence of motivation on initial and long-term participation (Rotman et al., 2014) found that initial participation in a CS project was highly dependent on 'egoistic interest' such as the 'personal development' motivation: whilst participants can express a favourable attitude towards CS, they tend to only participate if the

project has a personal value or benefit for them, e.g., if they have a personal interest or can take out personal gains. The 'career and recognition' motivation such as gaining experience for one's resume or feelings of self-efficacy was also an initial motivator. The social motivation, such as an external relationship with other communities and citizens became a motivation for some participants through their participation in CS project, which led to long-term engagement.

The **language** used in communication is of particular importance when addressing marginalised and vulnerable groups that may not be as familiar with the scientific domain: common scientific language will need to be adapted to the level of (scientific) literacy of the target group and texts provided should be easily understandable (Rüfenacht et al., 2021). General inclusive communication guidelines also apply (Varga et al., 2023), e.g., communication messages should be careful in referencing the participants' gender (Rüfenacht et al., 2021). The mere fact of naming participants as 'volunteers', 'citizens', 'amateurs, 'hobbyists', or 'helpers' should be carefully considered (Rüfenacht et al., 2021). Overall, the tone of the message should never be authoritative (Rüfenacht et al., 2021). Of course, all communications should be translated to the local language of the community (Lewenstein, 2022).

The Urban ReLeaf project will adopt the 'Storytelling for two' approach, which emphasises the need for teams to focus on creating compelling narratives that will encourage people to share them with others. To create such stories, the approach will follow the six "W" questions: "Why? Who? What? When? Where? hoW?" to guide the development and framing (see also D6.1 'Engagement, Communication and Dissemination Plan'):

- **Who?** Who are the target audiences and actors?
- **Why?** Why are we communicating, why do audiences need to know?
- **What?** What makes the issue urgent, what has happened or will happen? What solutions are we offering?
- **When?** Is this happening now, in the near term or in the more distant future? Is the communication a one-off, regular, and repeated, aligned with external events or opportunity?
- **Where?** Is this a highly local, national, European or global geographic context, aim to create a connection from local concerns to national or global issues.
- **HoW?** How does this relate to people in their everyday lives and more broadly to a bigger issue?
- **HoW?** How will we deliver the message through the most relevant medium or channel e.g., text, image, video, other is online, or physical?
- **What Impact?** What is the ideal outcome, is it effective and how will we follow up?

- ***What timing and medium would best reach your target group?***

A reliance on only one medium of communication could mean that the message does not reach all of the target group(s). Disseminating communication messages through a variety of mediums ensure that it reaches a diverse audience from different generations, socioeconomic backgrounds, with different cultural traditions and who have different technological skills (Chesser et al., 2020).

Face-to-face communication, such as events and other live outreach activities, provides the opportunity for the project organisers and the participants to meet. Although they are time and resources-intensive, they provide the benefit of recruiting new participants, rewarding existing ones, improving the retention of participants, and building trust. They also make it possible to

observe participant's behaviour, potentially improving data quality and reliability (Rüfenacht et al., 2021). Specific attention should be paid to the type of events and venue where these face-to-face events and outreach activities are organised: typical science institutions that have a tradition of sponsoring CS initiatives, e.g., museums, nature centres, universities, etc., can be unfamiliar or feel unwelcoming to diverse communities (Lewenstein, 2022). When organising such an event, the different motivations, needs, skills, and availabilities of the participants should be taken into consideration (Rüfenacht et al., 2021).

On the other hand, **online communication** enables frequent exchange which can be a motivation and prompt to regular contribution, such as through a newsletter, social media posts, or push messaging on website and mobile apps (Rüfenacht et al., 2021). Further, direct communication can facilitate exchange between members of the community.

Different type of projects might also require different type of communication:

- **Place-Based Community projects** (e.g., monitoring of air quality in a community) target an audience within a specific geographical range. Face-to-face communication and recruitment techniques (i.e., 'ambassadors' and 'gatekeepers') may be particularly interesting to solicit the participation of the target group (van Noordwijk et al., 2021). On the other hand, online communication can be a useful tool for continuous communication about the project (e.g., events, milestones, etc.) (Rüfenacht et al., 2021). Due to the focus of these projects, participants tend to participate due to the attachment to their surroundings, potential benefits/improvement to their personal life, and/or social interaction with the local community (van Noordwijk et al., 2021): these are elements that can be stressed in the different communication.
- **Interest Group projects** are projects targeting existing communities and interest-oriented groups (e.g., birdwatchers). Interest group participants are more likely to stay engaged in the long-term and their participation is supported by the opportunity to connect with like-minded participants (Rüfenacht et al., 2021; van Noordwijk et al., 2021). Online communication can help maintain contact between communities and help include communities from other geographical areas with a similar interest (Rüfenacht et al., 2021).
- **Educational research projects** have the objective to educate participants and are generally mediated by gatekeepers (e.g., teachers). Online communication is crucial to recruit new groups to participate (Rüfenacht et al., 2021).
- **Mass census projects** are projects that have the ability to appeal to a large array of citizens because of their societal relevance, limited commitment, and simplicity of the required tasks (van Noordwijk et al., 2021). Whether the project succeeds in being inclusive depends on other factors such as the recruitment technique and communication strategy (van Noordwijk et al., 2021): face-to-face communication can be relevant if organised at numerous locations but can exclude anyone from other areas or unavailable at the time (Rüfenacht et al., 2021). It is noted that the majority of successful mass census projects are conducted over a short timeframe (van Noordwijk et al., 2021).

- ***One-way or two-way communication?***

The CS field has, over the years, progressed from a **one-way communication** tradition based on the "deficit model"[1] where citizens should be educated to the scientific endeavour, to a **two-way communication** where citizens are seen as collaborators. As a best practice, participants should be provided with the opportunity to communicate with each other and with the project's organisers, to share ideas, concerns, and ask questions (Rüfenacht et al., 2021).

Guidelines: For each communication message, the why, what, when, where, and how are defined.

Outcome: A communication plan.

Potential challenges:

- Communication messages are not clear.
- Content of the communication is not relevant to the target group.
- Positioning of the project is not relevant to the target group.
- Communication medium does not reach the target group.

3.3.3 Engage

Description: In this step, you implement activities to keep your participants engaged and involved in the project, supporting as such their participation in the CS activities. This includes regular communication, events, rewards and recognition for their participation.

Considerations:

- ***Which activities could decrease the identified barriers of your taget group(s)?***
- ***Which activities could increase the motivations of your target group(s)?***
- ***Which elements could support the participation of your target group(s)?***

As mentioned in Phase II, adequate information on the data collection procedure either in the form of **trainings** or user guides as well as receiving help on demand should be provided to participants (Robinson et al., 2021). Training provided in-home by community members have been found to be an important support for participants without a college degree, while instruction booklets were found to be a support for college graduates, suggesting that written materials may provide disproportionate support to the college-educated (Davis et al., 2020). Moreover, trainings should be tailored to address specific needs in a clear and respectful manner. For instance, challenges related to language, culture, or literacy might necessitate translation, community-led explanations, or visual aids like pictures and symbols (Stevens et al., 2014).

Providing **prompts**, **feedback** and **recognition** to participants' contributions is also essential. Prompts act as reminders for participants to contribute, e.g. through the use of push messages

[1] The "deficit model" attributes the "public skepticism and hostility toward science to a lack of information, and held that the transfer of information to increase science literacy would encourage science-based decision-making by an informed citizenry" (Nadkarni et al., 2019)

or pop-up features on websites and mobile apps, while feedback and recognition (e.g., acknowledgement of receipt, message of validation, certificate of recognition, communication about the use/analysis of the contribution, etc.), act as a proof of the value of their participation (Constant & Hughes, 2023; Robinson et al., 2021; Rotman et al., 2014).

As barriers to participation can be both objective and perceived, an interesting element to consider is that the perceived level of demandingness might not be in line with the actual level of demandingness. While communication has a role to play to shed light on what participating in a specific project entails allowing participants to try the different tasks of the project during a "**taster session**" can be an effective tactic to provide citizens with the possibility to experiment with the tasks and tools before making a longer-term commitment (Constant & Hughes, 2023; West & Pateman, 2016).

In the same vein, facilitating the first steps of participants with the activities of the CS projects can be done via a "**buddy system**" where participants are grouped together, or via mentors that train new recruits (Constant & Hughes, 2023). Fostering an online community of events and using online communication platforms (e.g., WhatsApp) also increase the creation of social opportunities (Constant & Hughes, 2023) which supports participation. Some participants have also mentioned the idea of allowing them to invite friends to certain events as a recommendation (Constant & Hughes, 2023). Such relationship building has been identified as a strong support for continued engagement (Davis et al., 2020).

Further, it has been argued that the "voluntary nature of citizen science raises important questions surrounding the unpaid nature of many CS projects, which negatively impact young people or socio-economically disadvantaged groups that cannot afford the demands on their time, and high costs for transport, accommodation and equipment" (Constant & Hughes, 2023). As such, it has been recommended to consider a **financial compensation for participation** or at least the coverage of related costs (Constant & Hughes, 2023), e.g., by finding flexible funding sources that allow for this type of expenditure (Benyei et al., 2023).

The Urban ReLeaf project will be implementing '**Pop-up Community and Culture Labs'** (T2.3) to engage citizens in the urban greening discourse, raise awareness and spur interest in environmental monitoring. In collaboration with local artists and citizen associations, artistic and design-based innovation activities will be offered. Bespoke labs will be strategically organized in the city and during specific city events (local festivals and street events, organized walks, etc.) to stimulate the engagement of large numbers of participants (including women, marginalized groups, and vulnerable groups).

Guidelines : Based on the compatibility assessment between the target group(s) and the CS tasks and tools conducted in Phase II, adequate mitigation and supporting measures need to be implemented to maintain engagement of your target group(s).

Outcome: An engagement plan.

Potential challenges:

- Decreased engagement over time (i.e., drop-out).
- Change in motivations.

3.4 Phase IV - Monitoring for inclusion

Preconditions for phase IV:

For the successful implementation of this phase, it should be ensured that participants can voice their opinions about different aspects of the project throughout the different stages. Therefore, it is best that feedback is collected about both the processes and eventual outcomes, with the possibility to mitigate and implement solutions based on the feedback.

3.4.1 Assess

Description: In this step, you assess the results of the CS campaign based on the KPIs on community participation defined in Phase II.

- ***Are the KPIs met?***
- ***Can a reason be identified?***
- ***Can mitigation measures be implemented?***

Assessing CS campaigns through evaluation and monitoring is crucial. It allows to gauge the overarching objectives and benefits for participants and recipients (outcome-based evaluation) and pinpoints the operational strengths and weaknesses (process-based evaluation). It fosters self-understanding and accountability, involving participants, the public, and potential funders, emphasizing inclusivity and engaging diverse stakeholders in the process (Kieslinger et al., 2017).

Specific attentions should be paid to frustrations, challenges, and difficulties faced by participants, which might have already arisen in their feedback. Participation rates and changes in motivations are also monitored over time.

The results of the monitoring phase can disseminate and shared with the participants, and the broader citizen science community. For instance, the results of interviews and focus groups could be disseminated through storytelling, or scientific articles can be shared with good and best practices for recruitment and retention practices.

Guidelines: The community indicators can be monitored through various **instruments**:

- **A participant survey** with questions about SE and SD characteristics to monitor diversity can be completed at the start of the activities (when registering for the campaign), or at the end of a specific activity or study. It is best that these questions are asked at the end of an activity to avoid the effect of ‘priming’. This is a bias (activating a stereotype) that can be created when asking respondents to provide demographic information before completing a survey or an activity, and which might cause a significant decrease in performance (Fernandez et al., 2016). Examples of SE and SD questions to include in a survey are provided in the appendix (see Appendix 4 – SE & SD survey template).
- **Event and activity logs** whereby the date, location, role in the activities, retention rates, number of hours, etc. are tracked. A part of these data could be collected through

online logging statistics of the mobile applications such as retention rates, number of hours, etc., a template is provided for the manual and digital logging of activities in the appendix (see Appendix 5 - Events or Activity logging). This template could be potentially merged with the communication and dissemination logging of WP6.

- **Interviews or focus groups** can be organised. For collecting in-depth feedback about benefits and challenges of participation, interviews or focus groups can be organized.
- Last, **observations of meetings** can also be conducted with post-briefing sessions. In Appendix 6 – Observation of meetings / community participation, a survey template is foreseen for the pilot coordinators to distribute at the end of an activity. This questionnaire is taken from (Goodman et al., 1996 - Figure 1 'Meeting Effectiveness Inventory') and adjusted to the context of Urban ReLeaf. The measures evaluated in this form are organization, participation, leadership, decision making, conflict resolution, cohesion, and productivity. These measures align with the proposed measures in phase 2 of 'role in the activities', 'benefits and challenges of participation' and 'satisfaction with the process of participation'. This survey can be combined with the SD and SE characteristics.

Outcome: Process & outcome evaluation of community participation.

Potential challenges

- Difficulty in engaging participants in yet another (research) activity.
- Difficulty in assessing certain type of KPIs (especially long-term).

3.5 Blueprint

Access the Blueprint here. This blueprint will be further validated during the course of WP4 activities.

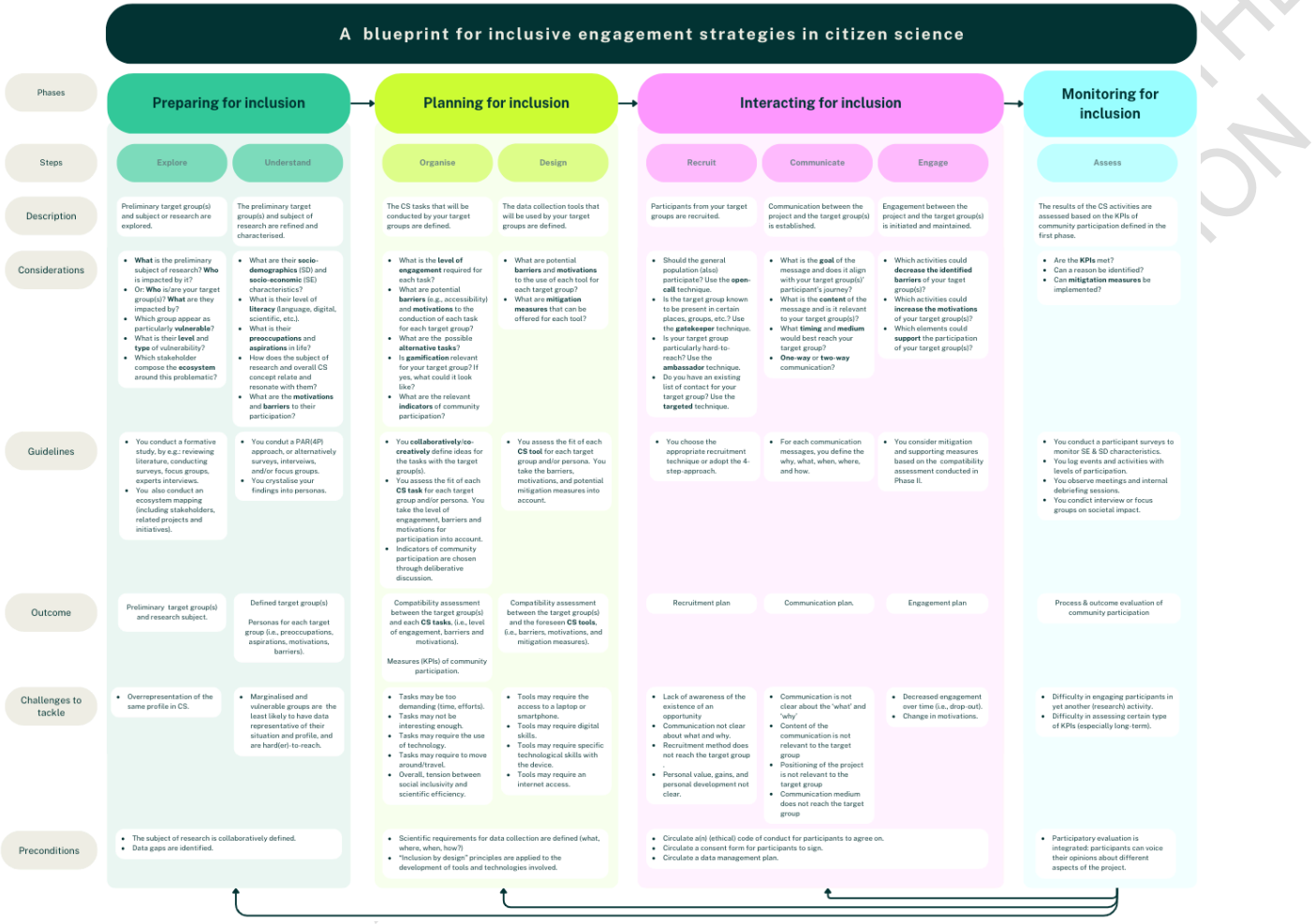

Figure 3: Inclusive CS engagement Blueprint

3.6 Annexes Blueprint – Inclusive engagement practices for specific target groups

The following annexes were added to the blueprint based on the identified main taget groups in the multistakeholder workshops (cfr. chapter 4). Further iteration and development of other annexes will happen in context of WP4-WP5.

3.6.1 Engaging with older adults

Based on the good practices found in (Blair & Minkler, 2009; Corrado et al., 2020; Hand et al., 2019; A. King et al., 2020; Liljas et al., 2017b; Schiau et al., 2018; Skorupska et al., 2021b; A. Tuckett et al., 2018), an appendix to the blueprint has been developed how to best engage with older adults. Guidance is provided in terms of motivations, barriers, support mechanisms and general strategies for engagement.

You can access the appendix via this link.

Figure 4: Screenshot appendix "Engaging with older adults"

3.6.2 Engaging with women

Based on the good practices found in (Kimura, 2019; Makarova et al., 2019; Santos et al., 2021), an appendix to the blueprint has been developed how to best engage with older adults. Guidance is provided in terms of motivations, barriers, support mechanisms and general strategies for engagement.

You can access the appendix via this link.

Figure 5: Screenshot appendix “Engaging with women”

3.6.3 Engaging with youth

Based on the good practices found in (Butkevičienė et al., 2021; Constant & Hughes, 2023; Göbel, 2023), an appendix to the blueprint has been developed how to best engage with youth[2]. Guidance is provided in terms of motivations, barriers, support mechanisms and general strategies for engagement.

Figure 6: Screenshot appendix "Engaging with youth"

[2] Youth, as a description of a certain part of the human population, has had different age gaps as identifiers. Currently, youth in EU law is identified as people between 15 and 29 years of age.

4 Phase 1: Preparing for inclusion

In this section, we focus **on Phase I of the Blueprint titled** "**Preparing for inclusion**". This phase consists of the preliminary steps required to set up an inclusive CS engagement campaign. The phase includes: step (1) **exploring** the subject of research, the target group(s), and the ecosystem; step (2) **understanding** the target groups.

4.1 Methodology: PAR4P

To carry out these steps, the PAR4P methodology was applied. The **PAR4P** methodology is a specific Participatory Action Research (PAR) approach with a focus on policy developed by the VUB (imec-SMIT, VUB). PAR is an approach based on the active participation of the individuals directly concerned by the subject of study in the definition of the problem(s) and formulating of solution(s) (Baldwin, 2012). The PAR4P approach aims to go a step further and adopt a more pragmatic approach through an intensive collaboration with policymakers, increasing the possibility that recommendations will be effectively translated into public policies (Laenens et al., 2019). The PAR4P methodology contains five steps:

(1) **problem definition**, where the general issue that needs to be solved is defined;
(2) **participants' identification**, where individuals affected by the issues are identified;
(3) **problem re-definition**: where participants have the possibility to re-define the problem if needed;
(4) **solutions identification**, where desirable and achievable solutions are identified, together with the actor that can carry on the activity;
(5) **solution formulation**, where a concrete scenario is drafted.

Within WP2, the PAR4P methodology is implemented as illustrated in Figure 7: the activities of T2.1, of which the results were reported in D2.1, focused on the preparatory phase of PAR4P, and worked towards the creation of landscape reports for each pilot. Based on the results of D2.1, a (preliminary) definition of the subject of research, the target group(s), and the ecosystem was conducted and is reported in the following chapter 4.2 "**Step 1: Explore**".

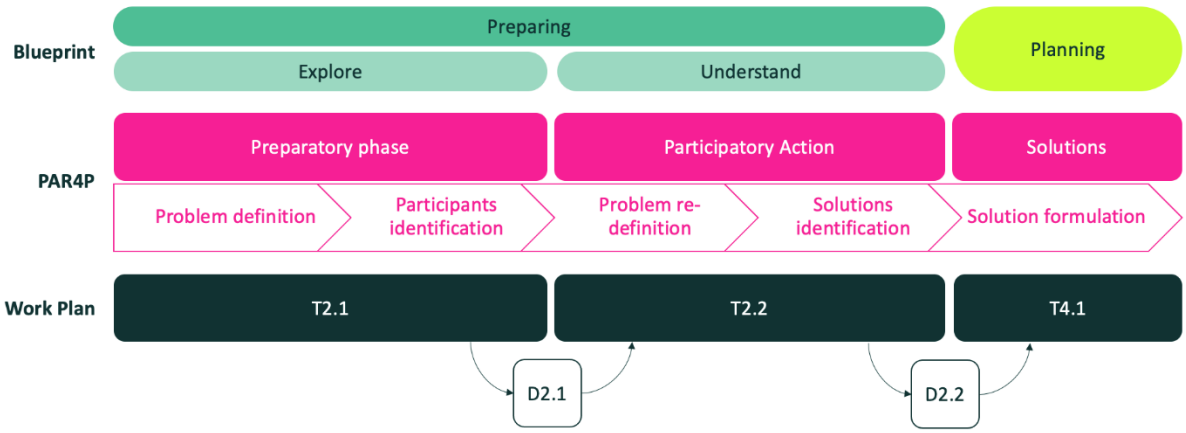

Figure 7: Relationship between the Blueprint, the PAR4P methodology, and the Work Plan of Urban ReLeaf.

T2.2 consist mainly of the Participatory Action phase of the PAR4P and focuses on re-defining the previously identified problem and identifying solutions. The results of each pilot are

reported in the following chapter 4.3 '**Step 2: Understand'**. The formulation of the final solution and its concretisation will be carried out from WP2 to WP4.

4.2 Step 1: Explore

This step builds upon the results from D2.1 "Landscape reports on policy processes and opportunities for inclusive participation" which reported results from (1) an analysis of local policy documents around urban greening and participation and (2) expert interviews at the local level for each of the six cities. Based on this work, several potential themes as subjects of research were explored, a list of potential target groups was highlighted, and the stakeholders and existing initiatives of the ecosystem on the issue were mapped for each city. This step allowed the project to explore potentiality in terms of topic areas, narrow down their scope, and consider the implications for different target groups. These elements are reported in Table IV.

Table IV: Preliminary themes of research, target groups, stakeholders and initiatives for each pilot.

Pilot	Themes	Target groups	Stakeholders	Initiatives
Athens	• Heat stress • Wellbeing • Quality of life • Tree risk management • Ecosystem services of urban green and blue infrastructure • Green recreation areas • Pocket parks	• Green-deprived neighbourhoods • Citizens with a low socio-economic profile • Older adults • Youth • Children • Refugees	• Office of Resilience and sustainability • Office of Innovation • CIBOS • Friendship Clubs of Athens • Green departments • Athens trigono • NOA • National garden • Participatory Lab of Commonspace coop • Observatory of Urban Greening and Climate Resilience	• Urban heat Watch project • TREASURE (HE project) • COMPAIR (HE project) • SynAthina • Geo-Cradle • Great Walk of Athens • Triangle Pocket Innovation and Revitalisation project • 100RC • Diaskepsis for Athens • Participatory budgets
Cascais	• Heat stress • Wellbeing • Health • Promotion of spaces to meet • Bioclimatic comfort • Microclimate • Mental health	• Citizens with a respiratory disease • Older adults • Citizens at risk of energy poverty • Citizens with reduced mobility • Children • Schools and teachers	• Residents' associations • Local schools • Community centre • Secondary schools • Parish Councils • Nova SBE University innovation Ecosystem • Environmental associations • Youth associations	• Re-Value (HE project) • Invest4Nature (HE project) • Climaborough (HE project) • Clima AML project • Hortas de Cascais • Programa Oxigenio • Tutores de Bairro • Ribeira das Marianas • Rotas Vivas project • Citizens Panels • Participatory budget • Reinvente o seu Bairro • Data4All
Dundee	• Heat stress • Bioclimatic comfort	• Older adults • Youth	• Community Outreach	• Eat Drink Dundee

	• Perception of greening initiatives • Air quality • Health • Perception of greenspace safety and vandalism • Quality of green spaces • Challenges of derelict land and building • Culture and heritage • Community Social Space • Biodiversity • Flooding • Active travel • Accessibility	• Citizens with a low socio-economic profile • Green-deprived neighbourhoods • Highly-skilled individuals • Citizen with a lower health profile • Citizens from the LGBTQIAS+ community • Citizens from the BME community • Strava users • Environmental interest groups • Outdoor active citizens	(Community Services) • Community Centers • Local community planning partnerships • Community health team • UNESCO City of Design • Friends of earth Tayside • Dundee Cycle Forum • Dundee conservation volunteers • Woodland trust • Friends of Riverside Nature Park • Maxwell centre • Abertay university • Community Empowerment Team • Stobswell Forum	• Streets Ahead (street design strategy) • Hello Lamppost • Eco-schools • Community food growing network • Climate Challenge fund • MVV schools • Liveable neighbourhood • Living Streets
Mannheim	• Heat stress • Wellbeing • Green and blue infrastructure • Microclimate • Bioclimatic comfort	• Youth • Youth with a migrant background • Older adults • Citizens with a lower health profile • Children • Citizens experiencing homelessness • Citizens with a mental disability • Citizens with substance use disorder	• Climate Protection Office • Climate Protection Agency • Climate Protection Department • Democracy and Strategy • Aid associations for the homeless • Youth Welfare office and Health Department • Coordination Office for citizen participation • Migration Advisory Council of the City of Mannheim • Schools and kindergardens • Youth Council • Working group on citizen participation	• Shaping Mannheim Together platform • Climate Protection Alliance • Environmental awards • 'Mannheim on a climate course' website • FlurfunkE programme • Green schools • BUGA 23 • '23 trees' action • '1000 trees' programme • '200 trees for citizens' programme • Tree stewards • ECOfit programme • Mobile Green room • 'Strenghten Greening' • Intelligent Cities challenge • Participatory budgets
Riga	• Green infrastructure • Trees • Microclimate • Perception of green spaces • Air quality • Ecosystem services	• Older adults • New parents • Children • Youth • Dog owners • People with a reduced mobility	• Neighbourhood associations • NGOs working with citizens • Landscape architects • The Grīziņkalns society • The Garden Society	• Ekocommunity • Ekoschool activities • Bolt/wolt food services • Neighbourhood channels • LATEST project • DESIRE project • +Urban Life Circle project • Green Class

			• City Lab territories (Ķīpsala, VEFresh and LU Torņkalns) • Riga center Development Society • The Sarkandaugava Society • Departement of Land Improvement • TET • NGO Pilsēta cilvēkiem	• Co-budgeting programme • Clean-up days • Neatest flower bed competition • Citizen Lab subscription
Utrecht	• Heat stress • Bioclimatic comfort • Green space for recreation • Microclimate • Health • Biodiversity • Wellbeing	• Women with a migrant profile • Youth • Citizens of low-green neighbourhood • Older adults • Citizen with a low socio-economic profile • Citizens with a migrant profile	• City together steering group • Children's council • Initiative network • Citizen's council • Talking Post poverty coalition • Council letter	• Initiative funds • Neighbourhood budget • City Talks • 900 trees for 900 years • Utrecht neighbourhood maps • Miliey Centrum Utrecht • Utrecht Natuurlijk • Neighbourhood nature 030 • Pientere tuiner • Samen Meeten Utrecht • Neighbourhood concierge and ambassadors

4.3 Step 2: Understand

4.3.1 Multistakeholder workshops

The Participatory Action phase of the PAR4P consisted of the organisation of one **multistakeholder workshop per pilot**. The goal of workshop was to re-define the 'problem' as identified in the previous steps and identify solutions for the inclusive engagement of citizens within the activities of the Urban ReLeaf project. A multistakeholder workshop provides the opportunity to harvest the knowledge and expertise of the participants and gives value to their diversity. As such, it confronts their diverse experiences to create a rich understanding on how to best engage with the target groups of each pilot city.

Each pilot city organised one 3-hour multistakeholder workshop between the months of May and June 2023 (M5-M6).

Table V: Date and number of participants per multistakeholder workshop organised.

Pilot	Date	N° of participants				
		Public	Private	People	Academia	Total
Athens	21/06	14	4	4	8	31
Cascais	19/05	11	2	6	-	19
Dundee	24/05	10	4	11	17	32

Mannheim	23/06	8	2	4	1	15
Riga	25/05	4	4	2	2	12
Utrecht	09/05	14	1	-	3	18

The workshops were organised as follows:

1. **Welcome (10 min)**.
2. **Introduction (20 min):** the goal is to (re)introduce the project, the role of the city/pilot in it, and the goal of the workshop. Participants should understand their value and what is expected of them.
3. **Ice breaker (15 min)**: the goal is to break the ice between the participants whilst introducing them to one another.
4. **Prioritisation exercise (20 min)**: the prioritisation exercise will define the focus on the rest of the workshop. Based on the preliminary themes as subject of research and preliminary target group(s), participants are asked to vote and prioritise the most relevant focus for their pilot in terms of: (1) themes and (2) target groups.
5. **Characterisation (30 min)**: the characterisation exercise focus on the target groups selected from the previous step. The goal is to characterise each target group regarding their concerns and aspirations in life, and potential barriers and motivations to participate, to better understand their reality and take it into consideration when developing engagement strategies.
6. **Break (15 min)**.
7. **Identification of strategies (60 min)**: the co-creation of the engagement strategies for the observation campaign takes place. The participants are asked to put the “pieces of the puzzle” (i.e., cards) together to create inclusive engagement strategies.
8. **Visioning exercise (20 min – only if time allows**): through a “future newspaper” approach, the visioning exercise aims to elicit the collective visions of citizen-generated data for urban greening.
9. **Closing (5 min)**.

Figure 8: Multistakeholder workshops

To support the pilots, the VUB provided guidance in the form of:

- **Invitations**: a template invitation was provided to the pilots (see Appendix 1) which they were free to modify and translate. Pilots were instructed to invite stakeholders previously identified in the ecosystem mapping, with a focus on representatives of vulnerable and marginalised groups.
- **Train-the-trainer workshop**: the pilots took part in a train-the-trainer workshop organised by the VUB which described: the purpose of the multistakeholder workshop; the different material that would be provided to them to support their facilitation; specific point of attention of the facilitation process; the different activities to be facilitate during the workshops (including: explanation, step-by-step guidance and timing, material required); and the next steps once the workshop was conducted.
- **Materials**: each pilot was provided with a set of material to review, translate, and print (see Appendix 2):
    - Facilitation script: this document summarised all the material required for the workshop (format and numbers of copies) and detailed a step-by-step on how to conduct the activities of the multistakeholder workshop, what to say at each step, and tips.
    - Templates: several templates to support the completion of the activities were provided.
    - Cards: based on the results from ‘Step 1: Define’, cards for each theme, target group, stakeholder and imitative were created.

4.3.2 Athens

During the prioritisation exercise, the participants of the workshop of Athens identified the themes **of heat stress, well-being and health**, and **air quality**. The target groups identified as the most relevant for Athens were **citizens affected by climate change** (e.g., older adults), **citizens living in a green-deprived neighbourhood**, and **city employees and officials**.

4.3.2.1 Citizens affected by climate change

During the characterisation exercise, the participants of the workshop of Athens created one persona for the target group “citizens affected by climate change” and chose to focus on the ‘older adults’ audience of this target group. Overall, the persona suffers from the lack of greenery in their city and aspires to see more green spaces.

Figure 9: Athens’ personas for "Citizens affected by climate change"

The campaign idea for the target group “citizens affected by climate change” co-created by the participants of the workshop of Athens focus rather on a communication campaign than on a monitoring campaign. Five ideas focus on tree mapping. The “**QR code for tree mapping**” describes the use of QR codes apposed on trees located near school as a way to recruit participants. The “Tree mapping with schools” describes the involvement of school children in the area of Kipseli to map the trees around their school, house, and neighbourhood streets. The “**tree mapping with Synathina**” describes the engagement of the Synathina community to participate in the tree registry. The “**Tree mapping with Universities**” describes the involvement of university students to map trees, and the ones living in Athens also receive a wearable sensor. Finally, the “**Tree mapping promotion**” describes the use of radio spots and leaflets to recruit participants.

The other two ideas described how to recruit participants to monitor the air quality in Athens. The "**assessment of AQ in green areas**" describes the distribution of static sensors in green areas of Athens such as in national parks. The "**events-focused monitoring**" described the distribution of wearables in events and communities, e.g., cyclists, runners, etc.

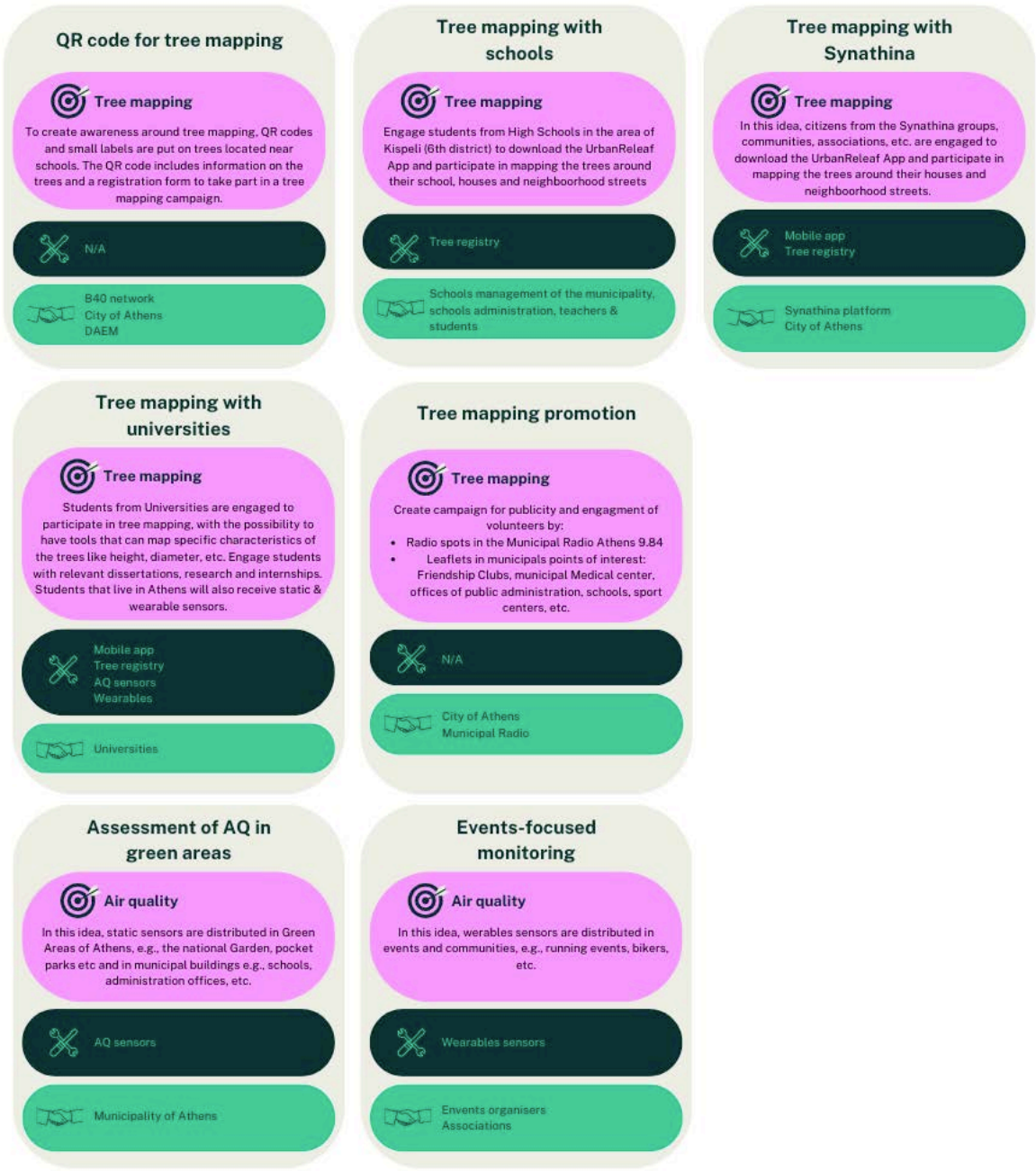

Figure 10: Co-created campaigns ideas for the target group "Citizens affected by climate change".

4.3.2.2 Citizens living in a green-deprived neighbourhood

The participants of the workshop of Athens created one persona for the target group "citizens living in a green-deprived neighbourhood" during the characterisation exercise. The persona describes a working man that might lack the time to participate and is cautious about what is being done with his data. He has a pro-environmental attitude (i.e., wants to change his car to an electrical/hybrid one) and longs for more green spaces in his neighbourhood. Socialising with his neighbours would motivate him to participate.

Figure 11: Athens' personas for "Citizens living in a green-deprived neighbourhood"

The campaigns as described above also apply to this persona and are the same for all envisioned participants. For this persona in particular, it was highlighted that a recruitment technique would be to approach these types of end-users through their children at schools, making the above-mentioned campaigns relevant as well. It was also suggested that these groups of citizens visit municipal facilities (e.g., municipal medical centres) where leaflets and other material will be distributed, as described in the campaigns above.

4.3.2.3 City employees and officials

During the characterisation exercise, two personas were created for this target group: one for the city official, in the form of the Mayor of Athens, and the second of a municipal employee. The persona of the municipal employee describes a working man that has a high workload. As such, he would be difficult to engage due to his lack of time and low willingness to put some extra efforts into a new activity. However, monetary incentives and professional perspectives could motivate him. A voice recording option could also decrease the barrier to participation.

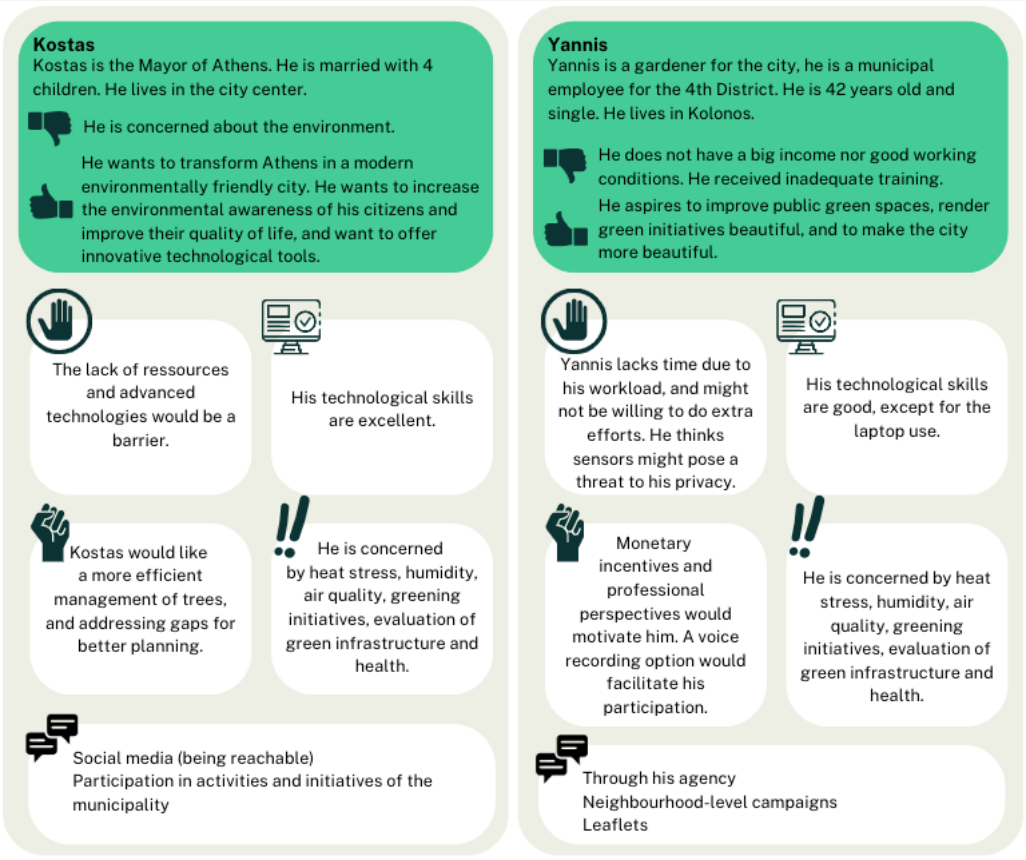

Figure 12: Athens' personas for "City employees and officials"

The co-created campaign idea identified during the workshop focuses on a collaboration with the municipal employee to develop a tree management platform, rather than a monitoring campaign.

Figure 13: Co-created campaign idea for the target group "City employees and officials"

4.3.3 Cascais

During the prioritisation exercise, the participants of the workshops identified three main themes of interest: **bioclimatic comfort**; **promotion of spaces to meet**; and **wellbeing**. The target groups of interest were: **older adults**, **schools and teachers**; and **citizens at risk of energy poverty**.

4.3.3.1 Older adults

During the characterisation exercise, the participants of the workshop created two personas for this target group. They are quite similar in the sense that they would be motivated by social elements such a being part of a collective initiative or participating in intergenerational programmes and staying active and having an occupation. They both struggle with the use of technology and will require assistance or another way to participate. They also display a certain level of mistrust and will require clear communication about the aim of the activities and what is being done with the collected data.

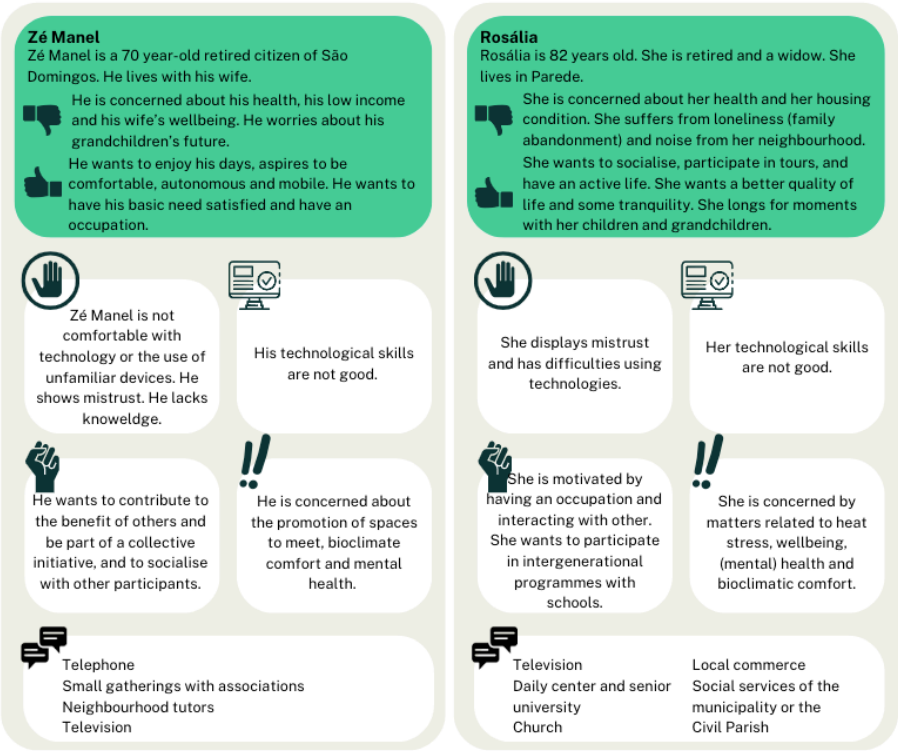

Figure 14: Cascais's personas for "Older adults"

Participants co-created two campaign ideas. The first idea "**walk with me**" make use of a buddy system, where participants are grouped together to complete information about thermal comfort in the mobile app. This could help profiles such as the ones identified here by supporting their participation with other participants which might be more comfortable with technologies. This would also answer their motivation to socialise and stay active.

The second idea "**wellbeing in outdoor spaces**" is less defined but proposes to promote the use of green areas as multipurpose spaces, and better understand how they are used through the use of the thermal comfort mobile app and the AQ sensors.

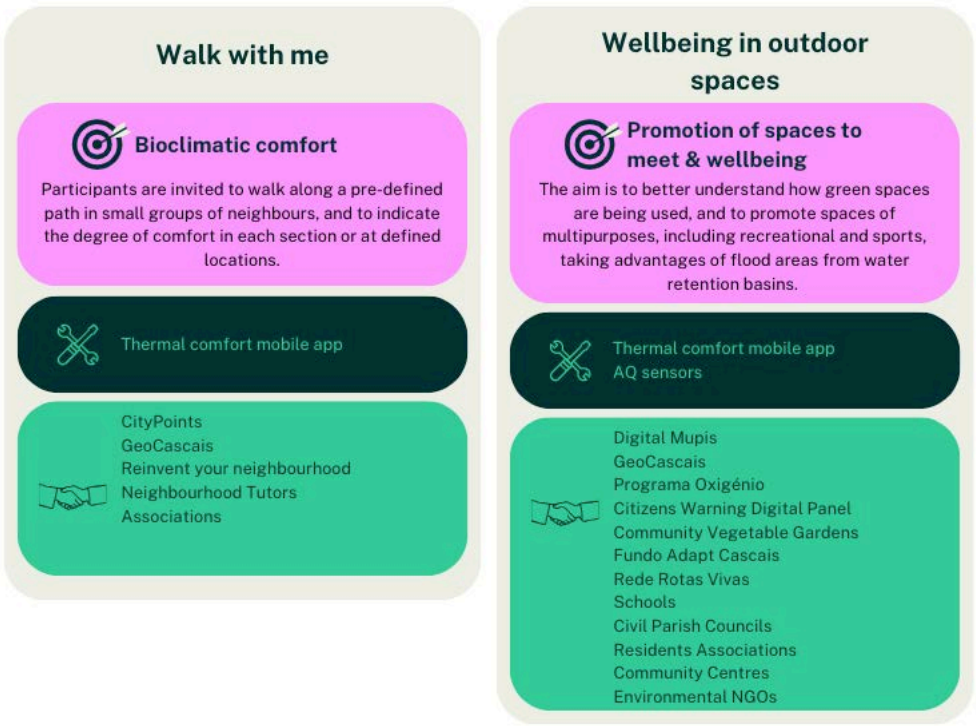

Figure 15: Co-created campaigns ideas for the target group "Older adults".

4.3.3.2 Schools and teachers

The three personas created during the characterisation exercise for this target groups are different from one another: the first one is about a teacher, the second one about a pupil, and the third one about a college student. They all have different motivations and barriers to participation that should be taken into consideration later on.

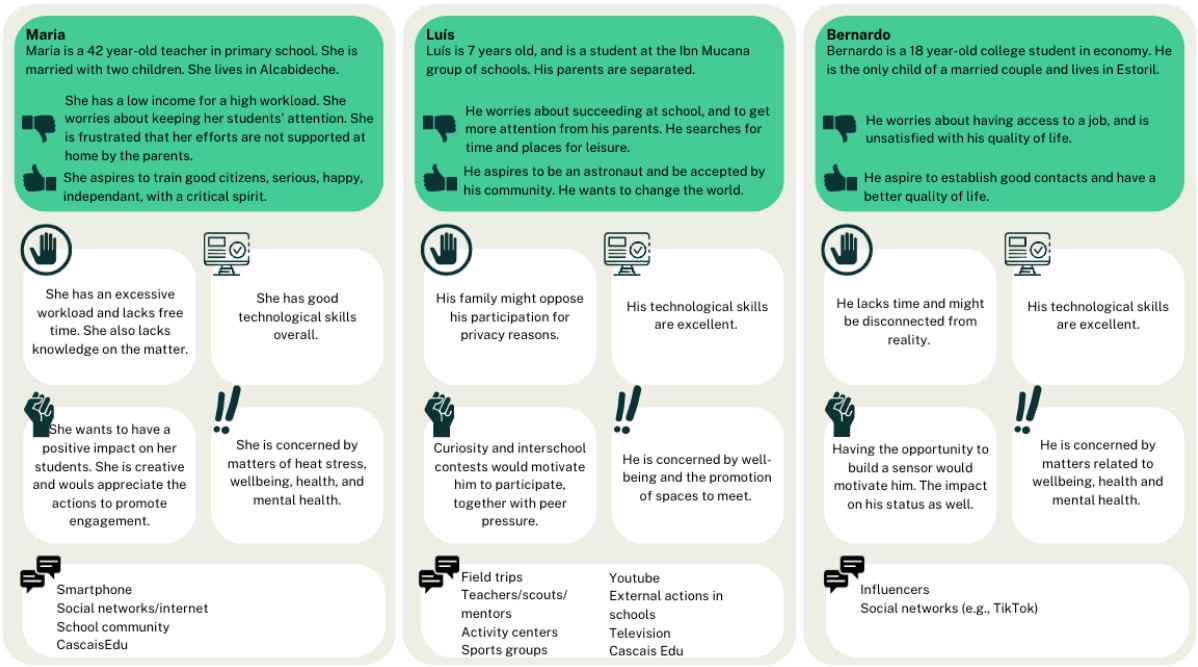

Figure 16: Cascais's personas for "Schools and teachers"

One campaign idea was co-created for this target group, which has the potential to engage two personas: the teacher and the pupil. The idea is that schools enter a competition, involving the teachers, employees, parents, and students to apply and signal heat-related behaviours. A tournament within the school would be organised, followed by an inter-school tournament, and a final.

Figure 17: Co-created campaigns ideas for the target group "Schools and teachers".

4.3.3.3 Citizens at risk of energy poverty

The three personas identified for this target group during the characterisation exercise describe citizens that are facing a lot of struggles in their life, such as financial instability and a lack of time. Because of this, they might be somewhat marginalised from society and not motivated to participate. However, certain types of benefits could incentivise them to participate such as CityPoints, discounts, or free public transport tickets.

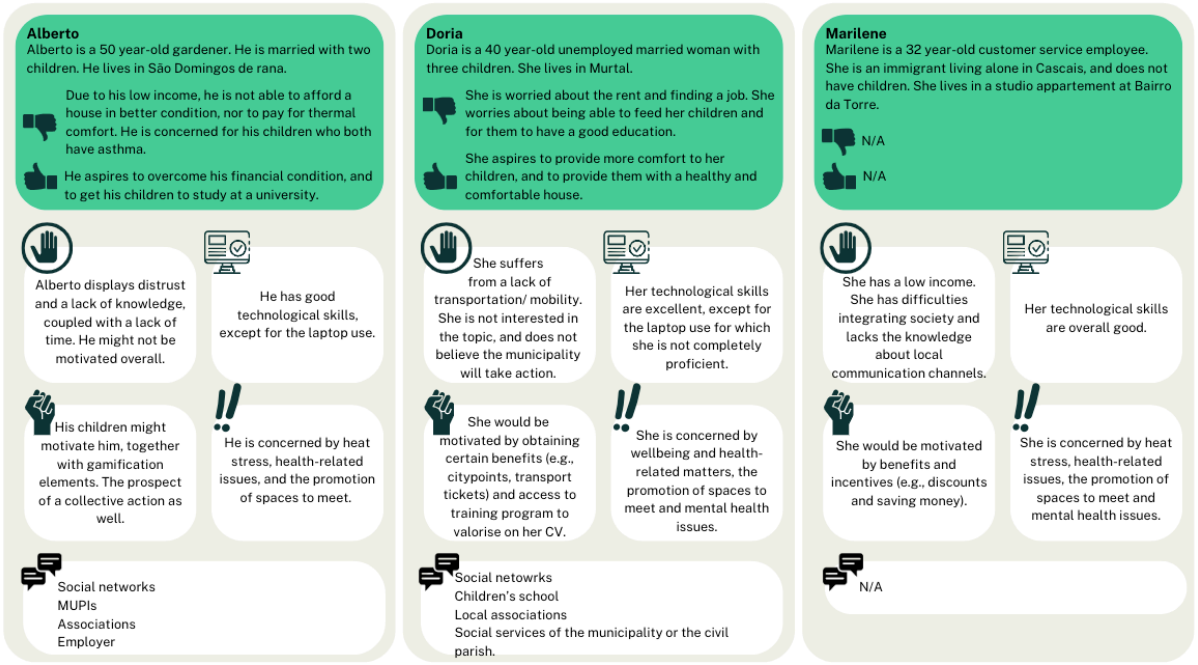

Figure 18: Cascais's personas for "Citizens at risk of energy poverty"

The co-created campaign idea for this target groups centres around bioclimatic comfort and aims to create a map of thermal comfort across the city. The specific value to the participants should be made clear, such as the identification of these 'refuge' points in case of a heat wave. The elements of the CityPoints should also be brought forward to appeal to this target group.

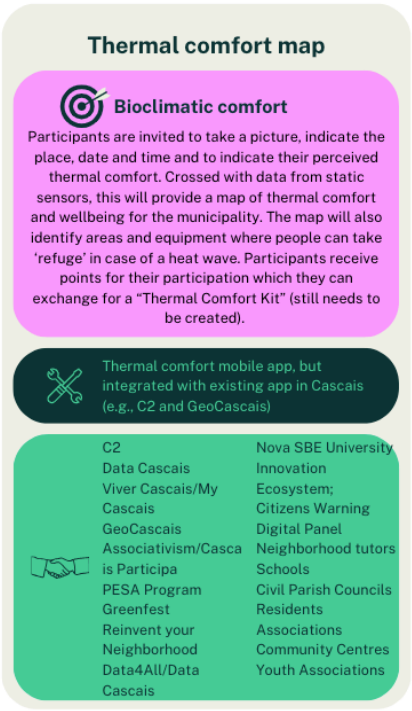

Figure 19: Co-created campaigns ideas for the target group "citizens at risk of energy poverty".

4.3.4 Dundee

Different topics were identified as relevant by the participants of the workshop during the prioritisation exercise: **health; quality of greenspace; community social space; challenges of derelict land and buildings; accessibility; biodiversity; active travel; air quality; perception of greening initiatives**. However, from these nine priorities, participants of the workshop mainly focused on the use and evaluation of greenspaces.

The target groups identified as the most relevant for Dundee were **young people**, **citizen living in green-deprived neighbourhoods**, and **citizens with a low socio-economic background**.

4.3.4.1 Youth

During the characterisation exercise, the participants of the workshop in Dundee created four personas for the target group “youth”. The personas are all teenagers living at home with their parents. Overall, the teenagers depicted by the participants of the workshop do not seem to live a carefree childhood and are already burdened with concerns regarding their financial stability and mental health. They are starting to build their identities and long for socialisation. They seem to be lacking places to hang out. **They are all willing to have some agency and see some changes around them, which seem to be the entry-door to their involvement**: they might be highly motivated to participate if the goals and results of their participation is made very clear to them.

On the other hand, they still require the permission of their parents – to some extent – to participate and might lack the time to fully partake. Their other concerns in life could also be barriers to their participation.

Figure 20: Dundee's personas for "Youth"

Both co-created ideas focus on green spaces in Dundee. Both ideas have very strong and defined end-goals, while the monitoring aspect is less extensively explained.

The first idea "**Community Social Space**" focuses on the current use and evaluation (i.e., perceptions) of existing green spaces by youngsters, in order to define the required improvements and increase the connection to nature. The collection of this information could be done by mobile app, but it is not clear how. All personas are susceptible to be motivated to take part in this campaign if promises of actual changes is made to them.

The second idea "**AQ improvement in derelict land transformation**" makes use of air quality sensor to monitor the impact of interventions on the local air quality aiming to turn derelict land into green spaces. This idea could work hand-in-hand with the previous idea and build upon

the identified areas which require improvements. Working first with “quick-wins” transformations might help increase their trust in the process and signal to them that their participation is valuable and that their voices are being heard.

Figure 21: Co-created campaigns ideas for the target group "Youth".

4.3.4.2 Citizens living in green-deprived neighbourhoods

During the characterisation exercise, the participants of the workshop identified five personas for the target group “citizen living in green-deprived neighbourhoods”. Most personas seem to have financial preoccupations, and to worry about the costs of living. However, the rest of their profile are quite different: from different ages (33 to 76 years old), different family situation (single parent, widow, divorced, young family), different technological skills (excellent to very poor). This target group and its different audiences will necessitate specific attention. However, they seem to be motivated by some of the same elements: socialisation with the community, different incentives, and the desire to bring about change and improve their lives and those of their children.

Figure 22: Dundee's personas for " Citizens living in green-deprived neighbourhoods"

Although only one co-created idea was identified by the participants of the workshop, the idea would be divided in two: (1) recording of journey from/to green spaces, together with the purpose in accessing the space; (2) identification of derelict spaces that would be improved in terms of accessibility, safety, usefulness, and welcomingness. Of course, both ideas can be coupled. The idea includes the use of wearables and of a tree registry.

Figure 23: Co-created campaigns ideas for the target group " Citizens living in green-deprived neighbourhoods".

4.3.4.3 Citizens with a low socio-economic background

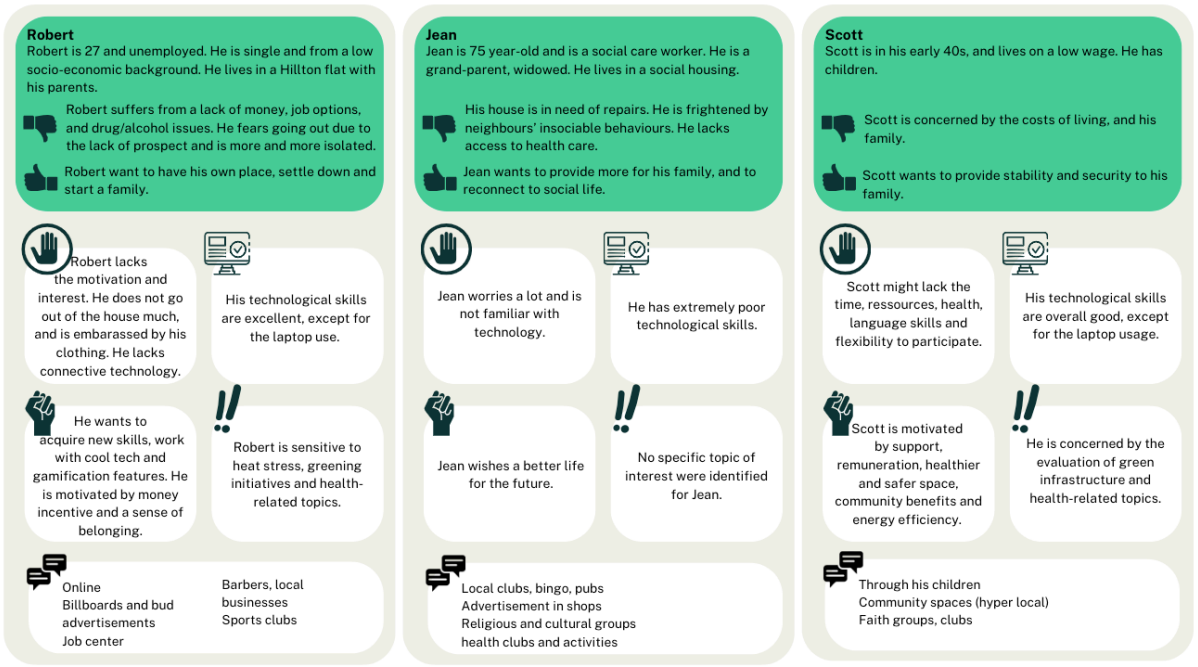

Figure 24: Dundee's personas for "citizen with a low socio-economic background"

The three personas created for the "citizen with a low socio-economic background" during the characterisation exercise are diverse in terms of age (27 to 75 years old) and technological skills (extremely poor to excellent), but they all struggle with the cost of living and financial instability. They want to provide for their (future) family and aspire to a better quality of life. This target group might suffer from socialisation problems (fear of going out, fear of neighbours) which might be a barrier to their participation. However, their (will for a) connection

to the community might be a strong motivator to their participation, if a clear link to tangible improvement for their family and community is made.

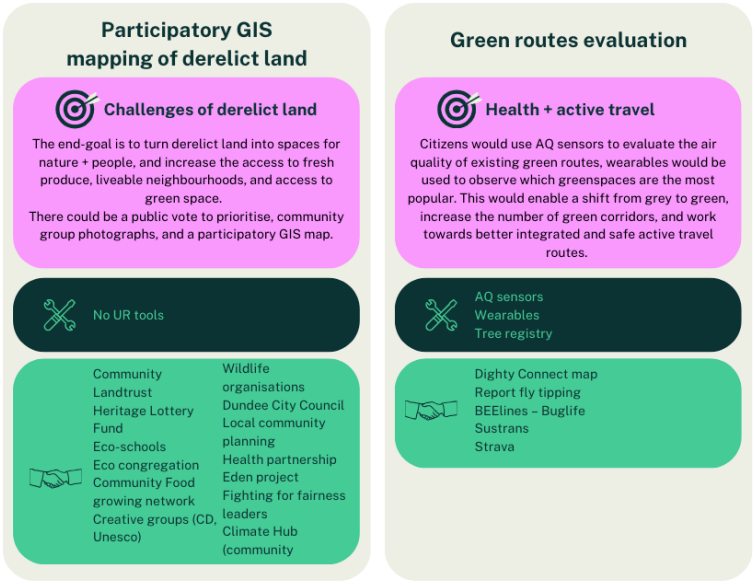

Figure 25: Co-created campaigns ideas for the target group "Citizen with a low socio-economic background".

The first co-created idea "**participatory GIS mapping of derelict land**" has a strong and clear goal for the community: increase access to fresh produce, liveable neighbourhoods, and green spaces. The participatory and monitoring aspect of the idea is less clear, although a GIS mapping is mentioned.

The second idea, "**green routes evaluation**" makes a clear use of the AQ sensors and wearables to evaluate the air quality of existing green routes, and show which green spaces are the most popular. The end-goal is also very clear: to enable a shift from grey to green, increase the number of green corridors, and to work towards better integrated and safe active travel routes.

4.3.5 Mannheim

The topic identified as most relevant for the participants of the workshop during the prioritisation exercise were **green and blue Infrastructure**; **microclimate**; and **heat stress**. The target groups identified as the most important to engage were **older adults**; **citizens with a lower health profile**; and **children**.

In the following section, we detail the step "Understanding the target group(s)" by analysing the personas created during the workshop for each target groups, and as such detailing insights on the socio-demographics characteristics, the level of literacy (digital, scientific, etc.), their main preoccupations and aspiration in life, and their potential motivations.

Further, the potential barriers of the target group in using the Urban ReLeaf's data collection tools are identified and a reflection on mitigation measures is provided.

4.3.5.1 Older adults

The personas created by the participants for the group "**older adults**" during the characterisation exercise depict a target group that might be challenging to involve, specifically in regard to their technological skills. This target group also has serious concerns in life, such as poverty and health-issue, which might reduce their willingness to participate in the project if presented to them in a trivial way. However, they are willing to be active, mobile, and do something good for their neighbourhood. Some may specifically be interested in the social aspect of the activities as they are suffering from loneliness. Some scepticism on their side about their ability to handle the technological component, and about the usefulness of their participation will need to be addressed.

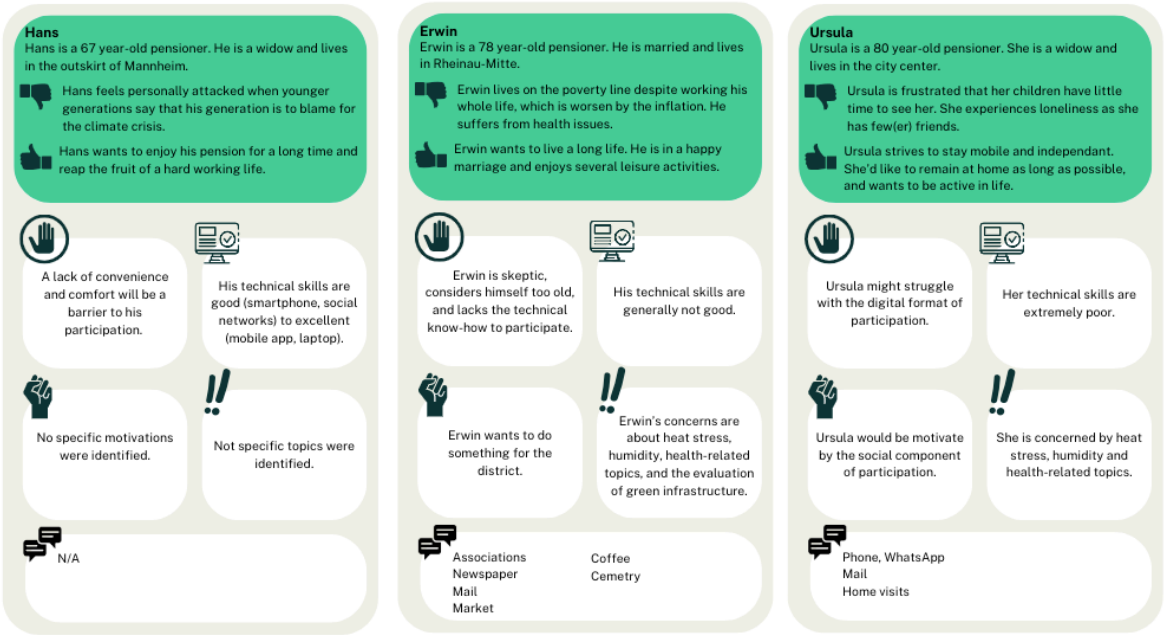

Figure 26: Mannheim's personas for "Older adults"

The co-created campaign ideas for the target group older adult heavily focus on the thematic of heat. Two out of the three ideas place the target group in an active position of using the sensors and doing an additional activity, e.g., going on a walk, planting greenery.

The idea "**personal space greening & air quality**" focusing on greening the courtyards, terrace, and/or balconies would specifically fit a persona like Hans who is looking for comfort and convenience, and who could participate from the comfort of their own home.

The campaign "**heat stress emergency service**" involving the prevention of heat-related death is positioning the target group in a passive position where the tools and data would help health-workers provide better assistance to them in case of a heat wave. This might be specifically interesting for the oldest adults who might have extremely limited digital skills and mobility.

The idea "**active microclimate monitoring**" involving going on walk would be of interest to a persona like Ursula, who wishes to stay active and is looking for social connection. Her digital skills are not great, but with the support of a buddy system, she might be able to overcome some barrier to the use of a wearable sensor or a mobile app.

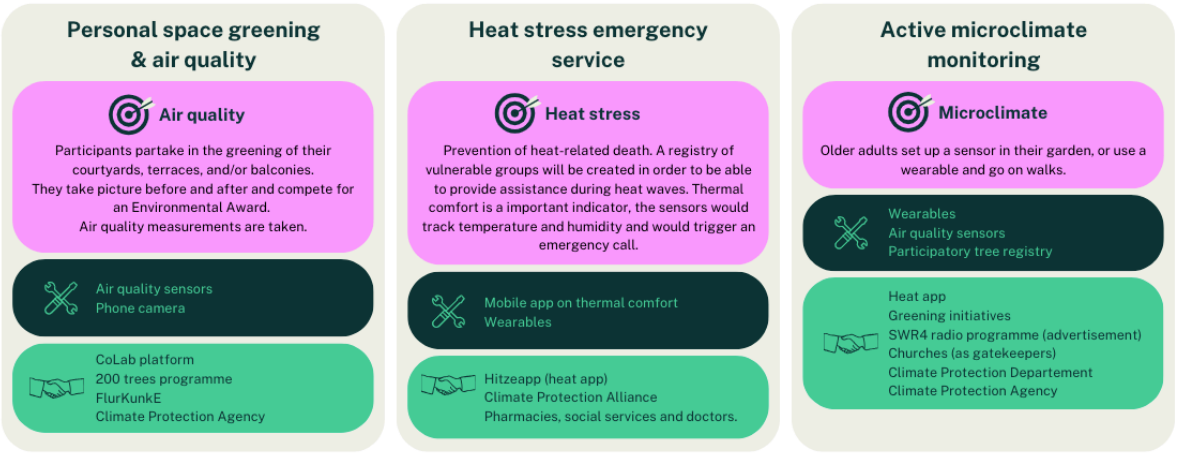

Figure 27: Co-created campaigns ideas for the target group "Older adults".

4.3.5.2 Citizens with a lower health profile

The personas created by the participants of the workshop for the group "**citizens with a lower health profile**" depict a target group that might be challenging to involve, specifically in regard to their state of health which impacts their mobility. Their state of health also implies that they currently deal with uncertainty in their life and might struggle with other consequences such as a reduced income. Facilitating their participation by taking into consideration the level of demandingness of the task will be of utmost importance. However, the personas were framed as being turned towards the future, which might provide a motivation to their participation, e.g., thinking about grandchildren, children, or future children.

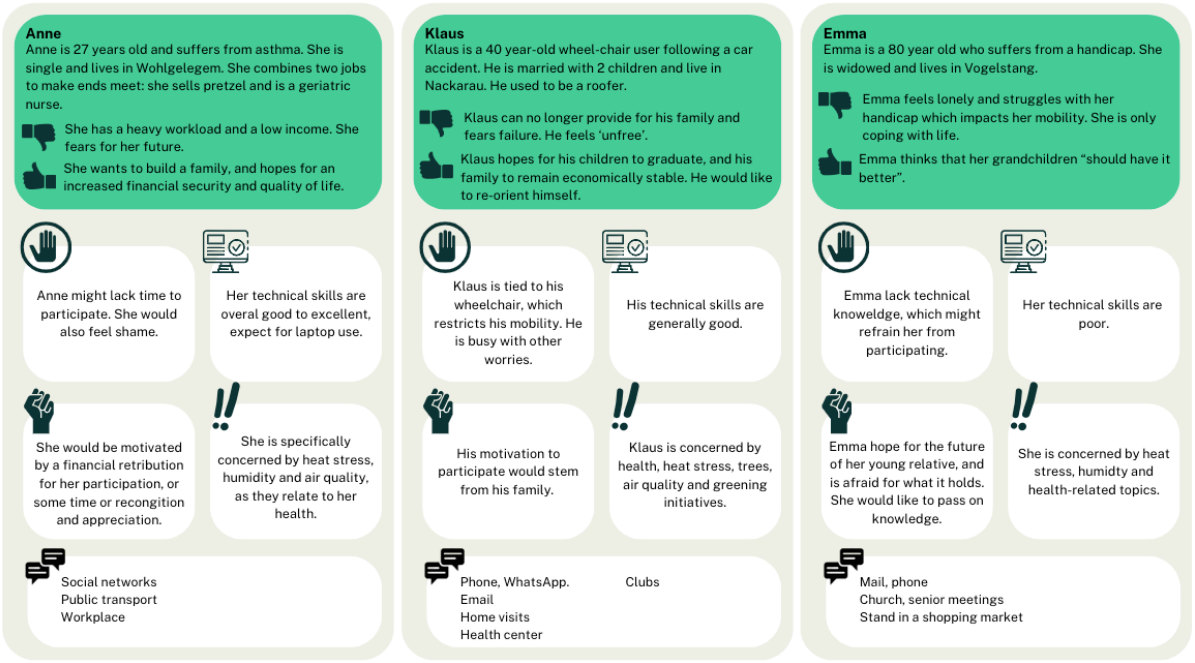

Figure 28: Mannheim's personas for "Citizens with a lower health profile"

The ideas of "**personal space greening & micro-climate**" together with "**perceived thermal comfort**" appear like interesting avenues to engage citizens who might present a mobility issues, as these ideas do not require participants to move around the city. They also link clearly to aspects which are directly impacting the target group and as such, might represent an interest to the target group. Klaus and Emma are profiles that might specifically be interested in these types of ideas.

The "**AI-assisted green space management**" idea could represent the opportunity to collect data on existing green spaces. However, it is to be noted that the Urban ReLeaf project does not foresee the use of AI. An alternative would be to collect the opinions of the target groups on these green spaces, including accessibility, which would be of particular interest to profiles such as Klaus.

The "**greening of traffic areas**" is presented as a quick monitoring idea, where traffic areas that could be greened as identified via an app or a wearable. This could resonate with profiles such as Anne who have little time to spare and might be able to partake on their way to and from work or grocery shopping.

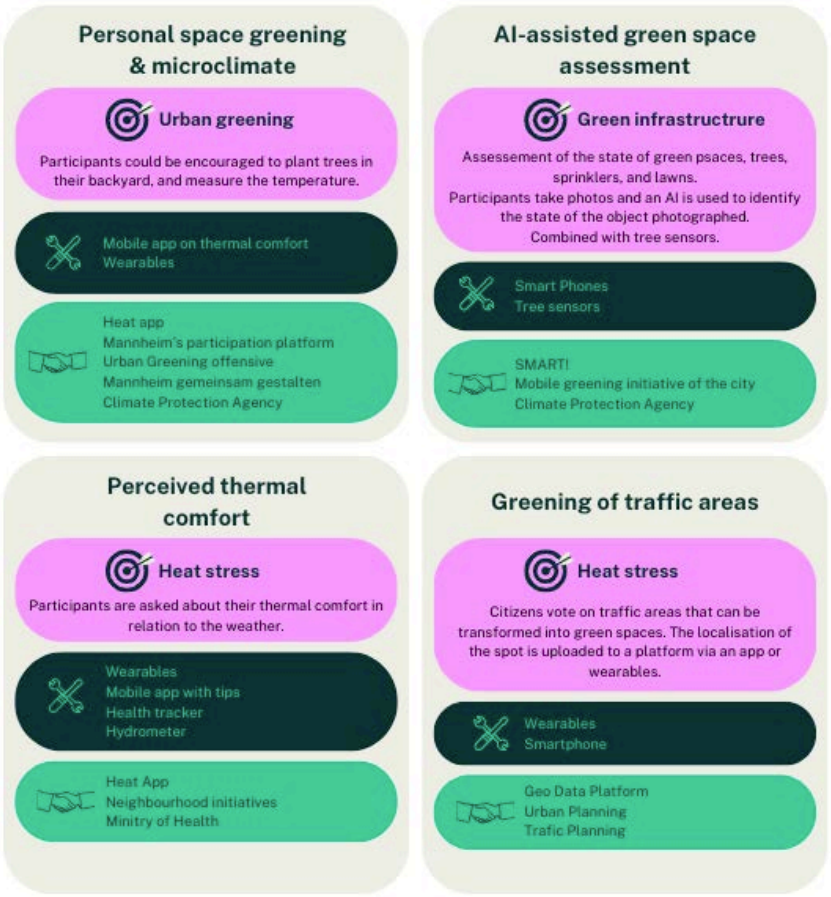

Figure 29: Co-created campaigns ideas for the target group "Citizens with a lower health profile".

4.3.5.3 Children

The personas created by the participants during the characterisation exercise for the group "**children**" varied in age and stay in the relatively "young" group of children (none above 10 years old) which impacts the way they could be involved in CS activities. Overall, the participation should be supervised by an adult, as the younger ones will lack the literacy and digital skills to participate. Subsequently, this implies that parents or other responsible adults are also to be taken into consideration as participants. The relevance of engaging very young children (e.g., below reading age) should be considered. Children's topic of relevance appears to be green areas, and more specifically playgrounds which they like and might spend a great deal of time using. Their participation would likely be motivated by extrinsic factors such as praise and gifts.

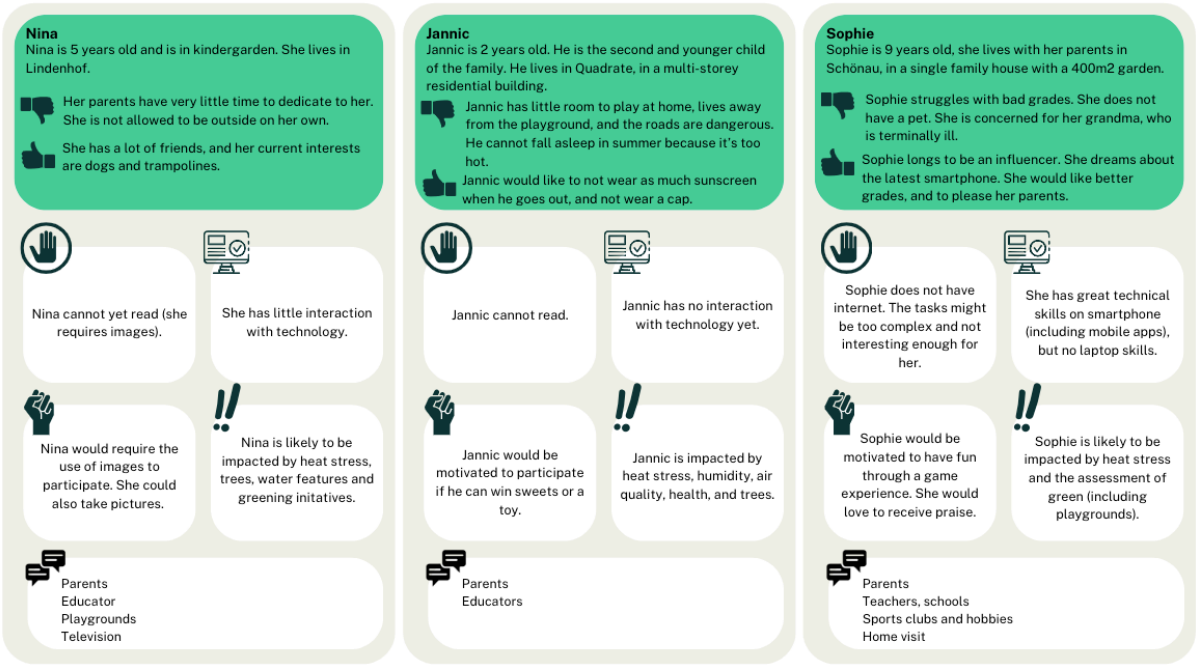

Figure 30: Mannheim's personas for "Children"

As is the case for the other target groups, the co-created campaigns ideas for children focus heavily on heat stress. Participants highlight that the educators and parents should also be considered as participants in these campaign as children will require their assistance.

The first idea "**gamified heat protection behaviour**" focuses on heat stress protective measures, and measurements of heat and sun exposure. As participants envision a gamified approach, this idea would suit children of age to use a smartphone, such as Sophie, who has been described as motivated by praise and a game experience. Jannic and Nina could be passively involved through their parents.

The "**playground testers**" idea engages children in assessing playgrounds in terms of heat stress level and associated elements such as trees, shade, and water features. Some gamification elements are also proposed to engage children, and as such, would again appeal to a profile such as Sophie. Jannic and Nina could be passively involved through their parents.

The idea focusing on "**green/blue journey charting**" is placing the children into an active position where they are meant to be interacting with their surroundings. As they are meant to use a map and pencil, this idea is addressed to children who are able to read and write autonomously, such as Sophie.

As a point of attention, participants largely agreed that some form of incentive of participation would be necessary to promote children's engagement. Ultimately, participants agreed that incentives should focus on recognition, such as certificates or participation rewards. This aligns with the idea that children may respond positively to a sense of ownership and trust in the campaign, rather than solely relying on fun-driven framing. However, there were disagreements about whether monetary incentive or coupons for ice cream should (also) be used to incentivise participation, mainly from a sustainability perspective. There was also debate on whether a little competition (e.g., based on whoever rates the most

playgrounds/features) was favourable or not – some participants felt pitting the kids against each other might be “too much”, while others see this as a way to better socialize an initiative.

Overall, the campaign ideas do not actively involve profiles such as Nina nor Jannic, who may be too young to take part in such data collection measures. However, their interests could be taken into account through the involvement of their parents.

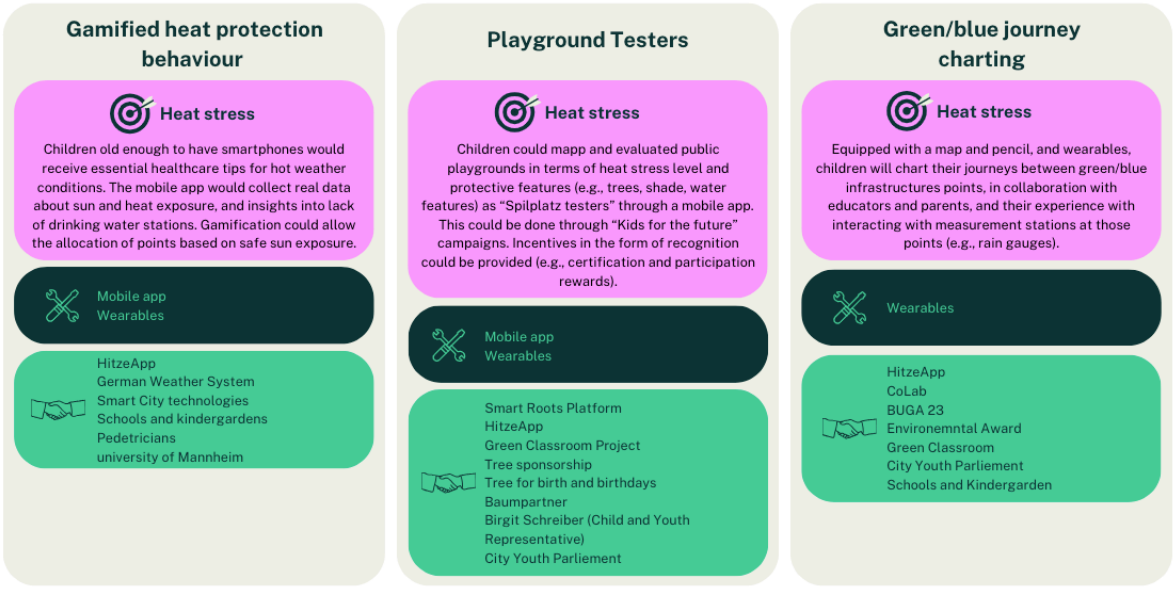

Figure 31: Co-created campaigns ideas for the target group "Children".

4.3.6 Riga

The topic identified as most relevant to the participants of the workshop during the prioritisation exercise were **public and semi-public courtyards**; **formal and non-formal environment**; and **close-by green space**. The target groups identified were **youth**, **older adults**, and the **general population**.

4.3.6.1 Youth

The participants of the workshop described one persona for this target group, who is depicted as a rather bored teenager. For him, there is not much to do in Riga, especially in the open space. He might not be motivated by the activities of the project, unless there are gamifications and reward elements link to it.

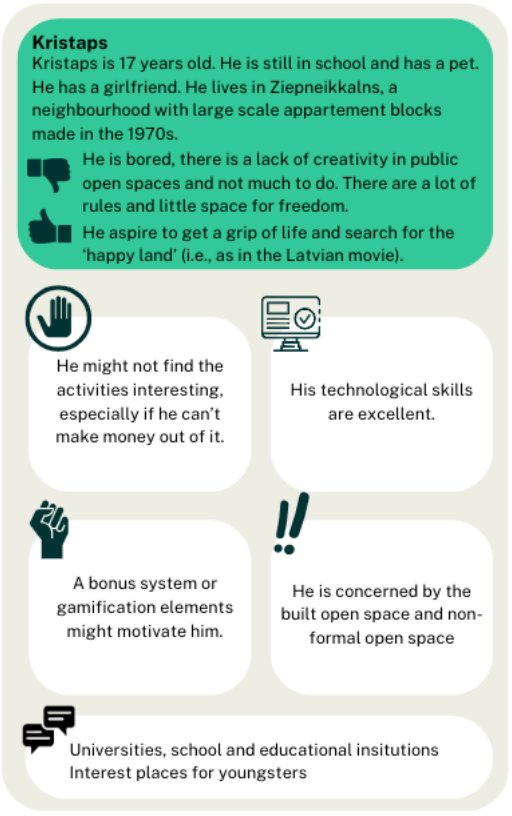

Figure 32: Riga's personas for "Youth"

The participants of the workshop did not describe ideas for monitoring campaigns but gave extra insights for this target group. The youth appear to have been left out of city planning, especially when it comes to parks and recreational spaces in Riga. While there are plenty of playgrounds, there is a lack of infrastructure providing older children with activities to do. Public parks do not seem to consider what these young adults might enjoy. The challenge is figuring out what they like, especially because teenagers usually want space, freedom, and something different from the norm. Participants indicate that getting young people's input and ideas for designing spaces that they would enjoy is tough, as it requires really understanding what they want, which requires the application of careful and thoughtful approaches.

Participants indicate that it is crucial to recognize that they naturally gather in places that are not formally planned or landscaped. One significant issue lies in the lack of engaging activities; for example, along the shoreline, there is a promenade, but it fails to establish a direct connection with the main attraction – the water, due to fences along the riverside. To effectively engage youngsters, the approach needs to be attractive and gamified, akin to popular games like "Pokémon Go". Addressing this requires a focus on motivation; offering incentives such as competitions or prizes can significantly enhance their participation.

Furthermore, integrating their involvement into academic pursuits, like incorporating project work into their bachelor's or master's theses, can provide practical relevance. In the educational realm, there is an opportunity to emphasize motivation. Implementing large-scale scientific research projects in high schools can serve as a valuable learning experience.

Additionally, creating a platform where participants can connect with mentors and professionals can provide crucial guidance. Leveraging social media platforms like TikTok with

specific hashtags and collaborating with NGOs and experts can generate a synergy, reaching a wider audience. Utilising existing platforms like student councils and youth centres, such as Kaņieris, can be instrumental in connecting with young individuals.

4.3.6.2 Older adults

During the characterisation exercise, the participants of the workshop described one persona for this target group. They describe a retired older adult with some time on their hands, but not enough financial means to travel, who, as a result, is bored. Family has an important place for them, and they would be motivated to take part in activities that they can do together.

Figure 33: Riga's personas for "Older adults"

Participants have also reflected on the fact that, although older adults are a vulnerable group in regard to the subject of the project, they might not be a good source for data inquiry.

They also indicate that reaching out to older adults presents challenges, which could be addressed through local neighbourhood events and face-to-face interactions. Instead of inviting them to educational events, it is said to be more effective to host social gatherings where they can feel a sense of community and belonging, reducing feelings of loneliness. Additionally, a powerful approach would be to involve their grandchildren in the conversation: when younger family members express concerns, the message resonates more profoundly. Unlike when adults advise each other, a message from one's own grandchild carries a different impact, making it more likely to instigate change.

4.3.6.3 General population

One person was created for the target group of the general population by the participants of the workshop. They describe someone who is quite negatively thinking about Riga, and Latvia's future in general. The cost of living is a worry for them, together with restrictions on cars. As a result, they would like to move out of Riga. Incentive such as lottery tickets could motivate their participation.

Figure 34: Riga's personas for "General population"

Participants of the workshop describe the general population of Riga as rather negative, with citizens liking to complain, and not focused on the positive aspects of life. Regarding the engagement of the general population, there is a desire for immediate real-time feedback. This immediacy is often perceived through the way data is stored and presented. Participants indicate that citizens expect that once they provide a response, they can witness instant results. For instance, when leaving a comment, the expectation is that it promptly appears on the map, indicating that their input is saved and visible to others.

Participants also indicate that Riga already has platforms, initiatives, and surveys to support citizen participation, but that the input might not be used as hoped. They indicate that citizens mostly complain about the necessary works for the maintenance and repair.

Parents could be involved in activities through their children, e.g., through school.

Participants also indicate that the use of a wearable sensor might not be useful for the general population of Riga who is not used to walking a lot and use their car to move around.

Identifying influencers specific to each target group would be incredibly valuable. Examples include Toms Bricis, known for meteorology updates, Māris Olte, a TV personality celebrated for his eco-conscious beliefs, and Edgars Fresh, a vlogger. Each target group has its own influential figure. Presenting information attractively, such as through brief interviews featuring individuals with sensors, can effectively reach the desired audience.

4.3.7 Utrecht

The topic identified as most relevant to the participants of the workshop during the prioritisation exercise were **health**; **heat stress**; and **green as place for recreation**. The target groups identified as the most important to engage were **youth**; **citizens with a low socio-economic background**; and **citizens living in a green-deprived neighbourhood**.

4.3.7.1 Youth

The personas created for the target group “youth” depict profiles ranging from 15 to 21 years old. These profiles live at home or in co-housing, and are not completely independent from their families yet. This target group is concerned by financial issues and worries about their future. While their technological skills are excellent and would not be a barrier to their participation, they are somewhat untrusting regarding the use of their data. **Social motivations**, the **feeling of being part of something bigger**, and other **monetary incentives** could motivate them to participate.

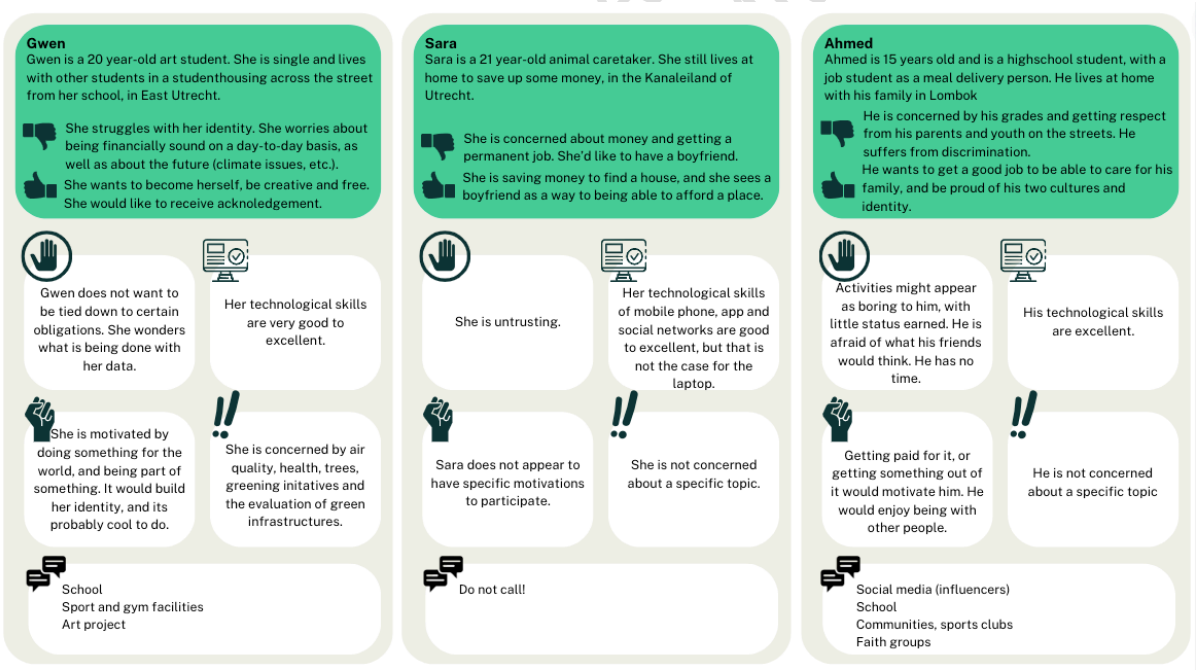

Figure 35: Utrecht’s personas for "Youth"

The co-created campaign ideas for this target group all have different focus.

The idea of “**heat stress in green sports fields**” would fit a younger audience, as it heavily focuses on the gamification aspects as a mechanism for involvement and positions the participation of the parents as necessary.

The “**collect them all**”, which is referencing the popular Pokemon-go game, could fit all the personas as they are all independent enough to move around the city by themselves. As the idea focuses heavily on flowers and plants, it is to be expected that the campaign will only reach youngsters that are already interested in the topic. Additional elements to the idea should be added to diversify the profiles involved.

The idea of “**Forest bathing**” focuses on mental health as an end-goal of the activity which would encourage participants to go into nature to contribute to a tree registry, associated with their opinion about the green spaces. Although TikTok and role models are identified as a way to reach youngsters, it is to be expected that additional elements should be added to this idea to create interest from the target group.

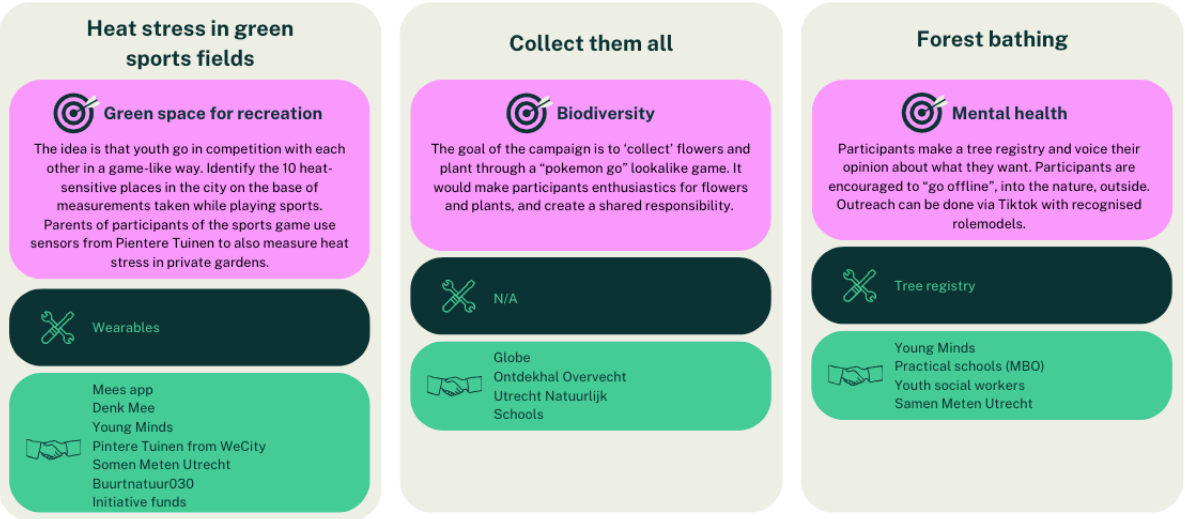

Figure 36: Co-created campaigns ideas for the target group "Youth".

4.3.7.2 Citizens with a low socio-economic background

Two personas were created during the characterisation exercise. Personas from the low socio-economic background target group depict profiles that are professionally active but still struggle to make ends-meet. They are focused on short-term issues, and as such might be difficult to engage if the activities appear too trivial to them. Money, health, and stress are constant topics of concerns on their mind. The direct value of their participation, for them or their family, should be made very clear. Their technological skills are ok overall, but they might struggle with the use of a smartphone and mobile app.

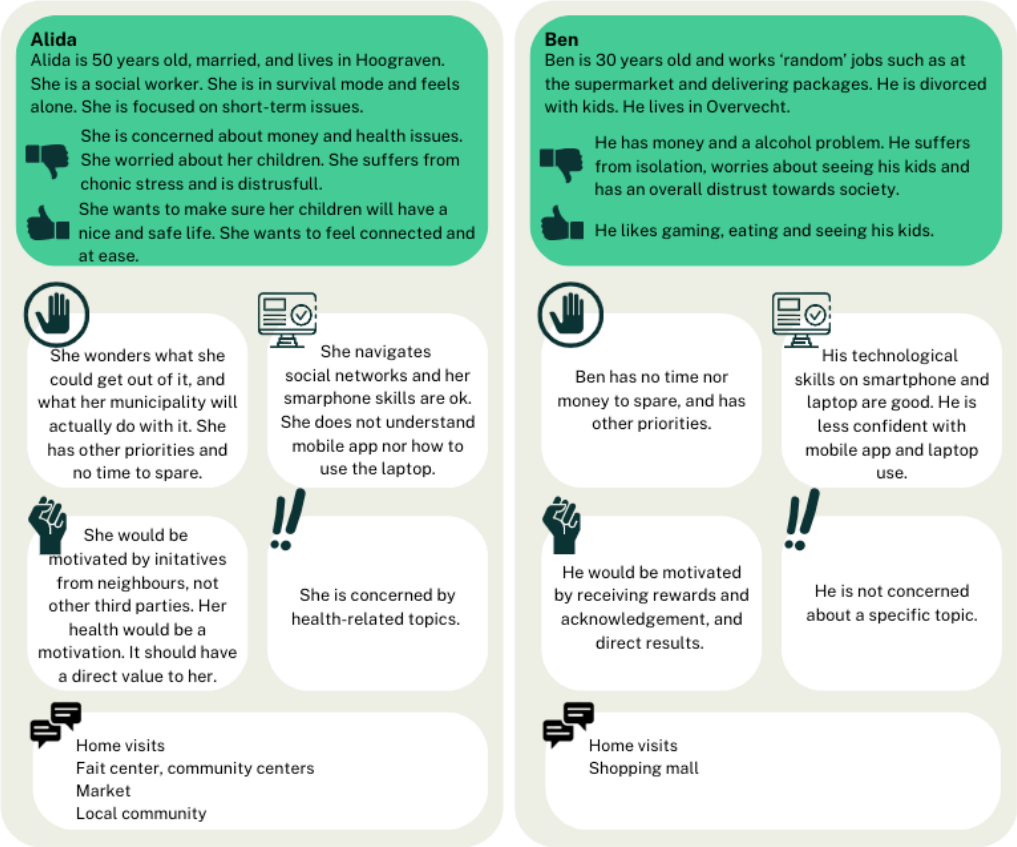

Figure 37: Utrecht's personas for "Citizens with a low socio-economic background"

Both ideas have "heat" as a central theme. The first idea is a "bottom up **co-creation**". This is less defined as the participants of the workshop believed the campaign should be completely defined in co-creation with the target group, but that it should focus on the collection of their insights regarding their experience of heat and the living environment.

The second idea "**cool dog routes**" would engage citizens who own a dog to measure the temperature during their walk. A mix of pictures of hot/cooler (shadow zone) places and wearables sensors on the dog's collar would be used. This would be an interesting idea to display a direct link between heat and something that is important to them (i.e., their dog), however, particular attention should be paid regarding how this is perceived by the target audience (e.g., "dogs are more important than me").

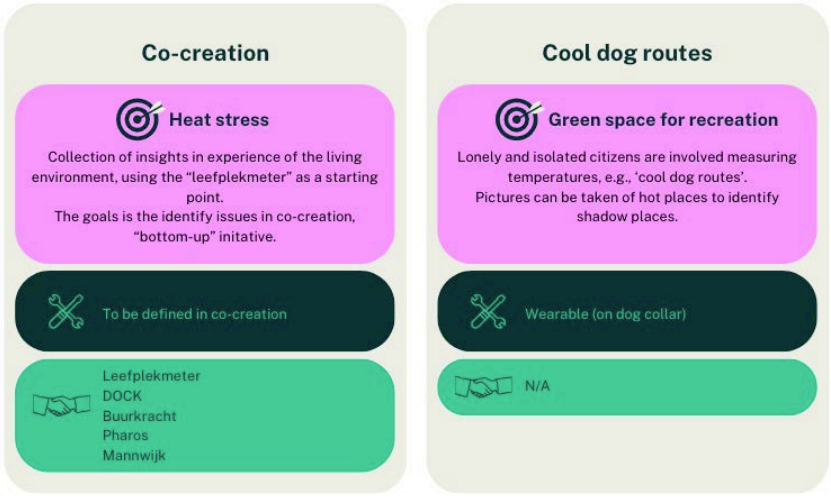

Figure 38: Co-created campaigns ideas for the target group "Citizens with a low socio-economic background".

4.3.7.3 Citizens living in a green-deprived neighbourhood

Two personas were identified for the target groups of citizens living in a green-deprived neighbourhood. The first persona describes Hans, who is distrustful towards the government and might be difficult to engage if personal data is requested for his participation. His technological skills are not good. However, he might be motivated by a social component of the activities, and by an acknowledgment of his contribution/value.

The second persona, Anne, has little time to spare in her life. However, she has excellent technological skills and wants to feel connected to her neighbourhood, which might act as a motivation to her participation.

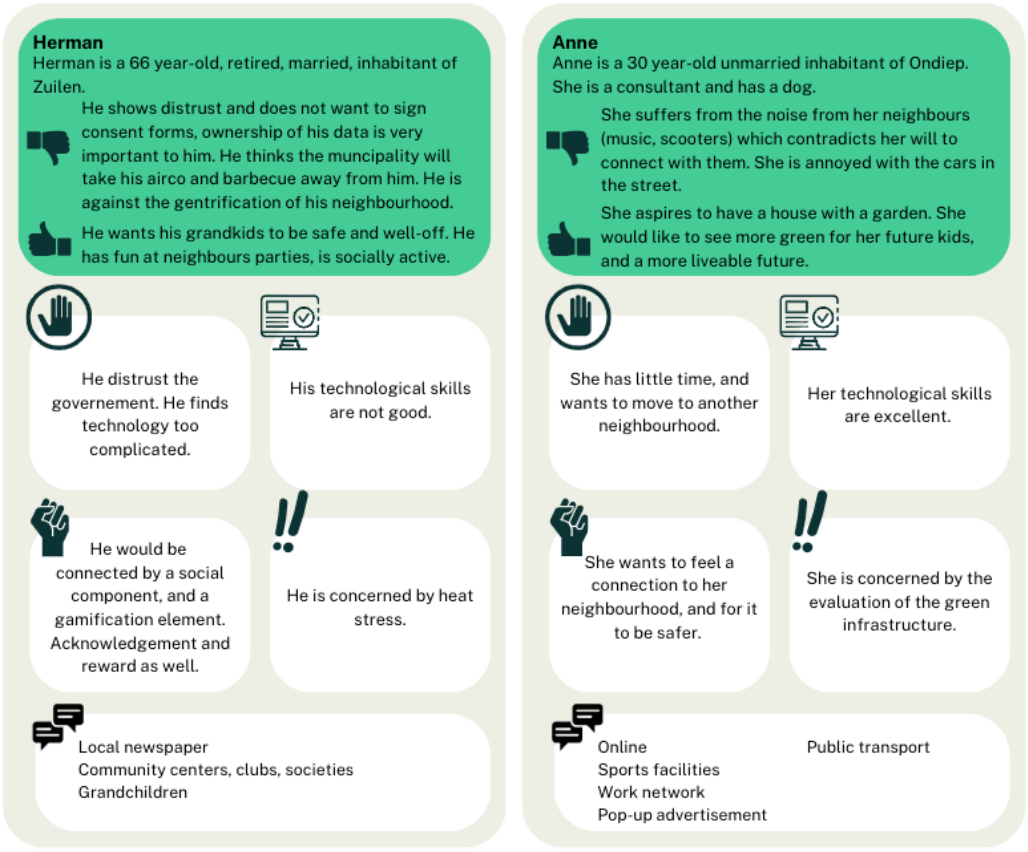

Figure 39: Utrecht's personas for "Inhabitants of stony neighbourhoods"

All three co-created idea focus on the topic of heat but focus on different type of audience within the target group.

The first idea "**cool kids**" engages kids to monitor their experiences with stony and grey areas, from which a gradient and experience of coolness is derived. When involving children in such a monitoring campaign, attention should be paid not to endanger the children, e.g., if the temperature gets too hot in these areas, children should not be encouraged to physically go there.

The "**warm nights**" idea invites participate to measure the temperature during hot nights, and to physically indicate the temperature on the surface measured. This idea would need to be made more tangible in terms of outcomes to engage this target group.

The "**tree planting**" idea invites participant to plant trees against heat stress. Facilitation from the competent authority would be required.

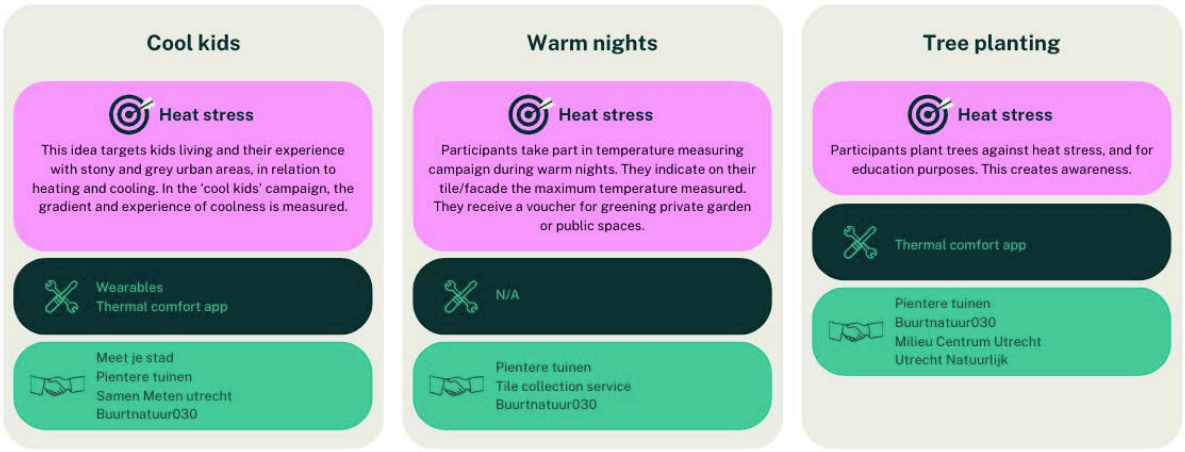

Figure 40: Co-created campaigns ideas for the target group "Inhabitants of stony neighbourhoods".

5 Conclusion

After a description of the relevance of the inclusion of vulnerable and marginalised communities within CS, and a review of the challenges and consideration linked to the inclusion of such target groups, this report delivers a Blueprint for Inclusive CS Engagement Strategies. Through its four phases (Preparing, Planning, Interacting, and Monitoring for inclusion) and eight steps (explore, understand, organise, design, recruit, communicate, engage, and assess), the Blueprint intends to foster increased engagement of "non-traditional", "left behind" citizens such as people from vulnerable and marginalised groups within CS activities. By providing a description, consideration, guidelines and challenges for each step, the Blueprint provides the six pilot cities of Urban ReLeaf with a comprehensive guide to develop their own inclusive engagement strategies.

This deliverable also reports on the result of Phase I of the Blueprint: Preparing for inclusion. Results of the multistakeholder workshops organised in each pilot cities are reported and discussed, together with visual summaries for the personas associated with each prioritised target group, and for the co-created campaign ideas. These visual summaries are intended as tools that pilot cities can use in the following stages of the development of their observation and monitoring campaigns in T4.1. As can be observed from Table VI, certain topics such as heat stress, well-being, health and green spaces as meeting/recreation spaces are similar topics to several of the pilot cities of the Urban ReLeaf project. Likewise, certain groups such as youth, older adults, children, citizens living in green-deprived neighbourhoods, and citizens with a lower socio-economic background are the target groups of several of the pilot cities of the Urban ReLeaf project. These similarities are a fertile ground for future collaboration between the cities which has the potential to foster shared learning and resource optimisation. By joining forces, these cities can exchange valuable insights, best practices, and challenges faced during the engagement process. This collaborative approach could foster the integration of diverse perspectives, encouraging the development of innovative and inclusive CS engagement strategies. Additionally, the pooling of knowledge and experiences enables the identification of context-specific nuances within their shared topics and target groups. This collective intelligence can not only improve the effectiveness of their respective campaigns but also promote a sense of community and solidarity among the cities, strengthening the overall impact of their CS initiatives, and of the Urban ReLeaf project.

Table VI: Summary of workshops' focus per city

			Athens	Cascais	Dundee	Mannheim	Riga	Utrecht
Topics	Impact on citizens	Heat stress	x			x		x
		Well-being	x	x				
		Health			x			x
		Bioclimatic comfort		x				
	Characteristics of urban infrastructures	Green spaces as meeting/ recreation spaces		x				x
		Quality of green spaces			x			
		Community Social Space			x			

		Derelict land and buildings			x			
		Accessibility			x			
		Perception of green initiatives			x			
		Green and blue infrastructure				x		
		Courtyards					x	
		Formal and non-formal environment					x	
		Close-by green spaces					x	
	Other	Biodiversity			x			
		Active travel			x			
		Air quality	x					
		Microclimate				x		
Target groups	Citizens affected by climate change		x					
	Citizens living in a green-deprived neighbourhood		x		x			x
	City employees and officials		x					
	Older adults			x		x	x	
	Schools and teachers / children			x		x		
	Citizens at risk of energy poverty			x				
	Youth				x		x	x
	Citizens with a low socio-economic background				x			x
	Citizens with a lower health profile					x		
	General population						x	

In conclusion, this deliverable underscores the urgency of inclusive CS engagement, especially for vulnerable and marginalized groups. By following the provided Blueprint and leveraging the insights from Phase I, the pilot cities of Urban ReLeaf can pioneer a transformative approach to citizen science, ensuring equal participation, just representation, and meaningful contribution from their communities.

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Appendixes

Appendix 1: Workshop invitation

URBAN reLeaf

INVITATION TO OUR PARTICIPATORY WORKSHOP

Co-create the inclusive strategy of citizen-powered data ecosystem for an inclusive and green transition in your city!

THE PROJECT

Urban ReLeaf is a European (Horizon Europe) 4-year project. The project will deliver **citizen-powered data ecosystems** to support cross-sectoral innovation and political agenda setting for **climate change adaptation** and **green infrastructure** planning in urban environments, for an inclusive and green transition.

Mission: Advance citizen-powered science to be a central resource for inclusive urban green planning and policy in support of the European Green Deal and SDG 11.7 target.

Funded by the European Union

THE WORKSHOP

At the heart of Urban ReLeaf's approach to innovation are public authorities, established communities and citizen groups in six cities: Athens, Dundee, Utrecht, Cascais, Mannheim and Riga. Public sector innovation will be underpinned by **co-creation** efforts and **inclusive citizen participation**, cutting-edge **technologies** to support citizen observations, as well as robust and quality-assured workflows for the integration and visualization of the data in authoritative data streams and platforms.

The project is currently in its preparatory phase and **you are invited to participate to the co-creation of the inclusive participation strategy of your city**. The workshops are multi-actor workshops, and you have been invited because you are working either on **urban greening** or **participation**, and are active at the public level (e.g., for the city of the municipality), academic level (e.g., researcher, expert, etc.), private level, or civil society level (e.g., NGO, citizens associations, citizens representative, etc.). At the workshop, you can expect to meet other people fitting these criteria.

The goal of the workshop is to define together, based on your shared experience and expertise, **participation strategies for citizen's observations** (e.g., sensors, mobile app, wearables, etc.) in your city and how they can complement official measures to **support the agenda setting** for climate change adaptation. The topics of discussions revolve around air quality, heat stress and heat islands, noise, biodiversity, well-being, and mobility.

A specific focus will be put on **inclusivity**, i.e., reaching and engaging minorities and marginalised groups.

WHAT TO EXPECT

1. PRESENTATION OF THE PROJECT AND ITS GOAL. OVERVIEW OF THE PRELIMINARY RESULTS FROM OUR POLICY ANALYSIS ON CITIZEN-GENERATED DATA FOR URBAN GREENING IN YOUR CITY.
2. COLLECTIVE RE-DEFINITION OF THE GAPS AND CHALLENGES OF CITIZEN GENERATED DATA FOR URBAN GREENING. SHARING OF EXPERIENCE AND KNOWLEDGE.
3. DESIGNING INCLUSIVE PARTICIPATION STRATEGIES: OPPORTUNITIES LINKING WITH EXISTING INITIATIVES, ALIGNEMENT WITH CITY'S AGENDA, LINK WITH PARTICIPANT'S ACTIVITIES, ETC. SPECIFIC FOCUS ON INCLUSIVITY.

Date:
TO BE DETERMINED

Location:
TO BE DETERMINED

Appendix 2: Workshop Facilitation Script

WORKSHOP FACILITATION SCRIPT

TASK 2.2 *Co-create inclusive strategies for Urban ReLeaf pilots*

BEFORE THE WORKSHOP

Make sure you have the following:

- Enough chairs and (round)tables for participants to be seated in groups
- 1 table and chair for welcoming participants
- 1 table for refreshments and small bites
- Enough pens, pencils, highlighters
- A lot of Post-its
- Name tags
- Scotch tape and scissors
- Projector for the presentation
- White board
- Templates and instructions translated, completed, then printed
  - "A4 Instruction Profiles": one per small table, in A4
  - "A3 Template Profiles": min of 4 per small table
  - "A4 Instruction co-creation collection campaign": one per small table, in A4
  - "A2 Template co-creation collection campaign": min of 4 per small table
  - "A4 Future Newspaper – Instructions": one per small table, in A4
  - "A4 Future Newspaper template": one per small table, in A4
- Cards translated, completed, then printed
  - File "A4 Dundee target groups": one in A4
  - File "A4 Dundee topic": one in A4
  - File "UR Tools cards" printed in A4 per small table
  - File "Dundee existing platforms or tools cards" printed in A4 per small table
  - File "Dundee existing stakeholder cards" printed in A4 per small table
  - File "Dundee initiative cards" printed in A4 per small table
- Smartphone or camera to take pictures
- Consent forms (2 copies / participant)

WELCOME – *10 min*

Have a table close to the entrance where you welcome your participants. Place the name tags and pens on the table. If you haven't sent the consent forms electronically, ask participants to sign them. Make sure they keep a copy for themselves. Prepare the refreshments (e.g., coffee, water, sodas, etc.) and cups, glasses on another table in the room. This will give participants something to do, not just standing awkwardly, while waiting for everyone to arrive. Make sure that someone from your pilot is always present, so participants feel welcome. Time management is key, so try to stick with the predefined timeline and clearly announce when you would like to start the workshop.

1

- **INTRO** – *20 min*
  - **Introduce Urban ReLeaf**

Quickly guide participants through the project in general. One facilitator gives the presentation (and optionally another facilitator switches the slides).

  - **Introduce the goal of the workshop**

At the final slide of the presentation, explain participants the following:

We invited you here today because we would like to leverage your expertise to shape our policies on blue and green infrastructure in our city.

Specifically, during this 3-hour workshop we would like to brainstorm about how we can involve citizens in the collection of environmental information on blue and green infrastructure using new technologies, such as mobile applications, sensors, and wearable devices. We call this "data collection campaigns".

Sharing your knowledge and ideas will help us create our campaigns to include people in vulnerable situations, collect data, raise awareness, and activate neighborhoods and city stakeholders. The collected data by citizens will also inform the city's official data sources. This way we will have a much better overview on the current situation on blue and green infrastructure and on citizens' perceptions and preferences.

Based on previous research (an extensive policy document analysis and interviews with multiple experts), we already identified the following:

1. *different target groups we would like to involve*
2. *what we want to achieve by the end of this project,*
3. *digital apps and platforms that are currently in use, and*
4. *ongoing initiatives in the city.*

Our main question for you for today's workshop is: ***how can we recruit and support different citizen groups in collecting data for blue and green infrastructure transitions? Through different exercises, our goal is to co-create these engagement strategies building on the information we collected and analyzed so far in the project.***

2

- **ICEBREAKER** – *15 min*

Icebreakers are quick, fun activities used at the start of a workshop or meeting to warm up the members of the group. Their purpose is, quite literally, to break the ice—to help people feel comfortable and relieve some of that initial awkwardness that is often felt in workshop settings.

- **Icebreaker - My feelings on climate change**

Ask participants to think about one positive and one negative thing (e.g., a future or past event, idea, an article they read recently, etc.) about climate change (e.g., heat islands, greening. etc.) and ask them to write down a sentence such as:

- " Pfew, I would be relieved if ....."
- "You have no idea what a relief is that....."

Go round and ask each participant to say out loud their name, their job and the sentence they wrote.

- **Explain how the workshop will look like**

Explain participants the following:

The workshop consists of four exercises:

1) *Voting*
2) *Profiling*
3) *Creation of a strategy*
4) *Future newspaper – if there is time*

Tip: at this point participants are likely to be already sitting in groups around the tables but if not, divide them in **three** groups. Make sure that the groups are diverse and include experts from different domains.

- **VOTING** – *20 min*

Tape the cards with the themes [A4 Dundee topic] and target groups [A4 Dundee target groups] on the white board or a wall. Explain participants the following and distribute the post-its or make sure they have them at hand (3-3 of two colors for everyone):

3

This exercise is about exchanging ideas on the environmental issues and target groups we identified in previous stages of the project.

Please stand up and come closer to the board. You see that on the sheet on one side there are the most relevant environmental issues and on the other side the target groups we might be able to involve in the project. Please vote for 3 themes AND 3 target groups that you think are the most critical in our city. You can place the post-its next to each theme and target group. You can put more than one post-it to one place.

If you think we missed an important group or environmental issue, you can add additional post-its.

Take a picture of the board. Ask participants to share some reflections on why they chose certain themes and target groups. Calculate the votes and choose 3 target groups with the most post-its. You can explain the following:

Thank you for sharing your views. We will take into account all this information as we advance in the project. But for now, for the sake of the workshop we will choose 3 target groups with the most post-its.

It seems that most of you found the [name of the target groups] most important to involve in the project. Now we will focus on these groups, and their barriers, and motivations to create engagement strategies.

- **PROFILING** – *30 min*

Distribute the instructions [A4 Instruction Profiles: one per small table] and templates [A3 Template Profiles: min of 4 per small table] for profiling. Place the three most voted target group cards on the tables (one target group per table). Explain participants the following:

Please take a seat again. Now, we are going to do a World Café. In this exercise, each table will discuss one of the target groups. Using the template in front of you, try to build an imaginary profile for a person belonging to this target group. Think about your expertise and experience working with these target groups. Think in general terms – what are the most prominent profiles that you have encountered when working with them? Who were they, what was their life like? Begin by creating a profile based on the template. If you have time, you can create a second or third one. If there are existing profiles created by the previous group, read them, and complete them if you think it is necessary, then create a new one. You have 10 minutes, then switch to another table to discuss another target group picking up where the others left off.

You have 3x10 minutes, overall.

4

Tip: walk around the tables and listen to the discussions. Do not influence participants, unless you see they are stuck with their ideas, or are off-topic. In this case, you can redirect them and/or give them examples to inspire the discussion. You can also rephrase what participants are saying and ask follow-up questions (e.g., What do you mean with….? Why do you think that's the case? What is your experience with / opinion on xyz?). **Ideally, both the facilitator and the note-taker(s) walk around to capture as much of the discussions, as possible.**

You can use these barriers and motivations below to give examples to participants:

Examples of barriers	Examples of motivations / expectations
lack of awareness, lack of technical knowledge, lack of time, data contribution process takes too much effort, technical limitations of sensors or apps, complex communication, technology not user-friendly, lack of attention to training or feedback, inaccessible language or interface, excessive feeling of competition, online reporting system too complicated/burdensome, limited feedback received, contribution not translated to impact, limited engagement between participants and organizers, inflexible employer, family commitments, lack of financial resources, travel distance too far, etc.	contribute to scientific knowledge, learn new skills, have fun, seeing change in local neighborhood, view real time (air quality) information, receive information on how to reduce environmental footprint, have information on other projects, have access to high quality data, share concerns with policymakers and other stakeholders, career development, improve local neighborhood, be involved in a community initiative, interest in new technologies, develop new technologies, health conditions, think about future generations, general curiosity, spend time outside, neighborhood is highly polluted, develop STEM (i.e., science, technology, engineering, math) capacities, etc.

At the end of the exercise, try to summarize the most important points (based on what you heard) in 2-3 minutes or ask each table to share their insights (be aware of the time). The note-taker(s) should note down everything the participants are saying. Collect the filled-out templates and take a picture of each.
Announce the break.

- **BREAK** – *15 min*

Put the sandwiches / bites on the table next to refreshments. Make sure that there is enough beverage. If you see a participant standing alone, try to engage in a conversation with them. Clearly announce when the second part of the workshop starts.

- **CREATION OF A STRATEGY** – *60 min*

The cards with the most voted target groups remain on the tables. Distribute the instructions [A4 Instruction co-creation collection campaign: one per small table], templates [A2 Template co-creation collection campaign: min of 4 per small table] and cards [UR Tools cards: one A4 copy

5

per small table; Dundee existing platforms or tools cards: one A4 copy per small table; Dundee existing stakeholder cards: one A4 copy per small table; Dundee initiative cards: one A4 copy per small table] for co-creation. Place the most voted themes on the board. Explain participants the following:

In this part of the workshop, we would like to generate ideas and create strategies on how we can involve the selected target groups in our project to collect data. Please take a look at the board for the most voted themes and keep them in mind. The input you give us here will help us to create our data collection campaigns. We prepared cards with the names and descriptions of different apps, platforms, and ongoing initiatives in Dundee and with the technologies that will be developed in the project. You can read the instructions in front of you and use the template. When discussing your ideas on engaging the different groups, please try to make a link with the technology, and some of these tools and initiatives on the cards. We continue with the World Café format, which means you have 15 minutes at one table, then you switch to another one.

You have 3x15 minutes, overall. Then we'll discuss together.

Tip: walk around the tables and listen to the discussions. Do not influence participants, unless you see they are wandering off too much from the exercise. In this case, try to bring them back by asking practical questions on how they would make a link with their idea and for example, a specific tool or a project phase (e.g., recruitment, campaign participation, etc.). **Ideally, both the facilitator and the note-taker walk around to capture as much of the discussions, as possible**. Announce 5 minutes before they have to switch tables and ask them to wrap-up their conversation **AND** write down their ideas.

At the end of the exercise, ask participants to share their thoughts (you have approx. 15 minutes for this). The note-taker(s) should note down everything the participants are saying. Collect the filled-out templates and take a picture of each.

- **FUTURE NEWSPAPER** – *20 min OPTIONAL IF THERE IS TIME*

Distribute the instructions [A4 Future Newspaper – Instructions: one per small table] and template [A4 Future Newspaper template: one per small table] for future newspaper and explain participants the following:

In this first exercise, we ask each group to write a piece about our city in an imaginary newspaper, Dundee Today. It is the year 2033. You are a reporter for the journal "DUNDEE TODAY". You are writing a piece for today's edition on urban greening in our city, and the role of citizens in it. You could not be happier as the situation in your city, on this year 2033, is exactly what you had hoped for – it is the best desirable scenario for Dundee in your opinion.

Please read the instructions in front of you and use the template. You can use post-its to note down keywords. You have approximately 10 minutes to write down your ideas, then 10 minutes to discuss.

6

After 10 minutes, ask the groups to share their "articles". Collect the post-its and/or note down the visions in keywords on the board. Try to group the similar visions / elements together.

Take a picture of the board.

- **CLOSING** – *5 min*

Thank participants again for their attendance and input. Try to summarize in a couple of minutes the main outcomes of the workshop (e.g., what the majority said or decided, what you found interesting, etc.). Explain participants the next steps:

In the next steps of the project, we will analyze and synthesize the information you provided us in this workshop. The same workshop will be repeated in the other five pilot cities of the project. Our colleagues from Brussels will compile the results of all workshops in their deliverable report. This document will be publicly available as of November 2023. We will send you a copy, and if you chose to be a contributor in the consent form, your name, affiliation, and email address will appear in the document.

You will receive a follow-up email from us on how to stay in touch with the project. For example, you can subscribe to our newsletter or be part of our future Communities of Practice.

Tip: check with the Urban ReLeaf project coordinators (i.e., Inian, Gerid, Vanessa) and the communication officer (i.e., Mel) how exactly participants can stay in touch with the project and how you should follow-up with them.

7

Appendix 3: Templates

Characterisation exercise: instructions and template

Creation of profiles

In this exercise, you create, together with your group, profiles based on the target group attributed to this table.

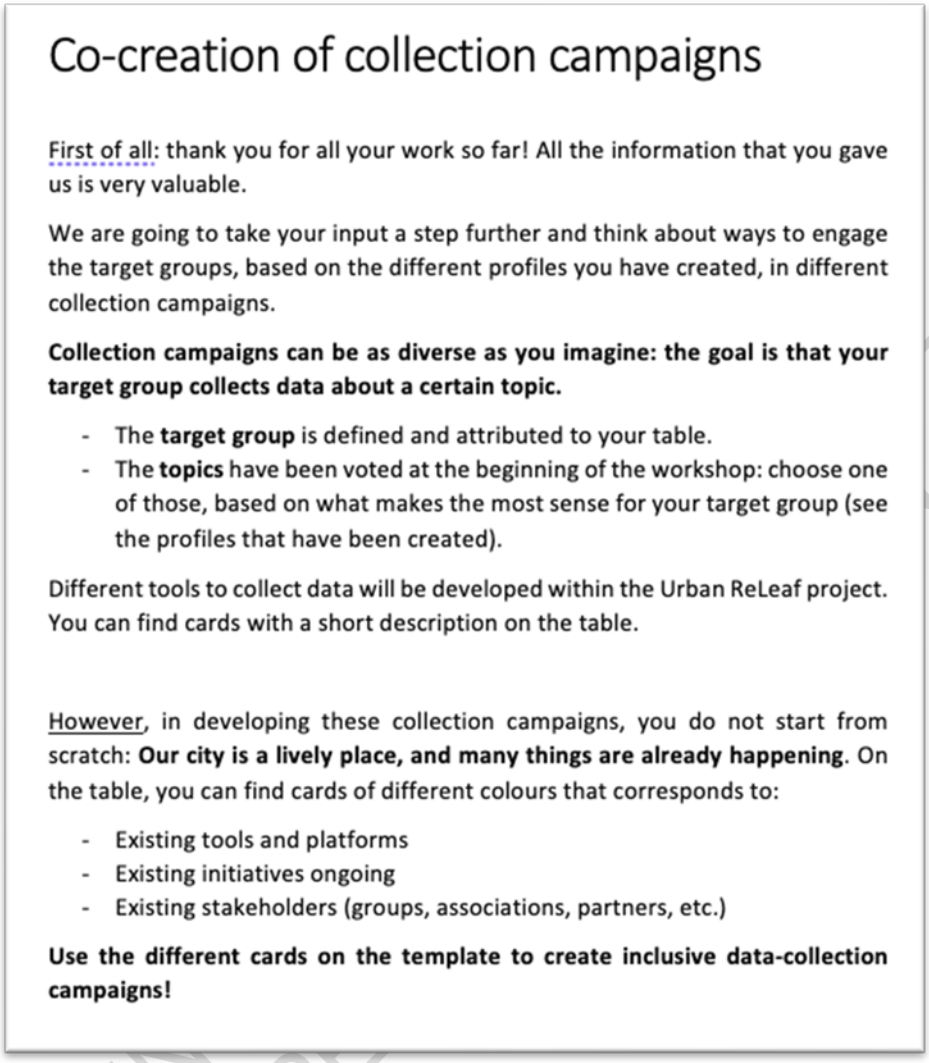
Think about your expertise and experience working with these target groups. Think in general terms – what are the most prominent profiles that you have encountered when working with them? Who were they, what was their life like?

Begin by creating a profile based on the template. If you have time, you can create a second or third one.

If there are existing profiles created by the previous group, read them and complete them if you think it is necessary, then create a new one.

NAME:		
 Age: Occupation: Family status: Belongs to the target group: Location:	**Main concerns and frustration in life:** **Main goals and aspiration in life:** **Technological skills:** Smartphone: *poor* o o o o o *excellent* Mobile apps: *poor* o o o o o *excellent* Laptop: *poor* o o o o o *excellent* Social networks: *poor* o o o o o *excellent* **How to communicate with/connect with/reach them:**	**Barriers to participate in data-collection (e.g., via sensors, wearables, observations, pictures, etc.):** **Motivation to participate in data-collection (e.g., via sensors, wearables, observations, pictures, etc.):** **Is mainly subject to be affected and/or interested by (topics chosen in previous exercise):**

Co-creation of collection campaigns: instructions, template, and example of cards



Co-creation of collection campaigns

First of all: thank you for all your work so far! All the information that you gave us is very valuable.

We are going to take your input a step further and think about ways to engage the target groups, based on the different profiles you have created, in different collection campaigns.

Collection campaigns can be as diverse as you imagine: the goal is that your target group collects data about a certain topic.

- The **target group** is defined and attributed to your table.
- The **topics** have been voted at the beginning of the workshop: choose one of those, based on what makes the most sense for your target group (see the profiles that have been created).

Different tools to collect data will be developed within the Urban ReLeaf project. You can find cards with a short description on the table.

However, in developing these collection campaigns, you do not start from scratch: **Our city is a lively place, and many things are already happening**. On the table, you can find cards of different colours that corresponds to:

- Existing tools and platforms
- Existing initiatives ongoing
- Existing stakeholders (groups, associations, partners, etc.)

Use the different cards on the template to create inclusive data-collection campaigns!

Target group:	Topic:
Idea / explanation of the collection campaign:	
Technology used to collect data:	Point of attention for this technology to be used by this target group:
Existing tool(s) and/or platform(s) the collection campaign can connect to:	
Existing initiative(s) the collection campaign can connect to:	
Existing stakeholder the collection campaign can connect to:	

Appendix 4 – SE & SD survey template[3]

(to distribute at the end of the activity, in print or online)

To capture the diversity of experiences, we ask you to fill in the following demographic questions:

1) What is your gender?

- Male
- Female
- Non-binary
- Another option (specify)
- I prefer not to answer

2) How old are you?

- Under 18
- 18-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old
- 55-64 years old
- 65 – 74 years old
- Above 75 years old
- I prefer not to answer

3) (for youth) What is the highest level of education that your *father* completed?

- No diploma
- Primary education
- Secondary education
- Technical, trade or vocational school certificate or apprenticeship
- Bachelor's Degree
- Master's Degree
- Doctoral degree
- Other degree:

4) (for youth) What is the highest level of education that your *mother* completed?

- No diploma
- Primary education
- Secondary education
- Technical, trade or vocational school certificate or apprenticeship
- Bachelor's Degree
- Master's Degree
- Doctoral degree
- Other degree:

[3] Based on (Berthold et al., 2023, (P. Fernandez et al., 2001)

5) What is your highest level of education that you completed?

- No diploma
- Primary education
- Secondary education
- Technical, trade or vocational school certificate or apprenticeship
- Bachelor's degree
- Master's Degree
- Doctoral degree
- Other degree:

6) To what extent do you agree with the following statements:

(Strongly disagree – disagree – neither disagree, nor agree – agree – strongly agree)

- I am content with my financial situation
- I have to save up to make ends meet
- It get by well with my income

Appendix 5 - Events or Activity logging

Manual logging of events

Pilot city	Type (list)	Start date	End date	Presence (list)	City	Country	Total number of attendees	Total number of no-shows	Level of participation (list)	Types of actions	Financial incentive

Type of activity (list)

- Workshop (ideation, data collection, analysis, etc.)
- Training (learning)
- Social event (community building)
- Focus group (research)
- Other type of activity

Total number of attendees (number of people who registered and showed up for the activity)

Total number of no-shows (number of people who registered but who did not attend the activity)

Level of participation (list)[4]**:**

- Non-participation
- Low - Participants are manipulated (e.g. participants are decoration)
- Low - Participants are informed (e.g. participants are provided with information to assist them in understanding a problem)
- Middle - Participants are consulted (e.g. participants can give feedback on the analysis, or decisions – but their input is not binding)

[4] Based on the ladder of participation of Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of planners*, *35*(4), 216-224

- High - Participants are involved (e.g. participants are collaborators in each step of the process, and are included in the development of alternatives, Urban ReLeaf makes the final decision and initiates)
- High - Participants are collaborators and take full control (e.g. final decision-making is in hand of the participants, Urban ReLeaf implements what the participants decide, participants initiate)

Types of actions (multiple options are possible, list)

- Formulating research questions (e.g. submitting ideas, expressing concerns, crowdsourcing challenges, etc.)
- Developing or choosing a method (e.g. becoming an interviewer, developing a measurement device, defining a survey protocol)
- Collecting data (e.g. submitting perceptions, collecting tree data, counting, observing, using sensors, etc.)
- Analysing data (e.g. annotating, transcribing, interpreting, summarizing, calculating, etc.)
- Reporting and dissemination (e.g. proposing new directions, formulating policy recommendations, co-authoring a publication, speaking at an event, etc.)
- Other type of action
- Not applicable

Incentive (a financial incentive was rewarded to the participants, e.g. a gift voucher)

- Yes
- No

Digital statistics[5]

- **Number of active days**: number of days a participant was using the mobile application and performed at least one task (*example: 3 days*)

- **Total days linked to the campaign**: the total number of days a participant is linked with a campaign from start till dropout day (*example 10 days*)

- **Days until campaign finishes**: the total remaining days from dropout until end of the campaign (*example 50 days*)

- **Activity ratio**: number of active days / total number of days linked to the campaign (the closer to 1 the more active a participant is during the days in a campaign, *example: 3 / 10 = 0.3*)

- **Relative activity ratio:** total number of days linked to the campaign / days until campaign finishes, the closer to 1, the longer a participant remains linked (persistent) to the project, from their joining to the end of the project. (*example 10 / 50 = 0,2)*

- **Daily devoted time:** the averaged hours a participant executes tasks on each day the participant is active

- **Lurking days:** the number of days a participant is using the application but without any active contribution *(example 2 days)*

- **Lurking ratio:** is the proportion of days on which the participant was lurking in relation to the total days the participant visited the project (active + lurking days). The closer to 1 means the more a volunteer lurks (i.e. logs into the platform and browses content but does not contribute) during the days they are online. *(example: 2 / 5 = 0,4)*

[5] Based on the engagement metrics of Aristeidou & Herodotou (2020)

Appendix 6 – Observation of meetings / community participation[6]

1. How clear were the goals of this activity to you?

Poor (e.g. unclear, diffuse, conflicting, unacceptable)	Fair	Satisfactory (e.g. moderately clear, shared by some)	Good	Excellent (e.g. clear, shared by all, endorsed with enthusiasm)
1	2	3	4	5

2. What was your general level of participation in this activity?

Poor (e.g. was bored or distracted, low verbal participation)	Fair	Satisfactory (e.g. paid attention half of the time)	Good	Excellent (e.g. paid attention, participated in the discussion)
1	2	3	4	5

3. What was the leadership like in this activity?

Poor (e.g. there was no leadership)	Fair	Satisfactory (e.g. some direction was provided)	Good	Excellent (e.g. clear sense of direction was provided)
1	2	3	4	5

4. What was the quality of the decision-making at this activity?

Poor (e.g. decision were dominated by a few participants)	Fair	Satisfactory (e.g. about half of the participants took part)	Good	Excellent (e.g. everyone took part)
1	2	3	4	5

5. What was the cohesiveness among the participants in this activity?

Poor (e.g. little cohesion)	Fair	Satisfactory (e.g. moderate amount of cohesion)	Good	Excellent (e.g. participants worked well with each other)
1	2	3	4	5

6. Overall, how satisfied are you with this activity?

Very dissatisfied (e.g. not much accomplished, wasted my time)	Dissatisfied	Moderately satisfied (e.g. accomplished a moderate amount)	Satisfied	Very satisfied (e.g. much accomplished, good use of my time,)
1	2	3	4	5

[6] Based on the 'meeting effectiveness inventory' survey of (Goodman et al., 1996)