



## D2.3 Social and behavioural innovations design



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## DEFINITIONS<sup>1</sup>

**A Green Building (GB)** (new or retrofit) is a building that, in its design, construction and operation, reduces or eliminates negative impacts, and can create positive impacts, on the climate, social, and natural environment. GBs preserve precious natural resources and improve quality of life<sup>2</sup>. Specifically, this means that GBs should be very energy efficient, use extensively the potential of locally available renewable energy, use sustainable materials, and aim for a low environmental impact over the entire life cycle. GBs offer their users and residents a healthy climate and a high quality of stay, they are resilient e.g., to environmental change and contribute to social inclusion.

**Green Neighbourhoods** aligned with the European Green Deal<sup>3</sup>, is a set of buildings over a delimited area, at a scale that is smaller than a district, with potential synergies, in particular in the area of energy. A green neighbourhood is a neighbourhood that allows for environmentally friendly, sustainable patterns and behaviours to flourish e.g., bioclimatic architecture, renewable energy, soft and zero-emission mobility etc. Green neighbourhoods are the building blocks of Positive Energy Districts (PEDs)<sup>4</sup> by implementing key elements of PED energy systems. For example, the exchange of energy between buildings increases the share of local self-supply with climate-neutral energy and system efficiency. They also provide the technical conditions to enable Citizen Energy Communities<sup>5</sup> and Renewable Energy Communities<sup>6</sup> to be implemented.

**Green Buildings and Neighbourhoods (GBN)** in PROBONO are GBs integrated at delimited area or district level with green energy and green mobility management and appropriate infrastructure supported by policies, investments and stakeholders' engagement and behaviours that ensures just transition that maximise the economic and social cobenefits considering a district profile (population size, socio-economic structure, and geographical and climate characteristics). Delivered in the right way, GBN infrastructure is a key enabler of inclusive growth, can improve the accessibility of housing and amenities, reduce poverty and inequality, widen access to jobs and education, make communities more resilient to climate change, and promote public health and wellbeing.

**DGNB certification** serves as a quality stamp ensuring the state of the building for buyers. The Green Building Council Denmark (2010) established the German certification DGNB meaning 'German Society for Sustainable Buildings'. The Danish version of DGNB was created to obtain a common definition of what sustainability is towards and making it measurable. A consortium of experts was established from all parts of the construction sector. DGNB had to be reshaped for the Danish standards, practice, traditions, and laws but is now available to certify any construction project. They chose DGNB as an innovation-forward and sustainable future guarantee. DGNB diversifies itself by focusing on sustainability and not just the environment. DGNB creates a standardised framework for the construction operations conditions and creates a common language which facilitates communication between professions and helps organize and prioritize the efforts in long and complicated development phases.

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<sup>1</sup> Please refer to the last submitted reports for the latest status of the definitions

<sup>2</sup> <https://www.worldgbc.org/what-green-building>

<sup>3</sup> European\_Green\_Deal\_EN\_200710\_fin

<sup>4</sup> SET-Plan Action 3.2: [https://setis.ec.europa.eu/system/files/setplan\\_smartcities\\_implementationplan.pdf](https://setis.ec.europa.eu/system/files/setplan_smartcities_implementationplan.pdf)

<sup>5</sup> Internal Electricity Market Directive (EU) 2019/944 5 Renewable Energy Directive (EU)

<sup>6</sup> Renewable Energy Directive (EU) 2018/20012018/2001

**Life cycle assessment (LCA)**<sup>7</sup> is a tool used for the systematic quantitative assessment of each material used, energy flows and environmental impacts of products or processes. LCA assesses various aspects associated with development of a product and its potential impact throughout a product's life (i.e., cradle to grave) from raw material acquisition, processing, manufacturing, use and finally its disposal. In PROBONO, LCA represents the statement of a building's total energy, resource consumption and environmental impact in the manufacture, transport, and replacement of materials and for its operation over its expected life. Social life cycle assessment (S-LCA)<sup>8</sup> is a method to assess the social and sociological aspects of products, their actual and potential positive as well as negative impacts along the life cycle. Life-cycle costing (LCC)<sup>9</sup> considers all the costs incurred during the lifetime of the product, work, or service.

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<sup>7</sup> <https://op.europa.eu/en/publication-detail/-/publication/16cd2d1d-2216-11e8-ac73-01aa75ed71a1/language-en>

<sup>8</sup> <https://www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/social-lca/>

<sup>9</sup> <https://ec.europa.eu/environment/gpp/lcc.htm>



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**Abbreviations and Acronyms**

Acronym	Description
BREEAM	Building Research Establishment Environmental Assessment Method
CCAA	Climate Change Awareness Assessment
CSR	Corporate Social Responsibilities
ESG	Environmental Social Governance
EV	Electric Vehicle
GA	Grant Agreement
GBN	Green Building Neighbourhood
IEQ	Indoor Environmental Quality
LL	Living Lab
Mx	Month x – referring to the project month
NGO	Non-Governmental Organisation
PV	Photo Voltaic
SME	Small Medium Enterprises
WP	Work Package

## Executive summary

This report outlines the social and behavioural innovations strategy for each of the six PROBONO Living Labs and, the stakeholder consultations needed for the successful development and implementation of the project's technological innovations. It is a high-level identification of activities and interventions answering to the challenges identified in the stakeholder analysis and mapping presented in the confidential *D2.1: Stakeholder Analysis and Mapping*.

The aim of the proposed social and behavioural innovations is on the one hand, to bring value to each Living Lab and support them on their paths towards a Green Building Neighbourhood (GBN). On the other hand, activities and interventions *across* Living Labs will feed into the development of the GBN concept and, the strategic tools developed in WP1. In practice this requires that we test and develop social and behavioural innovations addressing a diverse set of challenges and stakeholders.

With regards to the technological innovations in PROBONO, it is crucial that they are developed with and for the people who are to use them (end-users) and, those who are/can be impacting or impacted by the development and implementation. This will secure long-term solutions and increase the exploitation potential. This report presents the innovations needing stakeholder consultations and end-user testing through a scoping survey which forms the basis for a detailed planning to be completed in close collaboration with developers.

# 1 Introduction

This deliverable contains the first, high-level planning of social and behavioural innovation activities for the six Living Labs and, the technological innovations of the H2020 PROBONO project. Based on the findings of the stakeholder analysis and mapping for each of the Living Labs<sup>10</sup>, we define the social and behavioural innovations design strategy to support the Living Labs on their paths towards a GBN and, for the successful development and implementation of technological innovations.

The aim of this strategy falls in two streams: The *first* is to make sure that the social and behavioural innovations bring value to each Living Lab and matches their needs. The *second* is to ensure that across Living Labs and technologies, the social and behavioural innovations suggested feed into the Green Building Neighbourhood concept development and, the macro-knowledge base. Hence, we aim to define activities and innovations pertaining to all the GBN attributes (as defined in *D1.10: GBN Integration Strategies and Transition Models (I)*), that is, the technical, physical, natural and social attributes. In reality of course, most activities sit in the intertwinement of these attributes.

The remaining sections of chapter one cover the purpose, scope and structure of this deliverable.

## 1.1 Mapping PROBONO Outputs

One important finding of the work performed under T2.1 was that within Living Labs and across WPs, there were still some doubts as to what is actually a GBN and how do we ensure that activities are feeding into its development? These understandings will continue to be developed throughout the project but, a first step was taken at the General Assembly in Chania, M14. Aligning with ST2.1.2 and under the umbrella of the GBN Committee, a workshop was executed to support the alignment within partners, WPs and Living Labs on the GBN concept. By working with the “what, why, how and who” the value proposition of the GBN was defined and, activities and outputs of the Living Labs were mapped according to the GBN framework.

This workshop was an important step in aligning understandings across Living Labs and PROBONO partners and as such, a crucial element of understanding and defining the scope of social and behavioural innovations proposed under T2.3, which the current deliverable answers to. This task sets out to “*Deliver a strategic roadmap including a high-level description of events, roles and responsibilities, and implantation planning detailing the recommended actions for the stakeholders’ engagement. Activities will be designed for different target “levels”: individuals, building occupants, neighbourhoods, communities, cities, regions, national*”. This falls under Objective 2 of the GA, aiming to “*Maximise the adoption of the PROBONO energy efficient approach and innovations beyond the project lifetime by using a range of participatory methods that promote stakeholders (including citizens) participation in co-designing and co-delivering a*

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<sup>10</sup> Contained in the confidential *D2.1: Stakeholder Analysis & Mapping*.

sustainable GBN in the LLs and beyond”, more specifically, Result 8: “Social and behavioural innovations design and coordination for the stakeholders’ engagement, designed for different target “levels”: individuals, building occupants, neighbourhoods, communities, cities, regions, national”.

In practice, this is a complex task of mapping and linking the various needs for stakeholder consultations, citizen engagement, behavioural changes and more within and across Living Labs. Table 1 displays the adherence to PROBONO’s GA deliverable and tasks descriptions.

GA Component Title	GA Component Outline	Respective Document Chapter(s)	Justification
<b>TASKS</b>			
T2.3 Social and Behavioural Innovations Design and Coordination (M12-M18)	<p><b>ST2.3.1: Communication and Engagement Strategy at the LL areas</b></p> <p>Design engagement and communication strategies, tailored and specific to each LL involving a broad spectrum of stakeholders (including citizens). The strategy will take into account existing local area clean energy transition visions and plans linking them to PROBONO’s offerings. Effective messages, channels and campaigns will be tailored based on T1.1 personas developed. Engagement and communication methods will include information sessions, product/pilot sheets, surveys, interviews, focus groups, cocreation workshops, webinars, user testing, serious games, citizen science activities and citizen juries. The stakeholder adjusted communication tools-base will be extended so to be applicable in large scale for the general population. These tools will be based on robust evidence about behavioural interventions that increase the acceptance of sustainable reconstruction projects and policies. They will involve i) meta-analysis of behavioural interventions effects (e.g., social comparison, modelling, social norms, feedback etc.) and the factors (frames of benefits) that affect the energy efficiency policies acceptability ii) a series of online/laboratory experiments (N=600); and iii) a field experiment for the effectiveness of communication tools in the Prague Living Lab (N=400)</p> <p><b>ST2.3.2: Co-design Strategy for the PROBONO Innovations</b></p> <p>Design strategy for the collection of the feedback from stakeholders and external experts. Define engagement goals, strategies, methods, and timelines for each PROBONO</p>	Chapter 2-9 and Chapter 10	Chapter 2-9 answers to ST2.3.1 by mapping out the theoretical and methodological framework and outlining a plan for each of the six Living Labs. It also includes the current version of the Living Labs’ vision.

	innovation. The strategies will be tailored to suit each innovation partners' needs (e.g. usability research, concept testing), the target audience and task (e.g. insights research/prototyping/piloting). Stakeholder facing elements will be assessed based user experience (UX) and UI acceptance testing. Co-design methods will include user testing surveys and interviews, focus groups, co-creation workshops, demonstrations, serious games, and negotiation games.		Chapter 10 answers to ST2.3.2 by mapping out the need for stakeholder consultations, including user testing for each of the PROBONO Innovations where such a need has been identified through the scoping survey.
DELIVERABLE			
<b>D2.3: Social and behavioural innovations design</b> This report formulates the findings of T2.3, and explores step/s Provide a strategic roadmap and identify roles and responsibilities and implementation plan for stakeholder engagement.			

*Table 1: Adherence to PROBONO's GA Deliverable & Tasks Descriptions*

## 1.2 Purpose and scope of the document

As stated above, the current document defines the high-level strategy for social and behavioural innovation activities for each of the Living Labs. It also identifies the technological innovations needing stakeholder consultations and user testing. However, the various maturity levels of the Living Labs and the technological innovations means that the social and behavioural innovation strategies also differ in maturity. Where some activities have already taken place (as in the case of the Geodesign event in the Dublin Living Lab) some are still under planning. Furthermore, some interventions and activities must be defined after more detailed assessments, as the Climate Change Awareness Assessment (section 3). Hence, the strategies defined here are to be adapted and refined throughout the project duration, to ensure the highest quality of social and behavioural innovations, adding real value to the Living Labs.

## 1.3 Structure of the document and its relation with other WPs/Deliverables

In the following section, we will define the interlinkages to other WPs and tasks and present the structure of the content. Interlinkages to other WP2 tasks are strong, as the social and behavioural innovations strategy presented in this deliverable is based on the findings of the stakeholder analysis (T2.1) and the behavioural analysis and operational best practices (T2.2) while taking advantage of the collaborative engagement tools identified (T2.4).

The strategy and activities planned in the current deliverable, seeks to integrate with WP1, e.g., through stakeholder engagement activities supporting the investment analysis (ST1.2.2) and, by feeding information into the continuous refinement of our understanding of transition challenges and enabling factors (ST1.4.2).

Furthermore, the social and behavioural innovation strategy presented here, is linking to the technological innovations developed in WP3 and WP4 by identifying and planning stakeholder feedback processes and user testing. This is also the case for the development of the Digital

Twins (WP5) where User Interface design, User Experience and usability testing form an important part of the development of the stakeholder facing elements.

The Living Lab visions presented here will be used not only for communication activities within Living Labs but also on a project level, linking to the communication activities under WP8. Furthermore, updates and findings from the social and behavioural innovations activities will be feeding into the WP8 communication and dissemination activities such as the website article [\*Why should we care about Jim Ryan?\*](#) Finally, the activities planned in this report will be a means to create and strengthen relations to important stakeholders, hence linking to the exploitation activities of WP9.

The structure of the document is as follows:

Chapter 1 defines the purpose and scope of the current document, map the output and identify interlinkages with other WPs within PROBONO.

Chapter 2 introduces the theoretical framework and methodologies applied to ensure that the development of GBNs is people-centric from the onset.

Chapter 3 describes the *Climate Change Awareness Assessment*, developed to measuring the knowledge and attitudes of the public on climate and energy related matters with the purpose of creating customised solutions for the Living Labs.

Chapter 4-9 contains the social and behavioural innovations strategies for each of the six Living Labs respectively.

Chapter 10 identifies the technological innovations needing stakeholder consultations and user testing within the context of PROBONO.

Chapter 11 is the concluding chapter.

This deliverable is authored and edited by SIN. Where contributions from partners are integrated, partner acronyms are noted as follows for the respective chapter: *Chapter title [partner acronym]*. Where nothing else is stated, SIN is the responsible author.

## 1.4 Contribution to creating Green Building Neighbourhoods

Although a Green Building Neighbourhood as defined in PROBONO does include green energy and green mobility management and appropriate infrastructure which are depending on technological innovations and implementations, there are multiple reasons for prioritizing the people-centric approach which the activities presented in this document contribute to. *First*, it is crucial that the technological innovations and physical buildings are developed according to actual societal needs and, based on insights on human behaviour. The stakeholder consultations and user testing activities proposed in this deliverable are answering to this. *Second*, the green transition and the climate changes do require substantial behavioural and attitudinal changes across populations. The behavioural innovations presented in this deliverable are providing examples and tools of how to use the insights of the behavioural sciences to implement lasting behavioural changes, required in a GBN.



## 2 Why social and behavioural innovation?

Most of our planned interventions laid out in this deliverable will use a behavioural scientific approach to make sure that the creation of the Green Building Neighbourhoods has a strong foundation considering the users and citizens of the areas.

When it comes to behaviour change attempts, decision makers tend to think alongside the scale of the “carrot or the stick” – whether the better method is to incentivise the desired behaviour, or disincentivise the unwanted one. This traditional mindset fails to consider why people behave the way they do, what psychological and societal mechanisms lead to their preferences or barriers when it comes to energy and climate related behaviour. No wonder – measuring behavioural patterns is an undoubtedly hard task, since these behaviours exist in complex adaptive systems (CAS).

*“A complex adaptive system is a dynamic network of many agents who each act according to individual strategies or routines and have many connections with each other. They are constantly both acting and reacting to what others are doing, while also adapting to the environment they find themselves in. Because actors are so interrelated, changes are not linear or straightforward: small changes can cascade into big consequences; equally, major efforts can produce little apparent change. An important point is that coherent behaviour can emerge from these interactions— the system as a whole can produce something more than the sum of its parts”* (Hallsworth & Kirkman, 2020).

Navigating these complex systems and making decision based on them are a challenge to all researchers in the area. Many attempts to discover the origins and motivations of human behaviour relies on questionnaires on self-reported behavioural patterns. More and more literature show however that self-reported behaviours are wildly misleading. Although reports often rely on participants subjective estimates of their own behaviour, empirical evidence tells us that they rarely reflect reality accurately (Kormos & Gifford, 2014; Hansen, Larsen & Gunderson, 2022). This often brings misleading conclusions on environmental behaviour and failure to understand how people are acting and reacting in complex systems. This may lead decision makers to deem them “irrational” and consequently, they may only disrupt the systems in their misguided attempt to correct behaviours (Hallsworth, 2023).

Behavioural scientists need first to recognize the type of system that they are working within and then choose their approach accordingly. We should aim to find where a specific shift in behaviour will produce wider system effects; understand the collective implications of individuals using heuristics to navigate life and change the rules so that it is more likely that desired behaviours will emerge (Hallsworth, 2023). In this deliverable we outline methodologies that will aid us in understanding our users in their own cultural and social settings and map out their attitudes that are inevitable to understand if we would like to have their cooperation in the creation of a green future. Simply put, we would like to propose to throw out both the carrot and the stick. Instead, attempt to create a choice environment that is convenient and sensible for the public.

## 2.1 Communication strategies

T2.3.1 sets out to develop communication strategies for each Living Lab. Before doing that, it is necessary to define the purpose of the communication. *First*, the purpose can relate to awareness raising and/or knowledge building. The common denominator here is that they are not as such aiming at behavioural changes. Activities within this area could be educational or promotional, e.g., raising awareness about project results. *Second*, the purpose can be initiating behavioural change, aiming at changing well-defined behavioural patterns. This is very often the case with public communications, e.g., aiming at inducing more climate friendly behaviours. However, these campaigns often build on methodologies pertaining to awareness raising or knowledge building, although research shows that awareness raising and knowledge-building activities as they are seen in most public communication campaigns have very limited impact: “Meta-analyses have shown that information provision tends to cause shifts in behaviour is just 2-3%” (Park, 2023: 52). Hence, when the purpose of communication is to initiate behavioural change, methodologies based on *Behavioural Insights* are much more impactful. This is an evidence-based approach to integrating insights and methodologies from the *behavioural sciences* into public policy development, administration and development (Halpern, 2015). As such, activities related to this are closely linked to the results from Climate Change Literacy Assessment (see section 3) and, to the definition of the specific behavioural patterns that should be changed (e.g., reducing the lengths of showers, adjusting indoor temperature, taking the stairs instead of the elevator). The methodological framework applied in PROBONO will be described in section 2.2.

### Development of Living Lab Narratives

As for the educational purpose and the awareness raising activities, Living Lab narratives and visions have been developed based on the GBN Workshops hosted at the General Assembly (Chania, M14). The workshops were developed by the GBN Committee and aimed at scoping the *what, why, how* and *who* of a GBN, leading to defining the *value proposition* of a GBN. The workshops were organised in groups of the six Living Labs, consisting of Living Lab leaders and the primary technology providers in each of them. Each Living Lab group worked with answering how the activities of their Living Lab is feeding into the development of a GBN. Based on these insights, Living Lab leaders were given the homework of updating the Living Lab visions, which were later streamlined by WP8 leader for communication purposes. The visions are presented in the current deliverable under the respective Living Labs’ chapters. They will be used for on- and offline communication activities such as social media, brochures and other marketing collateral, briefings for workshops etc.

In addition to the PROBONO communication activities undertaken in WP8, the Living Labs will have communication activities related to their local target groups, such as newsletters, posters and local events to engage the local population (depending on the available budget in the Living Labs). For this purpose, the Living Lab narratives will be updated regularly to match the project’s development. The tools available and/or suitable for communication and engagement activities have been mapped out in *D2.4: IT Collaborative Engagement Tools*.

## 2.2 Implementing Behavioural Changes: The BASIC Toolkit

The following is a brief introduction to the BASIC Toolkit, published by the OECD (2019) to support the integration of Behavioural Insights into the development of public policies.

The idea of integrating Behavioural Insights into public policymaking, stems from the research of the behavioural sciences, demonstrating how cognitive biases and heuristics every day are influencing individual decision-making and behaviours. This, obviously, have significant impact on the success or failures of public policies. Although the purpose of the PROBONO project is not to engage in public policymaking, the toolkit offers a valuable methodology to define, analyse, test and scale behavioural changes through five steps:

- A) Identify relevant **B**ehavioural patterns,
- B) Analyse cognitive biases impacting said behaviours,
- C) Design **S**trategies to change the behaviours,
- D) Test the effect of various **I**nterventions,
- E) Scale for **C**hange,

This framework ensures a systematic approach to implementing and scaling behavioural changes through defining and testing various nudging interventions, based on insights from the behavioural sciences. Figure 1: The BASIC Framework (from OECD, 2019: 46), summarises the five steps of the framework and indicates the various tools available for each step.

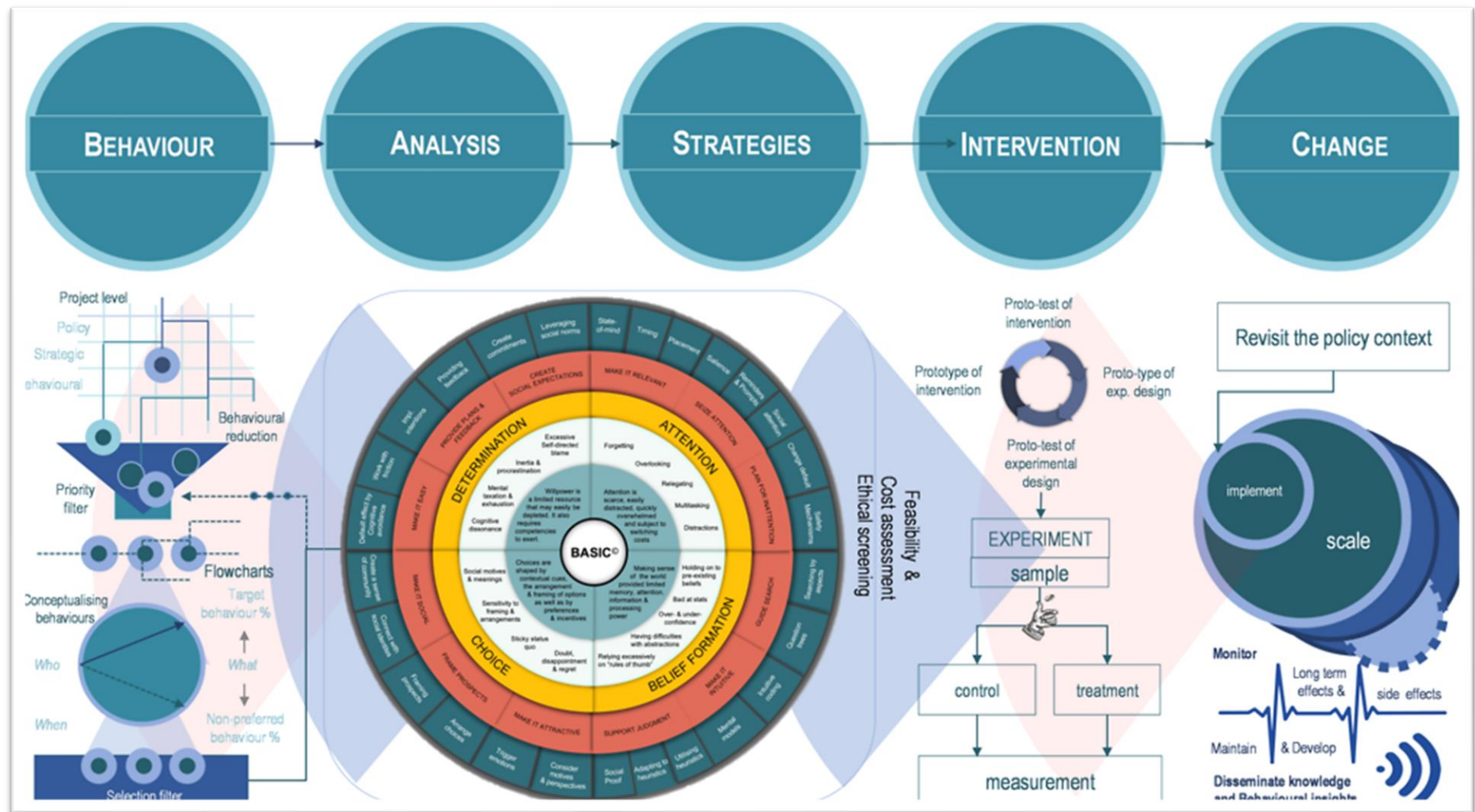


Figure 1: The BASIC Framework (from OECD, 2019: 46)

### 3 Climate Change Awareness Assessment

When talking about the green transition of six different neighbourhood in six different countries, there is no unified set of solutions we can pull out of our hats. The culture, the socio-economic circumstances, politicians, and policies are vastly different in each and every one of these Living Labs. Therefore, we need to start at step one: assessing the situation as is, by measuring what do people know (or think they know) about climate and energy related issues within each their contexts, what are the initial attitudes and behaviours that we will be working with – that we might want to change in order to create a Green Building Neighbourhood in the respective Living Lab. For this, we have created a Climate Change Awareness Assessment survey, to be used as part of the GBN strategy as a unified measuring tool for the purpose of creating customised solutions for the Living Labs at a later stage.

When it comes to supporting people in adapting their behaviour and making more sustainable, climate-friendly and energy efficient choices, providing information alone is rarely sufficient (Cadario & Chandon, 2020). Humans' perception is not solely influenced by information, but it is generally agreed upon that a myriad of heuristics effect our decisions unnoticed, every day. These are strategies that use only a small fraction of the available information. This makes our decision very rapid, which is incredibly useful in evolutionary terms, to survive approaching danger, for instance. Fortunately, most of the time the result of using automatic heuristic thinking is “good enough”, however in certain situations they lead to poor judgments. We might think of these as “errors in judgement” while in psychological literature they are commonly known as cognitive biases (Ellis, 2018).

Certain cognitive biases, e.g., the false consensus effect (our tendency to overestimate how many people agree with our own beliefs), the misinformation effect (our memory of events is heavily influenced by how that event is represented, for example in media), the availability heuristic (our tendency of estimating the probability of something based on the examples that we are aware of), or the optimism bias (underestimating the probability of bad things happening to us but overestimating the good) are all factors we need to consider and address when we would like to change energy and environment related behaviour. (Zhang et al., 2020) With the below proposed social and behavioural research and innovation approaches we aim to make sure that all aspects of human cognition are taken into consideration before a top-down intervention would be forced on the public – which might be ineffective or even polarizing.

Awareness, however, in many cases can be the first step to the adaptation of more sustainable behaviours. (Park et al., 2023). Public engagement is a two-way dialogue. Before intervening, we need to listen; assess knowledge and attitudes, understand interests and barriers to action through social scientific research. This will inform us about our starting point and allow us to plan meaningful interventions, targeted at the identified gaps in public understanding on climate issues.

For these purposes we propose to administer a Climate Change Awareness Assessment (CCAA) survey in all six PROBONO Living Labs (the implementation is specified in the sections relevant

to each Living Lab). In the absence of a comprehensive and suitable tool, the survey will be created by Smart Innovation Norway, inspired by available literature on *Energy literacy assessment*, *Climate Change literacy assessment*, and assessment on *Pluralistic Ignorance* related to climate issues. The aim of the survey is to map existing (mis-)conceptions of the most impactful energy- and climate behaviours within the population of the Living Labs, allowing us to target behavioural change interventions where they will have the biggest impact. Hence, the survey will be adjusted to the national context of the Living Labs as the most impactful energy and climate behaviours differ across countries.

### 3.1 Energy literacy assessment

Energy literacy is defined as the indicator of basic energy-related knowledge, the understanding of the environmental impacts of energy production and consumption, how energy is used and the adoption of energy-saving behaviours. This definition works with three dimensions: knowledge, attitudes, and behaviours (DeWaters & Powers, 2011).

The knowledge component refers to the understanding of basic scientific concepts, rules, theories, and the role and usage of energy in our everyday lives. The attitude refers to the ideologies and convictions of each person, based on their energy knowledge, influencing their decision-making processes. The behavioural component evaluates awareness of the impact of day-to-day actions, and each individual's responsibility and the commitment to save energy (Martins, Madaleno & Dias, 2020). It is important to note however that self-reported behaviours have proven to be unreliable in several examples (Hansen, Larsen & Gundersen, 2021; Kormos & Gifford, 2014), hence our approach is to utilize behavioural insights, where behaviour change will be monitored instead of inquired about.

In the interest of being able to design practical interventions for the Living Labs based on the data gathered here, our survey will work with all these three components, but will focus less on the scientific and theoretical knowledge, and more on the awareness of the efficient ways to save energy in terms of day-to-day practices of everyday life. Existing research suggests that people tend to overweigh the value of easier, more salient actions, e.g., turning off the lights, compared to other energy saving actions that in reality are significantly more effective, like reducing temperature and length of showers (Park et al., 2023). With this survey, we aim to find out, whether there are such misconceptions to address in the PROBONO Living Labs. This would open the door to a wide range of interventions, that, although of minimal effort, can bring significant improvements in energy behaviour. It could inform not only the content but also the timing and adequate context of the communication. Examples of targeted communications depending on our findings could be nudging stickers on household appliances, policy recommendations on different labelling of certain products, providing households with "energy toolkits" containing helpful information and tools, etc.

### 3.2 Climate change literacy assessment

Climate change is a complex issue which requires understanding the basic principles of multidisciplinary scientific principles of physics, chemistry, geography, biology and mathematics



(Anyanwu, Le Grange & Beets, 2015). For this reason, it is an unobtrusive, diffused, non-localised issue for many. Even for individuals who personally experience the effects of climate change, it is often unclear, whether they can be attributed to climate change or not, not to mention that many are unaware of the scientific consensus on anthropogenic climate change (Geiger, Gruszczynski & Swim, 2022).

Similarly, to energy literacy assessment, the available tools on climate change literacy assessment focus on scientific understanding of the phenomena. We instead propose to measure the awareness of the anthropogenic causes, the impacts, and possible solutions. We will measure the attitudes, concerns, or potential scepticism, to make sure that we can provide customized engagement suggestions to each Living Labs.

### 3.3 Pluralistic ignorance assessment

The aim of the Climate Change Awareness Assessment survey is to assess not only factual knowledge, but assumptions as well on other peoples' knowledge and attitudes. Social cognition research suggests that human behaviour is dependent on our subjective representation of reality, which is influenced by our perception and interpretation of surrounding. Our decisions and actions are largely influenced by what we perceive is the "social norm", especially if that is perceived as the norm of a group we strongly identify with (national, political, generational, etc.) (Farrow, Grolleau & Ibanez, 2017). When it comes to environmental issues, the underestimation of interest and awareness of our peers can be a huge barrier to action.

The literature calls this phenomenon pluralistic ignorance, which is a shared misconception on how others think or act (Park et al., 2023). According to a recent study, people vastly underestimate the public support for climate policies, and climate concern. While two thirds of the participants supported the policies, they estimated the supporters to be only one third of the population. Even though supporters of the climate action outnumber opponents two-to-one, these results have concerning implications. First, the underestimation of public willingness to discuss climate issues obstruct actions and behaviour change - in democratic models of governance, politicians are unlikely to propose climate actions without public support (Walker, Kurz & Russel, 2018). Second, overestimation of opposition to climate policies pressures us to oppose them as well, diminishing motivations towards the green transition. The absence of knowledge on the consensus around environmental issues gives way to polarization, which means these misperceptions will bring a self-fulfilling prophecy: not realizing the true level of support of climate action may in fact lead to decreased support in the future (Sparkman, Geiger & Weber, 2022).

Social norm interventions have been shown to be effective in reducing energy consumption in field experiments. The use of social norms in information provision, (informing people about others' behaviours and attitudes), and other types of peer influence interventions could be leveraged by policy makers to target pro-environmental attitudes (Farrow, Grolleau & Ibanez, 2017).

As Hansen (2018) pointed out, when it comes to addressing behaviour changes and policy making, before intervening, a precise diagnosis of the problem will no doubt increase the success

of said interventions. Merely treating symptoms may have short-term effects (with potential side effects) but also likely to lead to the regression to the status quo on the long run. With the above described three-component Climate Change Awareness Assessment survey we propose a diagnostic approach to a wide range of factors that influence environment and energy related behaviour. Understanding this is the first step to ensure that the planned interventions will be beneficial and understood by the targeted communities, and future policies will maximise their potential. As for the behavioural change interventions, we will be following the BASIC framework as described in section 2.2)

### **3.4 GBN Contribution**

An evidence-based approach to building behavioural changes and promoting pro-environmental social norms is a key aspect of building a Green Building Neighbourhood. The neighbourhood is to be developed with the people, for the people - thus any meaningful change must prioritise the community's participation and willingness to adapt. Therefore, designing interventions based on scientific insights on human behaviour will bring value when it comes to accelerating the green transition of the neighbourhood.

## 4 Dublin

The Dublin Living Lab is placed in the town centre of Dún-Laoghaire-Rathdown (dlr<sup>11</sup>), part of Greater Dublin. It is located right next to the sea and includes a number of heritage buildings. The Dublin Living Lab is a large-scale Living Lab focusing on refurbishment of the County Hall, the public Lexicon Library, the Beaufort social housing unit<sup>12</sup> and the Ferry Terminal and/or its surroundings consisting of an asphalted outdoor area.

As for the citizens of Dún-Laoghaire-Rathdown it is an ageing population and generally well educated. The digital skills are reported to be high, and the local authorities have prioritized activities upgrading digital skills also among socially vulnerable people.

The Dublin Living Lab is owned by the local authorities. In general, there is good experience and knowledge within the areas of green transition, energy efficiency renovations and communication to and with the public. The dlr county has an ambitious Biodiversity Plan and, a Climate Change Action Plan (Codema 2019) which among other things, sets out a decarbonization zone overlapping the geographical area of the Living Lab.

### 4.1 Summary of the stakeholder analysis

The Dublin Living Lab offers an interesting case to study the reimagination of a town centre as a sustainable neighbourhood, using the GBN concept. During the process of the stakeholder analysis and mapping, it was evident that when it comes to human resources, the capabilities of the Living Lab are high. The legislative framework is overall supportive, and the public authorities have initiated ambitious climate and biodiversity plans (CODEMA 2019). The analysis also revealed some barriers that should be addressed through the social and behavioural innovations:

- Reducing energy consumption
  - The public authorities are heavily impacted by the energy crisis and need to harvest low-hanging fruits to reduce energy consumption through behavioural changes, as the budget for technical and physical upgrades are limited.
  - The tenants of the Beaufort social housing have the opportunity to earn an extra income by selling energy from rooftop PV panels back to the grid, given that they have the necessary knowledge to reduce their own energy consumption.
- Mixed experiences with citizen engagement
  - dlr (the local authority) has mixed experiences with citizen engagement processes. On the one hand, they have seen that citizen engagement through public hearings are causing conflicts and stopping projects but, on the other

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<sup>11</sup> Following the official guidelines of the City Hall, the acronym is to be written in lowercase letters.

<sup>12</sup> This has already undergone an extensive energy efficiency refurbishment and the focus of the PROBONO project will be to assess and evaluate this process in a context with vulnerable citizens.

hand they have also experienced the problems when pushing projects with no citizen engagement. Hence, they express a need for and a wish to improve their citizen engagement processes.

- Improving refurbishment processes in social housing units
  - Refurbishment processes and energy efficiency improvements are object for conflicting interests between the tenants, the social housing department, the maintenance staff, and the responsible architects. Hence, a need is to improve this area to avoid antagonizing key stakeholders from the technological innovations needed to support the green transition.

## 4.2 Living Lab Vision

The following text presents the vision for the Dublin Living Lab. As described in section 2.1, this can be used for on-and offline communication activities to promote the PROBONO project and the Living Lab, for briefing stakeholders prior to engagement activities. For internal purposes, it is also a tool to ensure that activities are feeding into the development of a GBN.

*Imagine a neighbourhood that not only enjoys stunning views of the Dublin Bay and the Dublin Mountains but also boasts a cutting-edge energy and climate resilience system. That's the vision of the Dún-Laoghaire-Rathdown Green Building Neighbourhood.*

*Through a process of stakeholder and citizen engagement, combined with technological and social research, the Living Lab aims to find and implement a solution that addresses the complex challenges of energy and climate resilience in the Green Building Neighbourhood. The Living Lab's goal is to arrive at a solution that can be validated through the development of a digital twin and proven through scenario testing in a physical twin, the Harbour Lodge building.*

*The Mobility Hub, located in the basement of County Hall, will be the 'Energy Core' of the Green Building Neighbourhood, from where the physical infrastructure of the network will radiate outwards to the wider town and community. The roofs of County Hall and its 'mini-me' Harbour Lodge will generate energy to feed batteries in the basement that will trade energy with the e-cars and e-bikes of the Mobility Hub, as well as with the building, the national grid, and the local network of green buildings in the neighbourhood.*

*Moreover, a single 'Dual Distributed Network' cable system will be installed to provide power and communications interconnectivity for the neighbourhood, allowing for the expansion of the GBN network in the future.*

*In four years' time, visitors to Dún Laoghaire's Terrace Café on the roof of County Hall will be treated to stunning views of the water sports taking place in the harbour, Ireland's National Watersports Campus, while enjoying the shade provided by a canopy of photovoltaic panels. Citizens will also have the convenience of monitoring the energy produced, stored, and used in the neighbourhood through the dlrZero app on their phones, and they will be incentivized to opt for green choices in local energy and connectivity use.*

*The PROBONO lead Living Lab in Dún-Laoghaire-Rathdown is an ambitious and inspiring project that offers a glimpse into a sustainable and resilient future for communities. The Living Lab's*

*solutions can serve as a blueprint for other neighbourhoods and cities looking to enhance their energy and climate resilience while embracing a sustainable lifestyle.*

### **4.3 Social and Behavioural Innovations in Dublin**

This chapter presents an overview of the social and behavioural innovation activities planned for this Living Lab.

#### **4.3.1 Climate Change Awareness Assessment**

The Climate Change Awareness Assessment survey will be prepared by Smart Innovation Norway colleagues over the course of summer 2023. It will be ready to be cascaded online with the help of Alchemer software in September 2023. In Dublin the target groups will include County Hall employees and tenants of the Beaufort social housing. We will ask for the support of our Living Lab partners to connect us to the most appropriate channels through which the widest possible audience can be reached within these communities. The data from this survey will be processed by December 2023 and as a result, we will be able to advise on the most appropriate interventions in both facilities and suggest additions or improvements to the already existing Home Energy Kit. This will be especially valuable in the case of the tenants of the Beaufort social housing, who have the opportunity to earn an extra income by selling energy from rooftop PV panels back to the grid, thus can directly benefit from having knowledge on how to reduce their own energy consumption.

##### **4.3.1.1 Stakeholders**

This activity will involve Dún-Laoghaire-Rathdown County Hall employees and tenants of the Beaufort social housing.

##### **4.3.1.2 Contributions to a GBN**

The CCAA survey will give us information about the current stage of knowledge and attitudes when it comes to energy and climate change in the Dublin Living Lab. Based on this, we will be better equipped to engage the communities in the green transition, especially the tenants of the social housing units, who may gain financial benefits from understanding their household energy usage better.

#### **4.3.2 Geodesign [UCD]**

The Geodesign in Dún-Laoghaire-Rathdown was held on the 24th and 25th of April 2023 in the Lexicon Library, Dún-Laoghaire-Rathdown. The purpose of the event was two-fold: First, to test the suitability of the [Geodesign](#) co-creation software for building GBNs and second, to inform and engage local stakeholders about the GBN development.

There was a strong turnout from community members which was highly encouraging. The turnout from dlr staff was not as high as hoped, indicating that there is work to be done in

convincing dlr staff of the value of Geodesign. However, there were enough dlr staff to fully carry out the workshop, who were highly engaged in the process.

The first day of the workshop was mainly focused on explaining the process, the tools involved and initial data gathering and map drawing. The participants really saw the value of the workshop on its second day, where the rounds of negotiations were carried out. The mixing of dlr staff with members of the public at tables worked very well, and the involvement of students to both help operate the tools and act as low-key facilitators worked extremely well.

Feedback from both members of the public and the dlr staff was very good with one staff member stating:

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*"I've attended enough workshops over the years to not expect any level of enjoyment at all so that was a nice surprise!*

*I really did find the whole thing to be a brilliant process – it was so engaging and set up perfectly to maximise everyone's participation. Of course, the students involved have to take lots of the credit for that too, because they were great (low key) facilitators. I particularly appreciated how the process gathered all the strands pretty much in real time and made it very meaningful. The final coalition building and negotiating element brought a whole new dimension and I think it could work very well as a process."*

dlr staff member

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The next steps within the Dublin Living Lab, are to package the feedback and maps produced into a document that illustrates the value of Geodesign to dlr staff and management and to PROBONO project partners. This work will be led by UCD.

#### **4.3.3 Post Occupancy Evaluation [UCD]**

The Dublin Living Lab is currently investigating the possibility of a post occupancy evaluation on a social housing scheme similar to that of Beaufort. The Housing Maintenance manager in dlr has identified another social housing site that could be suitable for retrofitting and, similarly to Beaufort, the tenants would remain in situ while the works are carried out.

Further discussion and planning is needed, but this could allow PROBONO and dlr to conduct an end-to-end evaluation of the process. Starting with consulting the tenants before the works are carried out and then following up to gather feedback on their experiences. It is hoped that the lessons learned could be developed to create a guide for carrying out this type of retrofitting works. This work will be led by the PROBONO partner, UCD.

#### **4.3.4 Reducing buildings' energy consumption through behavioural changes**

This study will test how to reduce carbon footprint through changing behavioural patterns of buildings' end-users. The targeted building is the County Hall in dlr, where Living Lab leaders suspect that the three elevators are consuming a lot of electricity. As such, aiming at reducing energy consumption of the entire building, moving building users from using the elevator to



using the stairs is a low-hanging fruit. As a co-benefit, based on previous research we can also expect health benefits (Meyer et al (2010) although this aspect will not be part of the current experiment.

Previously, the dlr has had bad experiences with asking the staff for behavioural changes. Because energy efficiency renovations and building improvements have been long postponed, the fear is that asking them for sacrificing comfort (taking the elevator), it will antagonize the staff from the needed changes. This is indeed a valid point, which is why methodology and timing is essential for a successful intervention.

The BASIC framework (section 2.2) is in this case a valuable methodology as it proposes strategies and interventions based on the unconscious heuristics and biases causing the *irrational behavioural patterns* (in this case, taking the elevator instead of the stairs). Irrational in this context points to behaviours that are irrational as judged by yourself (Hansen 2016). Examples of changes in the choice environment that could move users of the elevator to the stairs could for instance be putting footsteps on the floor guiding people towards the stairs, putting signs on strategic decision-making points guiding people towards the lunchroom through the stairs (for examples, see Meyer et al (2010) or, slowing down the closing time on the elevator doors as tested in a study by Ron Van Houten, Paul A. Nau, Michael Merrigan (1981) where slowing down the elevator reduced the consumption with one third and, the number of people using it. These are examples of subtle interventions, not asking or moralizing but guiding people in the direction of the desired behavioural change without prohibiting or preventing other possibilities.

The proposed setup includes starting out with establishing a baseline of a) the electricity consumption of the elevator, b) number of uses of the elevator and c) number of uses of stairs while establishing the context of the uses (time of day, gender differences, people with limited mobility etc.). The energy consumption will be monitored using the sensors provided by Telcoserv if this information is not already available, whereas the use of elevators and stairs will be monitored manually over a period of one week. This will likely include activating students from local university, if GDPR regulations do not allow for using cameras.

#### 4.3.4.1 Stakeholders

dlr staff and management, university students.

#### 4.3.4.2 Contributions to a GBN

As the Green Deal sets out, buildings' energy usage must be reduced significantly to meet the climate goals. In addition, the energy crisis and the increasing prices has made it all the more important to reduce energy consumption wherever possible. Changing behavioural patterns is an important means to do this, but as found in *D2.2: Behavioural Analysis and Operational Best Practice* (M12), most studies rely on self-reported behaviours and simulations, which are unreliable sources when it comes to implementing behavioural changes. By using the methodology of Applied Behavioural Insights, emphasizing the diagnostic link (i.e., understanding what biases and heuristics are causing the irrational behaviour) we can identify

the relevant strategy to implement the desired behavioural changes. In this case, making staff take the stairs instead of the elevator.

As such, the potential of this experiment goes beyond reducing energy consumption caused by elevator usage in the dlr County Hall, but test a methodology that can be implemented across Living Labs and buildings.

## 5 Madrid

The Madrid Living Lab is centred in the design and construction of two new buildings, one residential and one office building. With these buildings, the Living Lab is aiming to demonstrate a geothermal energy model as European benchmark in sustainable urban design.

The new constructions are part of a large urban development project, the Madrid Nuevo Norte (Madrid New North, MNN). This project aims at regenerating an area of 300 hectares by addressing *“area segregation, recover the degraded and derelict spaces, connect isolated neighbourhoods, and improve the quality of life of the residents”* (PROBONO GA: p. 31). The Living Lab covers a small part of this area, making it all the more important to ensure that PROBONO activities are linking to the development of the remaining area.

### 5.1 Summary of the Stakeholder Analysis

The stakeholder analysis and mapping presented in *D2.1: Stakeholder Analysis & Mapping*, was restricted by a very limited access to interviewing and engaging with stakeholders outside of the consortium. As such, the analysis was based on interviews with the Living Lab leader and the DCM representative (the PROBONO partner responsible for the new construction) the information in the GA. Since the finalisation of D2.1, we have received information on the BREEAM certification (Building Research Establishment Environmental Assessment Method) activities ongoing in the MNN project.

The BREEAM certification process requires extensive participatory processes which are outlined for the MNN in the consultation plan (developed by Castellana Norte District and kindly provided by the Madrid Living Lab leader). Many citizen engagement activities have already taken place. The participatory processes are gathering inputs for the urban development, on indicators such as access points, safety, traffic calming measures, spaces for activities and sports, spaces for socio-cultural activities, recreational areas and, vegetation. PROBONO Living Lab activities will take these processes into account and design a set of social and behavioural innovations complementary to already ongoing citizen engagements, not to overlap and exhaust citizens' goodwill.

Areas that will be addressed through the social and behavioural activities are:

- Legislative barriers
  - There is a strong misalignment between developers and investors' needs in terms of meeting green financing/ESG commitments and those of the legislation in the context of new developments and/or large corporations. The current legislative requirements are targeted at SMEs and renovations, posing a significant barrier to develop the geothermal energy community.
- Improving citizen engagements in new construction projects

- Across PROBONO Living Labs, the stakeholder interviews revealed significant concern among urban developers and planners of the public authorities with regards to citizen engagement which often tends to block new developments.
- Energy literacy and climate crisis awareness
  - According to the Living Lab leader, there is still insufficient knowledge of energy efficient behaviours for building occupants (tenants and office space users) to take full advantage of the economic potentials a renewable energy community is offering by reducing energy consumption.

## 5.2 Living Lab Vision

The following text presents the vision for the Madrid Living Lab. As described in section 2.1, this can be used for on-and offline communication activities to promote the PROBONO project and the Living Lab, for briefing stakeholders prior to engagement activities. For internal purposes, it is also a tool to ensure that activities are feeding into the development of a GBN. The vision will be translated to local language when needed.

*The Madrid Living Lab Living Lab is set to showcase a geothermal energy model which stands as a benchmark for sustainable urban design, planning, and rehabilitation in Europe. Our model aligns perfectly with the goals of the European Green Deal, aiming to contribute to sustainability standards and design scalable solutions for urban regeneration, all based on renewable energy. At Madrid Living Lab, our objective goes beyond achieving zero CO<sub>2</sub> emissions. We strive to establish a positive energy balance and create green districts that promote a brighter future for our cities. Through innovative methodologies, we empower the implementation of feasible solutions for individual buildings while also considering the broader context of green districts. In terms of our contribution to the Green Building Neighbourhood (GBN), Madrid Living Lab excels in various aspects. From a technical standpoint, we conduct a comprehensive assessment of the GBN's current state, identifying opportunities, needs, and challenges. Our aim is to minimize environmental impacts, support preventive management, and facilitate decision-making by tailoring solutions for specific profiles. Socially, the Living Lab promotes long-term vision and resilience in the face of future regulations. It also encourages collective interests over individual ones, reduces human impacts, fosters behavioural change, decentralizes aspects of the GBN, improves quality of life, and contributes to climate energy crisis resilience while reducing fossil fuel consumption. Lastly, from a natural perspective, the Living Lab reduces material usage by implementing circularity in building materials.*

*Looking ahead, the Madrid Living Lab project is progressing smoothly according to our planned timeline and deliverables. We have several exciting actions underway, including the construction of a geothermal network, two buildings (a commercial building and a residential building), and urbanization projects. The thermos activation of the buildings connected to the geothermal network is a key aspect of our vision.*

*Join us on this transformative journey toward a sustainable and greener future. Together, we can create a lasting impact in Madrid and beyond!*

## 5.3 Social and Behavioural Innovations in Madrid

### 5.3.1 Climate Change Awareness Assessment

The Climate Change Awareness Assessment survey will be prepared by Smart Innovation Norway colleagues over the course of summer 2023. It will be ready to be cascaded online with the help of Alchemer software in September 2023. In case of the Madrid Living Lab, we will appreciate the help of Madrid authorities to reach as many respondents as possible. The survey will be distributed in the Nuevo Norte neighbourhood. It will be translated to Spanish to ensure the proper understanding of the questions by every participant. The results from this assessment are expected to be processed by December 2023 and will be used to inform communication activities and behavioural change interventions, possibly linking to the BREEAM activities.

#### 5.3.1.1 Stakeholders

This activity aims at targeting a representative sample of the Nuevo Norte neighbourhood around the PROBONO buildings.

#### 5.3.1.2 Contributions to a GBN

The CCAA survey will give us information about the current stage of knowledge and attitudes when it comes to energy and climate change in the Madrid Lab. Based on this, we will be better equipped to engage the communities in the green transition and the creation of new Green Building Neighbourhoods.

### 5.3.2 Pre-Design Citizen Engagements

Across Living Labs, the findings of the PROBONO stakeholder analysis revealed a certain degree of reluctance within the local authorities towards the value of citizen engagements related to urban development projects. Not least in the planning departments, citizen engagements, e.g., in the form of public hearings, are met with mixed feelings as often engagement processes have been “hijacked” by citizens vocalizing their concerns and objections towards the suggested projects, leaving little or no room for a constructive dialogue and shared solutions (emphasizing here that this is not necessarily the case for Madrid, as we did not have a chance to engage directly with the local authorities there – in fact, Madrid has had extensive citizen engagements through the BREEAM processes). Based on our interviews, this is at least partly due to the engagements coming very late in the project development phase, leaving little room for adjustments and integration of citizens’ needs and interest.

As the two buildings of the Madrid Living Lab have not yet been designed, it is a great opportunity to test and demonstrate the potential of *pre-design* citizen engagements in new construction projects. The hypothesis we wish to test is that by engaging citizens prior to the design, development, and construction of new buildings, we can mitigate objections and secure important buy-in from citizens and other stakeholders.

In practice, we will host a workshop in M22 in Madrid, inviting the neighbourhood of the PROBONO buildings. In an initial conversation, Geodesign was seen as an interesting tool for this negotiation process. However, after considerations regarding the scale, an alternative tool that would be more suitable for the buildings is currently being searched.

The task will be to identify, negotiate and prioritize a list of requirements to be integrated into the briefing for architects. This briefing will be part of the procurement phase, so that we ensure that local needs and interests are integrated into the design and construction of the buildings and their immediate neighbourhood.

#### 5.3.2.1 Stakeholders

The workshop is aiming to include local GBN stakeholders: Residents of the surrounding neighbourhood, potential users of the office space, local retailers, local authorities, NGO's and community groups.

#### 5.3.2.2 Contributions to a GBN

With the built environment forming a crucial part of GBNs (and urban areas in general) both on the technical part but also as the physical surroundings in which people live their daily life, the importance of integrating local needs and interest in this development is evident. As stated above, citizen engagements are perceived of with mixed feelings in many local authorities, hence, the aim is to test and develop what value citizen engagement can bring if applied already in the pre-design phase.

### 5.3.3 Stakeholder Workshop: Bridging the ESG Gap – Understanding & Managing the ESG Reporting Gap between Investors and Policy Makers

One of the key challenges for the Madrid Living Lab, is the misalignment between developers and investors' needs in terms of meeting their green financing and ESG commitments on the one hand and, on the other, the legislative framework for *new* developments and/or large corporations as the current legislative requirements are targeted at SMEs and renovation projects.

This challenge is closely linked to the goal of *ST1.2.2: Investment analysis* and *ST1.5.3: Commissioning, procurement and financing the transition towards GBNs*. Hence, this workshop will be aiming at gathering stakeholder inputs on the needs pertaining to the green transition and the current legislation and directives. The results from the workshop will be analysed and summarised in a Green Paper (ST8.4.3, M24).

The workshop will be held in M22 in correlation with the workshop described under section 6.4.2.

#### 5.3.3.1 Stakeholders

Currently, the event is targeting construction companies, local authorities, financial institutions and investors but this will be updated and adapted.



#### 5.3.3.2 Contributions to a GBN

The aim is to identify legislative challenges to creating a GBN by harvesting the knowledge and experience of key stakeholders.

## 6 Porto [SIN & SONAE]

The SONAE Campus<sup>13</sup> is the head quarter of the SONAE Group, one of the largest private employers in Portugal. SONAE is a complex entity, consisting of different business units in areas such as retail, financial services, real estate, investment management and, telecommunications. SONAE was founded in 1959. An important feature of the SONAE narrative is that already from the onset, sustainability and corporate responsibility was “part of its DNA” as the founder soon recognized that the timber, they depended on was a limited resource if mitigation actions were not taken.

The campus is located outside Maia, a relatively big city at the outskirts of Porto. Even though, the surroundings are rural with a park, a river and open spaces it is well-connected to Maia and other cities, being close to one of the main roads and a highway. With 2000 employees coming and going every day (the majority by private car), the infrastructure is important. The campus offers charger stations for electric vehicles. For those without car, a shuttle bus is connecting the campus with public transportation.

Other services offered by the campus includes restaurants, coffee shops, a laundry service, a beauty lab (with hairdresser and a beauty centre), a car washing and maintenance service, a delivery service of pharmacy products, physiotherapy and pilates classes, and a space focused on health - Health & Nutrition Lab with clinical analyses services, nutritionist and a doctor. Besides that, Sonae Campus has a different place to promote a healthy and active lifestyle like a gym, two paddle courts and a football court.

### 6.1 Living Lab Vision

The following text presents the vision for the Porto Living Lab. As described in section 2.1, this can be used for on-and offline communication activities to promote the PROBONO project and the Living Lab, for briefing stakeholders prior to engagement activities. For internal purposes, it is also a tool to ensure that activities are feeding into the development of a GBN. The vision will be translated to local language when needed.

***The goal is to demonstrate how enterprises can contribute to a better world***

*“SONAE aspires to become a great example of sustainability, reduce GHG emissions, and increase the use of clean energy. Porto Living Lab, located at Sonae Campus, aims to inspire a collective change and mobilise stakeholders by becoming a reference sustainable campus, raising awareness and promoting technical innovations that will have a positive impact in the environment.*

*On a technical approach, Porto Living Lab wants to increase the use of green energy and implement solutions that allow a better energy management, giving preference to the consumption of renewable energy produced in loco. By raising awareness for sustainability, the*

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<sup>13</sup> This introduction was first used in D2.1: Stakeholder Analysis and Mapping, Chapter 5.

*goal is to create knowledge for the community and positively influence the campus population to make better decisions regarding energy consumption, involving stakeholders.*

*To boost biodiversity by creating natural green spaces in the campus is another goal of the Porto living lab vision for achieving a GBN. These initiatives will have an impact on the architecture and spatial qualities of the campus targeting its employees and serving as a hub for team building, learning and empowerment of the communities.*

*After its implementation, Porto Living Lab will be a real proof of a true GBN, fulfilling its technical, social, natural and physical components and creating a thriving ecosystem that allows for experimentation with huge potential for replication. SONAE will move forward on a path of carbon neutrality and creating knowledge for the community.”*

## 6.2 Summary of the Stakeholder Analysis

The Sonae Campus offers a case to study how corporate economic drivers (e.g., energy savings), employee welfare, and sustainability expectations can be structured through the GBN concept. The capabilities and experiences within the organisation on working with corporate sustainability are high and so are the ambitions as expressed by managers. The stakeholder interviews revealed a high interest in sustainability matters but it is important to stress that interviewees all had a professional and/or personal commitment to this subject. The general level of awareness and knowledge must be assessed with a representative sample of the employees. During the stakeholder analysis and mapping<sup>14</sup>, the following themes were identified as areas to be targeted with social and behavioural innovation activities:

- Engaging and educating employees
  - The Sonae Campus has a strong wish to continue and develop activities related to awareness raising and knowledge building on areas related to a GBN, such as biodiversity (pertaining to the *natural* attributes of a GBN).
  - Implementation of climate friendly behavioural changes is also articulated as a wish, but no specific area has been identified yet.
- Using energy smarter
  - Several drivers including the energy crisis and CSR commitments means that a smarter use of energy is needed. The technologies supporting this, should be accompanied by appropriate behavioural changes.
- Strengthen the bonds with research communities
  - The campus management wish to make available their facilities to establish stronger collaboration with local research communities.

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<sup>14</sup> The confidential D2.1: Stakeholder Analysis and Mapping

## 6.3 Social and Behavioural Innovations in Porto

### 6.3.1 Climate Change Awareness Assessment

The Climate Change Awareness Assessment survey will be prepared by Smart Innovation Norway colleagues over the course of summer 2023. It will be ready to be cascaded online with the help of Alchemer software in September 2023. In case of the Porto Living Lab, our target group is Sonae employees, white and blue-collar alike. The survey will be translated to Portuguese to ensure the proper understanding of the questions by every participant. We will rely on the support of the Living Lab partners in the Sonae campus to reach as many respondents as possible, and to advise us on how to engage the blue-collar colleagues, who do not have a company email address. The results from this assessment are expected to be processed by December 2023 and will feed into the design of Behavioural Insights informed interventions to support climate friendly behavioural patterns.

#### 6.3.1.1 Stakeholders

This activity will involve Sonae employees, white and blue-collar alike.

#### 6.3.1.2 Contributions to a GBN

The CCAA survey will give us information about the current stage of knowledge and attitudes when it comes to energy and climate change in the Porto Lab. Based on this, we will be better equipped to engage the community in the green transition and advise them on effective energy related behaviours in the workplace and at home as well.

### 6.3.2 House of Birds

During the spring of 2023, 25 birdhouses were installed around the campus to provide nesting opportunities for wild birds. In addition to this, the SONAE management has formulated a hope, that employees will be inspired by the birdhouses and generally be more involved in biodiversity subjects. The installation of nest boxes for birds can contribute to conserve local biodiversity and maintain the natural balance of insects in urban areas. With this activity they intend to build and install nest boxes, helping them to complete their life cycle.

To support the uptake amongst employees and, to be able to monitor and evaluate the number of installed birdhouses, SONAE propose a series of communications and initiatives:

- Celebrate special days like International Biodiversity Day with internal communications to reinforce all biodiversity initiatives including House of Birds. This will be followed up with a quiz where the winner receives a prize: a paddle class and a double entry at Serralves Museum, a garden which is a unique biodiversity example in the city of Porto. This initiative allows for the Sonae Campus to engage with employees and their families and support knowledge building on sustainability and biodiversity.
- Communicate frequently on the Sonae Campus App, which has a specific page just to present biodiversity initiatives to all employees and what they have been doing.

#### 6.3.2.1 Stakeholders

Sonae Campus employees and their families.

#### 6.3.2.2 Contributions to a GBN

These activities will contribute to knowledge building on biodiversity issues, pertaining to the *natural attributes* of a GBN.

### 6.3.3 Innovation Initiatives

The ambition of the Innovation Initiatives is to link the campus to local universities through a variety of activities. The campus offers various opportunities for the universities to engage in research and have an explicit ambition of opening up for experimentation. As management has reduced the number of times the grass is being cut, in addition to other initiatives supporting the biodiversity, one such opportunity could be to engage employees and neighbours to support research by monitoring the development of the local wildlife and flora. Examples of successful Citizen Science projects on birds and wildlife are available at the [Citizen Science Hub](#) supported by the EU.

Another interesting way of opening up the campus for research facilities is to evaluate the impact of the many green activities on employee welfare and work efficiency through an evidence-based approach. An increasing amount of scientific literature is demonstrating how access to nature and/or green spaces impact health and mental well-being (see e.g., WHO 2016). The Sonae Campus offers an interesting case study where the Vegetable Garden could be a testbed for monitoring employee wellbeing linked to green spaces. Vegetable Garden at Sonae Campus was launched in 2022 and it's a great example about employee involvement, sustainability, and corporate social responsibility. The Vegetable Garden has monthly sessions with all employees where the partners (experts in agriculture) share with all employees what they should produce in different seasons of the year, the needs and particularities of each one. They also learn concepts of organic farming, how to plan crops, fertilize or even manage their vermicomposting process. With these training monthly sessions, more than vegetables they create well-being and moments of interaction. Besides that, after these sessions, all needs in the vegetable garden are made by their employees that are 100% volunteers in the process. The Vegetable Garden is fully managed by their people, which includes maintenance support and deliveries to the institution, with 100% of what is generated and collected in the garden being donated. With their teams, in 1 year, they donated 330 kgs of vegetables, reused 150 kgs of organic waste from their restaurants and saved 52,000 litres of water and 660 kgs of CO<sub>2</sub>.

At Sonae Campus various other innovative solutions, more related to energy, that have the potential for future replication are under development. These advancements encompass technologies like Solar 2 Vehicle, Vehicle to Grid, 2nd life batteries and the implementation of a renewable energy community. Collectively, these solutions enhance the availability of renewable energy sources and foster the adoption of renewable energy consumption.

#### 6.3.3.1 Stakeholders

Academia, innovation companies, schools.

#### 6.3.3.2 Contributions to a GBN

This will contribute to the development of GBN by opening up for research activities on climate and energy related matters.

### 6.3.4 Digital Twin

The Sonae Campus is requesting a Digital Twin enabling a dashboard informing employees about the optimum time for charging their EV's, that is, when there is an excessive storage of renewable energy (see full description of the use case<sup>15</sup>). The current behavioural pattern is that employees plug in the car when they arrive in the morning and leave it in until they leave the campus in the afternoon which is not the optimum use of energy.

Research within the academic area of behavioural science has demonstrated that providing information has a very limited effect when the goal is to implement behavioural changes (see section 2). Hence, it is necessary to carefully consider how, where and when this information is provided to employees to achieve the desired behavioural changes. On this basis, the Digital Twin is currently being developed under PROBONO, incorporating some initiatives related to Porto Living Lab. Using the BASIC Framework (section 2.2 and OECD (2019)) of Applied Behavioural Science, we will determine the cognitive biases and heuristics influencing current behaviours and posing barriers to the desired change. This is the *diagnostic link* allowing us to suggest and test the best way to design the interventions initiating the desired behavioural changes.

#### 6.3.4.1 Stakeholders

App developers, campus employees using EVs, energy provider.

#### 6.3.4.2 Contributions to a GBN

With the integration of renewable energy sources and, the need for reducing energy consumption, behavioural changes are necessary to ensure optimum use of available energy.

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<sup>15</sup> “In this use case related to Energy Conservation and Efficient Consumption, the DT will provide users with information about energy usage (consumption/production) of the campus based on data collected at different levels so that they will significantly increase their awareness of how they could consume energy, especially in the form of electricity. As a result, it will be clear for the users what the best times are during the day to consume energy and consequently they can adjust their behaviour. Among the provided information, the DT will forecast future consumption peak or lack of energy production on the campus. Moreover, the exploitation team of the campus will have access of these information and in return, they could alert the users, so they could adapt their behaviour to avoid or mitigate the forecasted events. Finally, by adjusting their energy consumption, the worker will contribute to a better management of the energy consumption throughout the Campus, the increase of renewable usage and the access to cheaper energy for EV charging, for example.” (from D5.1: GBN DT Requirements Specifications (2023): Section 8.2.2)

This activity will contribute to behavioural changes aiming at best use of the renewable energy sources linked to charging of EVs.



## 7 Brussels

The Living Lab in Brussels is centred in De l'Autre Côté de l'Ecole (ACE) in Auderghem. This part of Brussels is located close to forests and green areas which is in general appreciated by inhabitants. As pointed out by the school's principal, Auderghem is a fast-growing neighbourhood and, the many new construction projects are often met with local protests as it involves deforestation.

On a technical level, the school is sharing building with other companies. Some parts of the building are in need of a refurbishment to match better the needs of the school and, to meet the environmental and regulatory requirements of the Green Deal. This requires an energy efficiency refurbishment, a need emphasized by the energy crisis. As the building is hosting a school, the refurbishment must be in line with and support the optimum socio-technical learning environment.

From a project perspective, the Brussels Living Lab offers an interesting case to study how to develop a GBN with a local school as the starting point. With no other buildings involved, this Living Lab offers, for the scope of developing a GBN, with the words of the Living Lab leader "*a blank sheet of paper*". Although a single school does not make for a GBN, it does offer opportunities to reach out and connect to the surrounding neighbourhood through both physical, technical, natural and social means. Through a wider understanding of other Green Deal initiatives that form part of what contributes to making a GBN, such as a Renewable Energy Community, the discussions at the Brussels Living Lab Discovery Event (held on 9 June 2023) concluded that '*To build a GBN you need to first build a community*'.

### 7.1 Summary of the Stakeholder Analysis

For the Brussels Living Lab, one setback of the stakeholder analysis was a very limited access to engage and discuss directly with stakeholders external to the project consortium. This will be mitigated through a stakeholder workshop, aiming at mapping local interests and capabilities linking to the GBN concept (section 7.3.2). As such, the starting point for the GBN is the school educating students from 12-18 years old.

A bearing element is the Freinet pedagogy, with several implications for the development and implementation of social and behavioural innovations. In practice, this means – among other things – that student has significant influence on specifying curriculums; a multi-disciplinary approach is valued; competitive elements are *not* available. It also means that the school has extensive experience in bottom-up collaborations, including students and parents in the development of the school. Finally, it is worth mentioning that since its establishment, ACE has had a clear focus on sustainability and environmental issues.

- Integrating the school with the wider neighbourhood
  - The school has articulated a wish to integrate better with the wider neighbourhood, as relations are sometimes complicated by assumptions of students' causing noise and trash. This has now been further confirmed by the

discussion held with neighbours at the Discover Event and the range of corresponding actions the Living Lab team have discussed at a post event brief.

- Improving indoor environment
  - With a limited budget for physical renovations, the school needs to look into other ways of improving the indoor environmental quality which forms an important aspect of ensuring an optimum learning environment for the students as well as a better working environment for the staff.
- Safe and active mobility to and from school
  - ACE is located in a busy neighbourhood, at the junction with crucial entrance roads to the city. Road safety and facilitating active (e)mobility (bike, foot, (e)scooter) are crucial to enhance a shift towards safe and sustainable travels that can benefit to the wider neighbour community.

## 7.2 Living Lab Vision

The following text presents the vision for the Brussels Living Lab. As described in section 2.1, this can be used for on-and offline communication activities to promote the PROBONO project and the Living Lab, for briefing stakeholders prior to engagement activities. For internal purposes, it is also a tool to ensure that activities are feeding into the development of a GBN. The vision will be translated to local languages when needed.

*Introducing "De l'autre côté de l'école" (ACE), the PROBONO Living Lab school located in Auderghem, a Commune of Brussels. Our mission is to empower stakeholders, raise awareness, and promote innovation in technical, social, natural, and physical aspects, ultimately in collaboration with our neighbours and the Commune, transform our neighbourhood. At ACE, students are not mere spectators but active participants, as we strive to empower our neighbourhood toward becoming a GBN community across the technical, physical, social, and natural dimensions from which a GBN is made.*

*We are dedicated to showcasing the positive impact of data-driven knowledge and its translation into practical reality on sustainability decision-making. By influencing behaviour and promoting the use of technology where appropriate, particularly in energy control, mobility, and well-being, we aim to maximize social and technical innovation and Quality of Life. The pedagogy practised in the school provides an excellent opportunity to foster social innovation, expand and build the community and highlight the neighbourhood's attractiveness.*

*While emphasizing the technical and physical components as perceived by GBN stakeholders and social behaviours, we also recognize the significance of natural elements, such as the parks and the nearby Soignes forest. This recognition extends to the daily management and operation of our school, encompassing areas like facilities, sustainable procurement, (micro)mobility, and circular economy approaches. We ensure that these efforts align with the educational, technical, and social needs of the school. Additionally, we support LL decision-makers in green fundraising, technical expertise, and administrative management. A comprehensive GBN approach is crucial*

*in mitigating risk and showcasing the return on investment in new holistic and sustainable approaches.*

*Strengthening connections and fostering collaboration with local neighbourhood stakeholders is crucial for transforming a mere building renovation into a project that ignites stakeholder momentum around various neighbourhood initiatives. These initiatives encompass significant aspects like green energy, transport safety, circular economy and Just Transition. By doing so, we aim to cultivate a stronger sense of community and collectively work towards a sustainable future. Join us in this transformative journey and let's create a positive impact together!*

## **7.3 Social and Behavioural Innovations in Brussels**

### **7.3.1 Climate Change Awareness Assessment**

The Climate Change Awareness Assessment survey will be prepared by Smart Innovation Norway colleagues over the course of summer 2023. It will be ready to be cascaded online with the help of Alchemer software in September 2023. In case of the Brussels Living Lab, our target group is ACE students and staff. The survey will be translated to French and/or Dutch to ensure the proper understanding of the questions by every participant. We will rely on the support of the local stakeholders such as ACE or VIAS to reach as many respondents as possible. One option is to engage a local agency to ensure a representative sample of the neighbourhood. As for ACE, we will collaborate with them on how to engage parents to make sure we abide by all ethical guidelines, when addressing minors in our questionnaire. The results from this assessment are expected to be processed by December 2023 and will feed into the design of Behavioural Insights informed interventions to support climate friendly behavioural patterns in the school.

#### **7.3.1.1 Stakeholders**

The CCAA in Brussels will target a representative sample of neighbourhood citizens.

#### **7.3.1.2 Contributions to a GBN**

The CCAA survey will give us information about the current stage of knowledge and attitudes when it comes to energy use and climate change in the Brussels Living Lab. Based on this, we will be better equipped to engage the community in the green transition and advise them on effective energy related behaviours.

### **7.3.2 Stakeholder Workshop: Discovery event**

On 9 June 2023, ACE hosted a Discovery Event at the school. A varied set of neighbourhood stakeholders of the local community were invited and 14 attended (for a full report of the event, please see Annex 1). These covered some of the stakeholder categories of the GBN stakeholder map. The event presented Probono and the GBN concept as well as discussion on the renovation aims of the school. Through the ensuing discussion, the potential to discuss and explore how improvements to the neighbourhood could occur was a key theme. Understanding that to build a GBN a community must first be built, the Discovery Event was intended to establish a kernel

around which the schedule of ACE student, school and neighbourhood activities for the coming school year can be exploited, with the support of the wider Brussels Living Lab partners and stakeholders, to do just this. This objective, along with the exploration and discussion on how and where the neighbourhood improvements might be made, was achieved. This will allow us to identify and map out local interests and capabilities the PROBONO partners can utilize as a steppingstone on the path towards a GBN. For instance, is there a great local interest in establishing an energy community? Or is improved mobility more prevalent? Or maybe, the first step is to organise community gardens or shared meals?

To follow up on the event, we will set up an online consultation forum (managed by SERCO). The tool to be used will be determined in collaboration with T2.4 leader.

#### 7.3.2.1 Stakeholders

The workshop was targeting the immediate neighbourhood, citizens, local businesses and the local authorities. For a full list, see Annex 1.

#### 7.3.2.2 Contributions to a GBN

In the transition towards a GBN, it is crucial to build a strong community. To this end, engaging with local stakeholders, listening and mapping out their individual as well as shared needs and interests is a key step, allowing to build relations and a common goal.

### **7.3.3 Mobility [VIAS]**

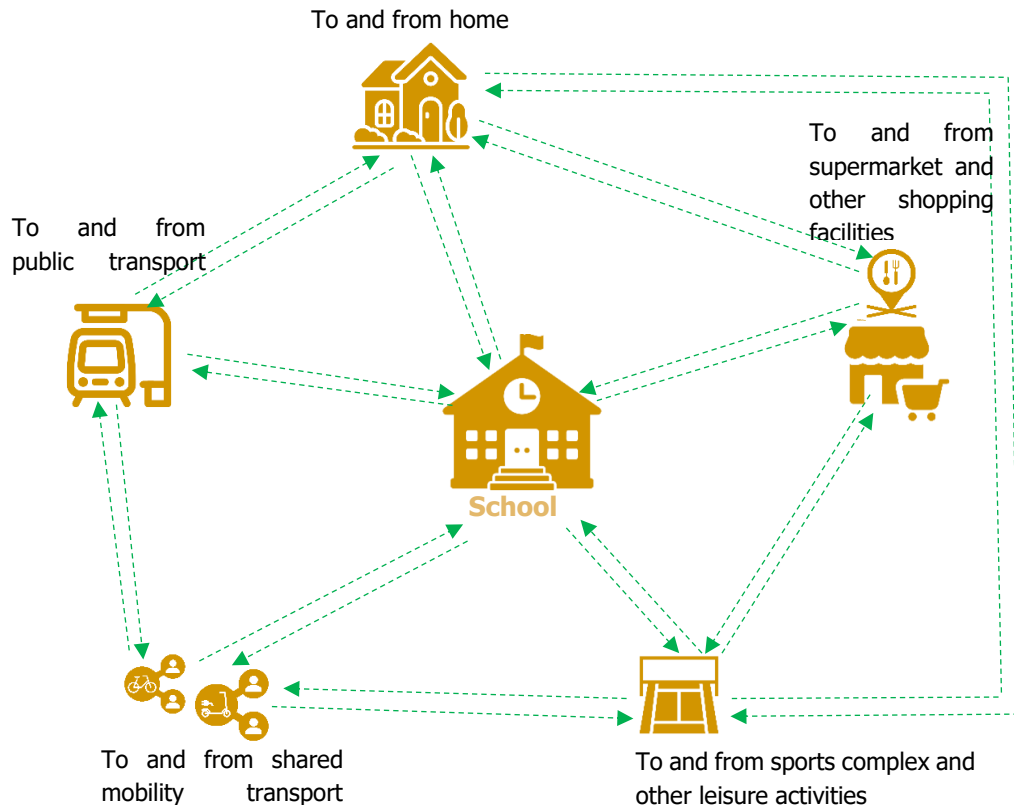
The definition of Green Buildings and Neighbourhoods (GBN) in PROBONO are Green Buildings integrated at a delimited area or district level with green energy and green mobility management and appropriate infrastructure supported by policies, investments and stakeholders' engagement and behaviours that ensure the transition that maximizes the economic and social co-benefits considering a district profile (population size, socio-economic structure, and geographical and climate characteristics). Delivered in the right way, GBN infrastructure is a key enabler of inclusive growth, can improve the accessibility of housing and amenities, reduce poverty and inequality, widen access to jobs and education, make communities more resilient to climate change, and promote public health and wellbeing.

Mobility shares a significant proportion of the total energy consumption of a country or city. For instance, in Belgium, transportation accounts for 25.9% of the total energy consumption (ODYSSEE-MURE, 2022). The definitions of GBNs and zero-energy neighbourhoods both include the transformation of energy consumption of buildings and transportation of its inhabitant to local and renewable energy production sources (A.-F. Marique et al., 2013).

Inherently, the social, political, economic and cultural activities of the human being influence their mobility (Rodrigue, 2020). In the case of Brussels Living Lab (LL), a sustainable mobility design of a school will mean it uses its energy sources efficiently and the end-users of the building have safe and walkable access to the building itself and connected land uses. The building sustainably connects its end users and influences long-term social and environmental

impacts. It minimizes the energy use of transportation and motivates its users to use active and efficient modes of transport.

In spatial representation, a delineated boundary of a neighbourhood belonging to a building as in the case of Brussels LL relates to its functional uses. For example, the trips it generates that satisfy the social, economic, environmental or cultural needs of its users. For a school building, an example of its eco-system of functional uses is presented in Figure 2. The use of positive energy and sustainability goals of a building should be achieved within its functional use. However, the impacts of measures taken for a building can be resonated to other buildings or the whole neighbourhood.



*Figure 2 Green building neighborhood (GBN) mobility: efficient use of building's energy resources and safe and accessible mobility of users to and from the school building in the spatial and social context*

### 7.3.3.1 Objectives

Transportation and safety are among 19 themes that are mentioned in the *ISO 37120:2018 - Sustainable Cities And Communities- Indicators for city services and quality of life*. These themes aim to evaluate city services and quality of life and more precisely city's resilience planning and assessment. It is important to mention as the GBN in PROBONO context is aligned with the sustainability goals of *ISO 37120:2018*.

PROBONO aims towards a people-focused European construction industry working in harmony with the whole value chain to deliver scalable, sustainable, and viable energy-positive and zero-carbon Green Buildings and Neighbourhoods (GBN). Participation of Brussels LL in the PROBONO project is an opportunity to accomplish this transformation by meeting the highest standards of green innovation and the 2040 vision of the Brussels Government grouped in four major themes: mobilize the region to build the framework for regional development and create new neighbourhoods; mobilize the region to develop a pleasant, sustainable, and appealing living environment; mobilize the region to develop its urban economy; mobilize the region to promote multi-modal travel (*PROBONO Grant agreement n° 101037075*).

Brussels LL is aiming to examine the business and socio-economic aspects of the Green Buildings and Neighbourhoods (GBN) transformation journey. As an education provider in the heart of a vibrant commune the Brussels Living Lab will have a special focus on citizen & stakeholder

engagement and behaviours. Mobility as described is among the important operation of the school. Mobility is a crucial aspect of school operations, and ensuring that it is emission-free or even generates positive energy requires careful planning for the next generation of mobility requirements. This entails establishing a supportive ecosystem for e-mobility and providing the necessary infrastructure to facilitate the transition towards sustainable transportation options among others.

An assessment of the existing mobility situation is necessary which can guide the future needs of Brussels LL. As mobility connects many actors in the neighbourhoods and influences social and economic relations, it can play an important role as a catalyst in the creation of GBN. For example, sharing energy for E-mobility among the neighbours, bringing the important stakeholders together to induce infrastructural changes that increase the sustainable transport modes use. Such schemes can multiply their positive impact and other communities can also replicate the approach.

A specific use case for mobility is defined after contextualising the mobility issues through secondary data sources. The mobility use case attempts to make an impact across the overarching goals of PROBONO and GBN. These goals include reducing Brussels LL energy needs, and near-zero emissions which will be achieved through a people-focused and systematic approach. The following section provides details on mobility issues, use case definition and the design to implement the mobility use case.

#### 7.3.3.2 Mapping the mobility challenges of Brussels LL

Initial safety and mobility diagnostic is conducted using secondary research and field observation surveys to identify the issues and provide a tailored mobility solution for Brussels LL. The initial safety and mobility information is gathered using open-source maps and secondary data (i.e., the website of Brussels Mobility, google earth maps, and accident data at VIAS). In addition to this, a mobility survey has been conducted in a parallel project from Brussels Mobility. This project is called a *plan de déplacements scolaires (PDS)* and aims to, at first, evaluate the current mobility situations of the schools and then recommend and advise the actions to promote more active and safe transport modes use<sup>16</sup>. The timeline and synergies in terms of collecting mobility baseline information match with PROBONO. Therefore, the information collected for PDS purposes is used to look at the baseline mobility situation.

Safety and mobility information based on secondary research is grouped into the following four categories.

- Location and accessibility
- General mobility infrastructure and facilities
- Mobility behaviour
- Safety and security

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<sup>16</sup> <https://mobilite-mobiliteit.brussels/fr/ecole/les-plans-de-deplacements-scolaires>



### Location and accessibility

ACE school (Brussels LL) is located at the crossroads of two main regional roads; Chau. de Tervueren, Auderghem (N281) and entrance to Brussels centre from Av. Herrmann-Debroux, Auderghem (E411) via Chau. De Wavre (*Figure 3*). The general accessibility of school by public transport (PT) modes is relatively good. Tram, metro, and bus stations are located within proximity of 1km and walking distance of 3-8 minutes. The detail of passing bus lines and tram and metro stations can be seen in Table 2. Mainly bike-friendly roads instead of dedicated bike lanes are present. Bike-friendly roads are demarcated in the maps by Brussels Mobility and Google Maps as seen in *Figure 4*. As per the assessment provided by PDS, the school street is not welcoming for bikes. The actual assessment of the level of friendliness will be done in a mobility and safety audit by observation (expert view). Pedestrian paths are present alongside Chau. de Wavre and other local roads. Generally, the development surrounding the Brussels LL is quite compact as the rest of the Brussels region.

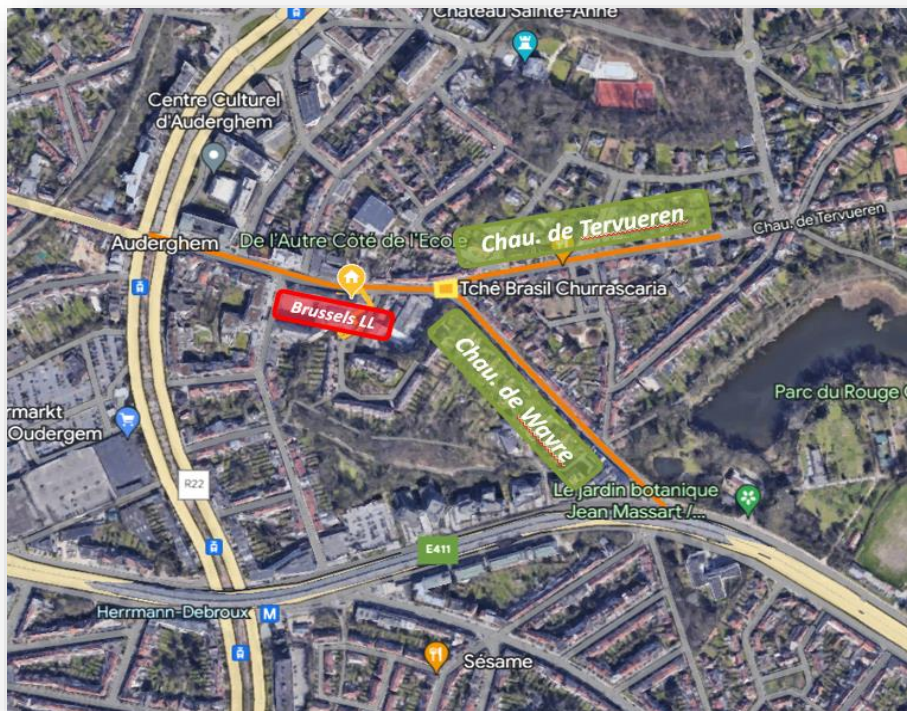


Figure 3 Brussels LL is located at the crossroads of two regional roads (N281, E411)

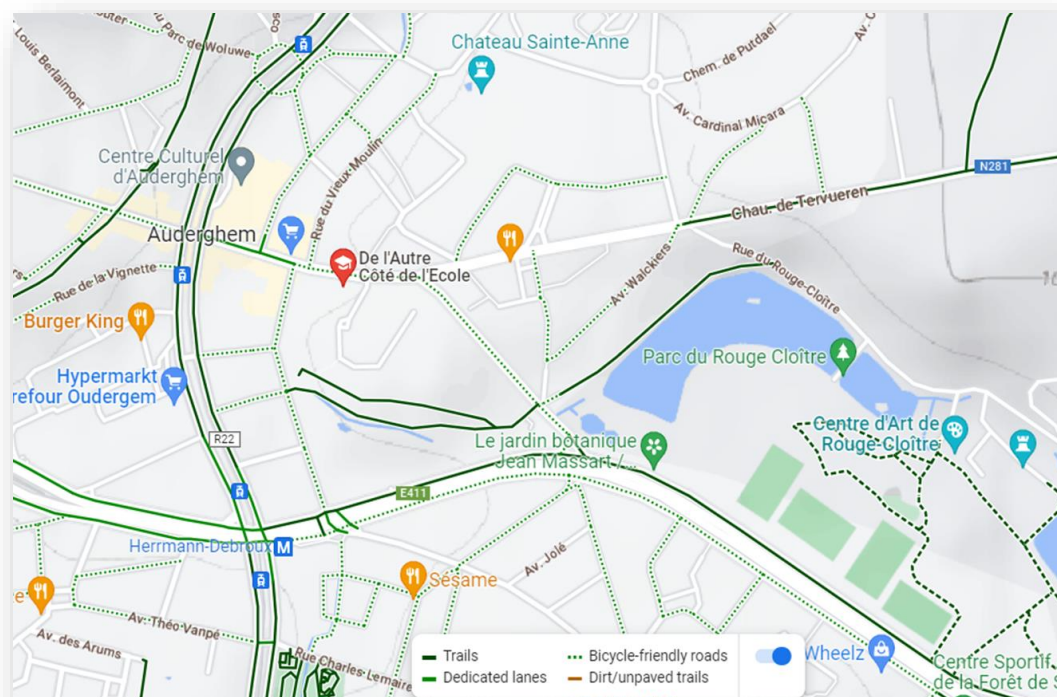


Figure 4 Bike lanes in the Brussels LL's neighbourhood

PT provider	PT lines within 1km
STIB	Bus 34 - Bergoje stop (1 min walk - low frequency) Bus 41- Herrmann-Debroux stop (8 min walk - medium frequency) Bus 72– Herrmann-Debroux stop (8 min walk - low frequency) Tram 8– Auderghem-Shopping stop (3 min walk - high frequency) Metro 5 – Herrmann-Debroux station (8 min walk - high frequency)
De Lijn	Bus 504, 544, 547, 548 – arrêt Auderghem Waver (5 min à pied) Bus 341, 343, 344, 345, 348, 349, 504, 544, 547, 548 – stop Herrmann-Debroux (8-minute walk)
TEC	Bus 543, E13 – Herrmann-Debroux station (8 min walk)

Table 2: Public transport (PT) lines within 1 km proximity of Brussels LL

At the building level, Brussels LL has 4 access points. As shown in Figure 5, access points 1 and 2 both have access to the building from the main road, *Chau. de Wavre* and 1 is currently the main entrance. Access point 3 faces the street *Clos du Bergoje* but currently, its access is also combined with the main entrance point 1. The 4<sup>th</sup> access point is an emergency exit of the school which opens and it is accessible through the local street *Rue Jacques Bassem*.



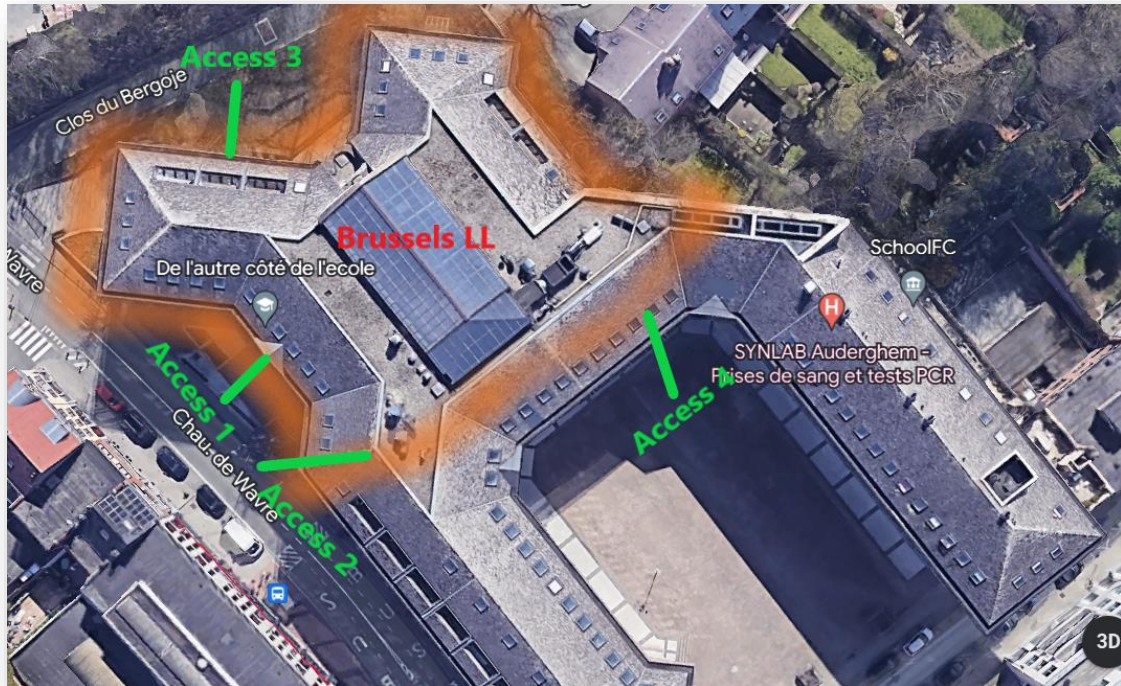


Figure 5 Access points of Brussels LL

#### Mobility infrastructure and facilities

In this section, the important infrastructure facilities and their quality has been evaluated mainly from the information collected for PDS and field observation done by the VIAS institute. The infrastructure and services related to all modes of transport (e.g., bikes, cars, micro-mobility) are evaluated in the school street and within the school building. In general, there are no designated car parking areas available for staff or for drop-off/pick-up of students by parents on the streets surrounding or within the premises of the Brussels LL.

Although sufficient bike parking is available on the surrounding streets of Brussels LL, the quality and security are real issues. The bike parking on the school premises is neither sufficient nor secure. Various cases of bike theft have been reported in the school. The bike parking place is not covered and is shared by both students and staff. The footpath in front of the school is present but it is narrow and is shared by pedestrians and bikes. The detailed situation of car and bike parking places and other infrastructure is present in Table 3.

The Brussels LL has a designated room for parking students' scooters and skateboards. Usually, these scooters are not electric but push scooters or kickboard scooters.

<b>Cycles</b>	
Parking and other services for cycling and micro-mobility (staff + students combined)	
➤ Number of places in school street Chau. de Wavre	20
➤ Sufficiency of places	Yes
➤ Distance from the school entrance	>50 m
➤ Bike fleet reserved for secondary school children	No
➤ Bike fleet reserved for the school staff	No
➤ Number of places in school (bike parking area is located at the access point 1)	42 on the bike rack + 10 on the corral bike rack
➤ Sufficiency of bike park places	No
➤ Accessibility to the bike park is easy as it is located right at the front entrance	No
➤ Basic equipment for bicycle repair (e.g., bicycle pump, multi-tools, and bicycle stand)	No
➤ Bike sharing players	Velo
➤ The price range for one trip	
<b>Micro-mobility</b>	
➤ A designated place for kickboard scooters	Yes
➤ Number of places	~20
➤ Scooters locking facility	No
➤ Scooter-sharing providers in the neighbourhood	Yes, (mostly used around school is dott)
<b>Car</b>	
➤ Parking on school street and pick/drop off dedicated park area	No
➤ Parking area for cars	No
➤ Parking area for staff	No
➤ Kiss and ride facility at school	No
➤ Regulated parking	Yes (blue zone)
➤ Speed limit on the street	30 km/h

*Table 3: Overview of parking and other services related to different transport modes within the premises and surrounding neighbourhood of Brussels LL*

### Mobility behaviour

The Brussels LL is a secondary school for children of 12-18 years old. There are almost 504 students in total and 70 teachers and other staff members come to school. The travel behaviour of Brussels LL users is based on voluntary participation in the mobility survey. In total 117 students and 43 staff members and teachers participated in the mobility survey conducted by Coren. An overrepresentation of some modes might be present. Thanks to the good accessibility of Brussels LL via public transport, the majority of the staff and children come to school by public transport mainly by metro and tram station (Figure 6). 23% of students already use active transport modes (bikes, on foot, and scooters). Provided almost 10% of the student live within the proximity of 1km and 50% within the proximity of 4km. There is still a potential to accomplish more active transportation modes. The staff and teachers usually use public transport and bikes. Almost, 49% of the staff/teachers use active transport modes which is an exemplary high percentage. Generally, secondary school children tend to use public transportation more frequently because they have a relatively lower dependency on their parents and are capable of travelling independently. Better access to public transport, student discounts, and the absence of dedicated school bus services are factors that contribute to the increased usage of public transportation in Brussels (Geurts, 2014). Brussels LL's full potential for bicycle usage has not been fully realized, likely due to a perceived lack of security and an unsafe environment for bicyclists on Chau. de Wavre.

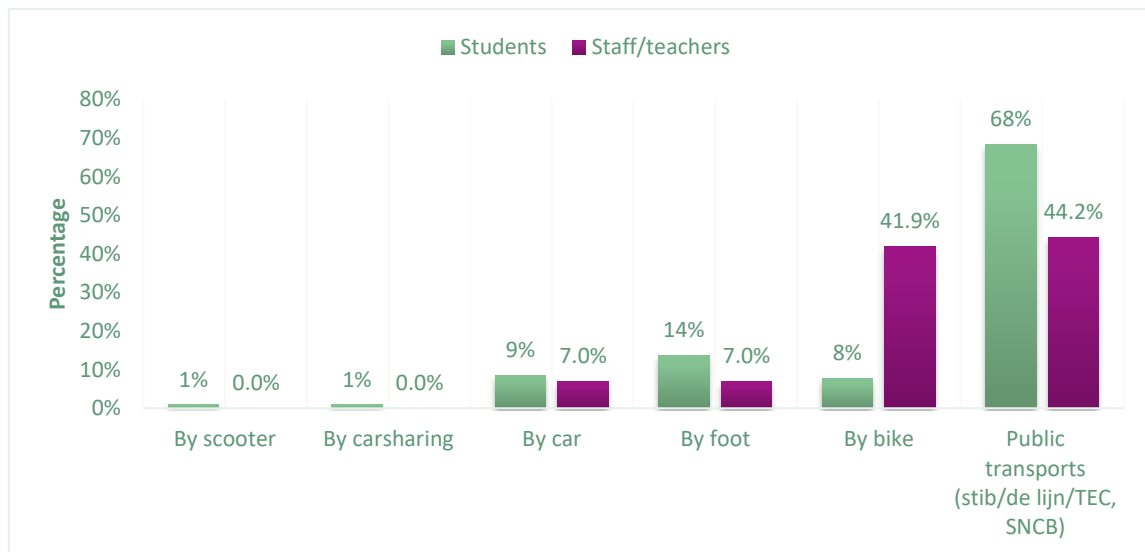


Figure 6 Travel behaviour of Brussels LL users (Survey 2022, by Coren)

### Safety and security

The safety and security situation of the Brussels LL is evaluated by the trends in road crashes in the Auderghem municipality and other reported mobility-related issues. Reporting on deep analysis and tracking the evolution of reported road crashes is done by VIAS Institute for many years and it plays a key role in enhancing road safety in Belgium. Therefore, the data on road crashes based on the accident database from Statbel on period 2017-2021 is gathered specifically for the municipality of Auderghem, where Brussels LL is located. Furthermore, the

information is specifically focused on road crashes that involved individuals between the ages of 0 to 18 years. In total, 387 road crashes with injuries were reported in Auderghem municipality of which 341 are geo-located on the map in Figure 7. Figure 7 shows a clear trend of the concentrated number of crashes alongside both roads N281 and E341. The intersection at Chau. de Wavre, R22, and N4, nearby Brussels LL are characterized as a collision-prone zone by Brussels mobility. The Bike lanes in the Brussels LL's neighbourhood also indicate the street (Chau. de Wavre) in front of Brussels LL is one of the major collision-prone zones.

Additionally, almost 17% (64) of the crashes that happened in Auderghem involved a child of age between 0-18, of which 48% involved a pedestrian or bike Figure 8. Figure 9 shows the distribution of all crashes involving children and it indicates that the ratio of slightly injured cases is high across all modes of transport except with cars. The majority (94%) of the crashes that happened involving a pedestrian or bike were cases with slight injuries. As already mentioned, the data only presents the figures of the reported cases. A huge under-reporting bias of pedestrian and cycle crashes can be expected. For example, a study states that only 7-15% of all bike crashes are reported (Vandenbulcke et al., 2017). The school reports 11 road safety

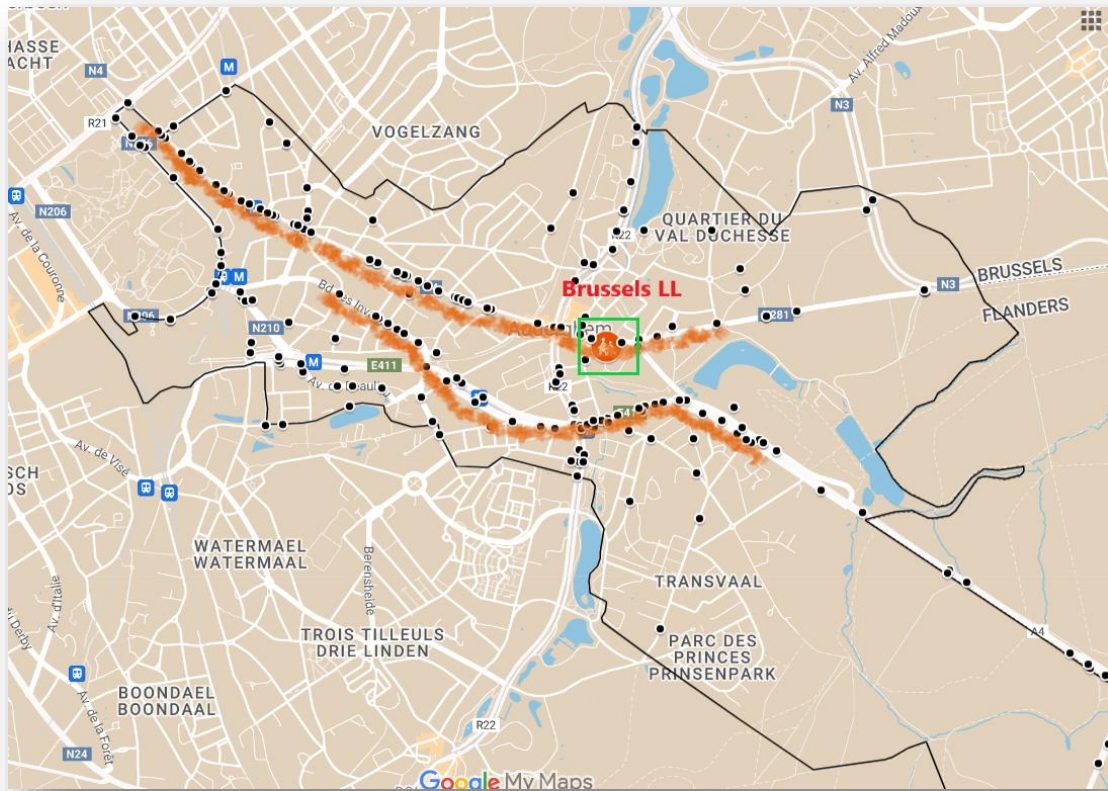


Figure 7 Crashes trend alongside N281 and E411

Source: Statbel (Directorate-general Statistics - Statistics Belgium) | Infographics: Vias institute

accidents with, for most of the cases, non or light injuries. Early 2023 schoolkid was seriously injured on a cross-road nearby the school.



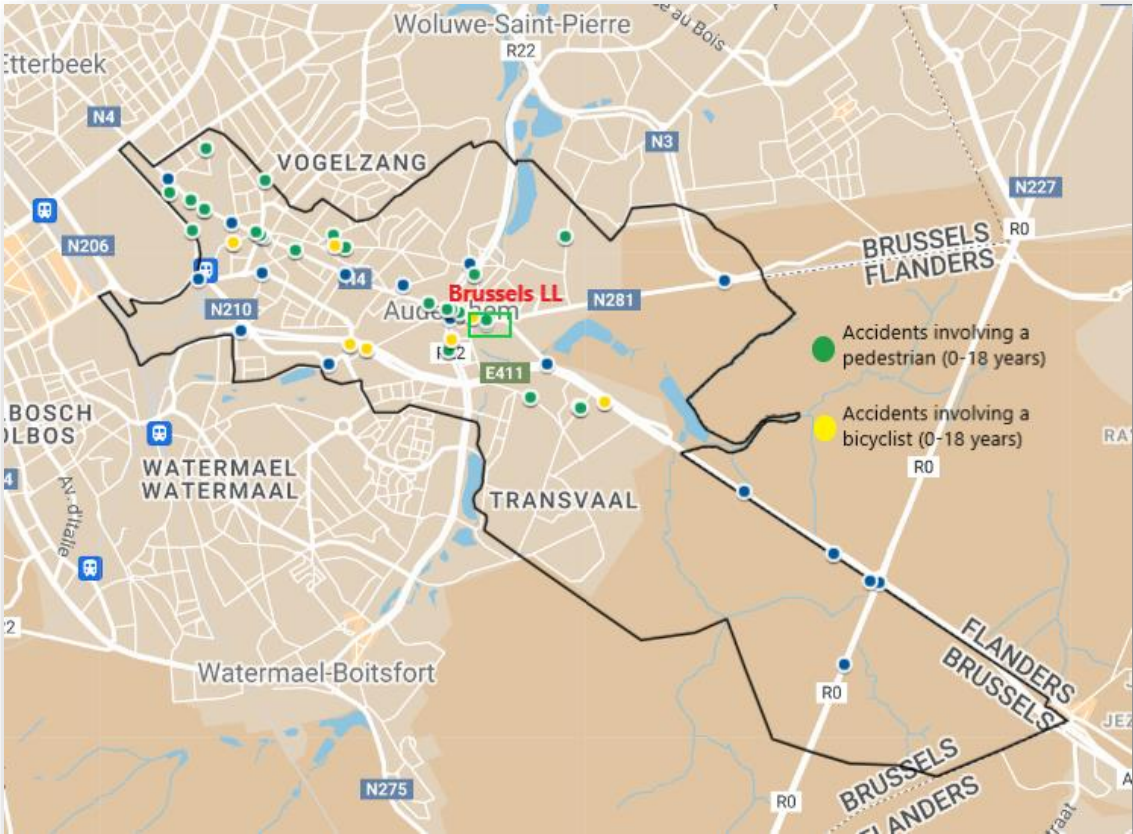


Figure 8 Crashes involving at-least one pedestrian or bicyclist of 0-18 years old  
Source: Statbel (Directorate-general Statistics - Statistics Belgium) | Infographics: Vias institute

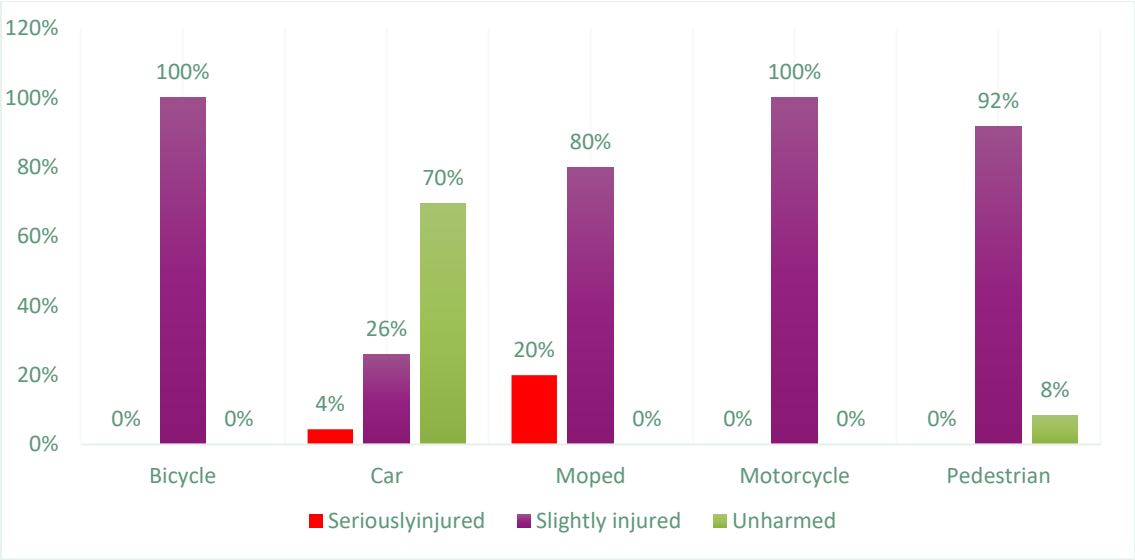


Figure 9 Percentage of crashes involving 0-18 years children by severity and transport modes



### 7.3.3.3 Mobility issues

The primary mobility assessment provides an overview of major mobility-related issues for Brussels LL. These issues are summarised as follows:

- Unsafe environment for Brussels LL users and neighbourhood on Chau. de Wavre.
- A limited number of parking places and security arrangements especially for bikes.
- No E-bike charging service within the school premises and in the neighbourhood.
- Direct air pollution exposure to Brussels LL users and neighbourhood.
- Difficult traffic flow at the intersection due to road design.
- Limited use of active transport modes especially bikes.

### 7.3.3.4 Mobility as a mechanism of GBN formation for Brussels LL

PROBONO envisions applying a people-focused approach by working in harmony with the broader community of stakeholders to achieve energy-positive Green Building and Neighbourhoods (GBNs). The Brussels LL aims to achieve a GBN by applying this bottom-up people-focused approach. Two separate workshops are proposed for preparing the stakeholders to collaborate on building a GBN. A stakeholder's workshop will be planned to invite the Brussels LL neighbours (e.g., local businesses, neighbourhood community, municipality officials, activists etc.) to engage and inform them about upcoming green renovation and get their feedback. The workshop would be focused on identifying the contacts and collaboration of interested people, platforms or organizations who can join the green renovation of Brussels LL and extend its scope to the neighbourhood level through different schemes. These schemes might operate across different aspects of a neighbourhood such as food, health, mobility, security, economy and landscape/built environment to improve the overall quality of life.

The stakeholders' workshop will be an open discussion and the project will consider suggestions or offers made by stakeholders. The interested stakeholders can express their interest to collaborate or identify resources to influence energy efficiency, sustainability, renewable energies, safety and security and electric mobility in Brussels LL's neighbourhood. Examples of mobility schemes interesting for stakeholders to collaborate with PROBONO might be:

- Energy sharing scheme for Brussels LL electric mobility (collaboration required from local business)
- Safe and secure bike parking spaces (collaboration required from local businesses and neighbours)
- Infrastructural changes proposed at Chau de. Wavre and surroundings to make it safer and attractive for active transport modes (regional traffic control authority)
- Defining healthier accessibility routes and changes in local streets to promote active travel (regional and local authorities)

Such example schemes would contribute to solving the issues identified concerning mobility challenges. However, these are only mentioned as examples as the actual schemes would be the outcome of the stakeholders' workshop which will be defined and shaped by the interests of the workshop participants. This workshop partly fits with the discovery event (see 2.3.2) and will be further developed through long term consultation and involvement of stakeholders in the discussions about mobility schemes.

A second workshop will be conducted locally with the Brussels LL users. The workshop with volunteering students and staff participants will be a co-creation moment. Parents and thematic school work groups will also be involved through dedicated existing channels. In this workshop, the students will participate in identifying the mobility issues and risks in combination with their input in a fun way of approaching the solutions. The purpose of the workshop is to mediate an open discussion to solve the mobility challenges as perceived by the students, their parents, and the teachers. This workshop will be conducted and arranged with mobility week<sup>17</sup> activities in September 2023 in which Brussels LL intends to participate.

The workshop with Brussels LL users is intended to discuss mobility issues and solutions in a manner suitable to the learning capacity of their age group (12-18). The outcomes of this workshop are important for policy recommendations concerning the strategies that are effective and practical for children and adolescents to enhance for example the active transport modes use, awareness of safety rules and equipment or adapting to alternative safe routes. The outcome of this local workshop or co-creation workshop will identify the inputs for setting up an intervention to change the behaviour to enhance safer travel practices in the neighbourhood. This will identify the important mobility indicators that would be used to monitor the behaviour and evaluate its change after the intervention. This can be done in three stages:

- **Pre-change:** setting up a baseline study and measuring the indicators for the mobility issues identified in the workshop. The specific duration of baseline monitoring will be determined after the workshop based on the identified KPI's.
- **Change, facilitate and engage:** to achieve behavioural changes in the mobility patterns of Brussels LL's users an intervention would be designed by considering the interests, willingness and ways to change the habits of school children and staff. This feedback from school children, staff and parents would be gathered in the local workshop mentioned above. The intervention can include various example schemes and will be co-designed with the workshop participants. The scope of this intervention will also depend on the available budget. Some examples of such schemes are provided as follows:
  - Developing knowledge of pedestrian and active transport users' safety and the benefits of using more active transportation through self-learning activities and assignments.

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<sup>17</sup> <https://mobilityweek.brussels/>

- Identify safe routes to school and enhance their attraction e.g. by serious games or education.
- Implementation of a locale-mobility scheme and shared e-mobility scheme in the Brussels LL's neighbourhood to enhance the adaptability to healthier routes.
- **Post-change, nudge and encourage:** this stage concerns the evaluation of the intervention scheme and would be designed to monitor the indicators of the mobility issues chosen. This stage will evaluate the impact of the intervention on the behaviour of Brussels LL's users and neighbourhood.

Solving the mobility challenges can bring the following expected positive outcomes for Brussels LL and its neighbourhood (Table 4). These expected outcomes are aligned with the Regional Mobility Plan 2020-2030<sup>18</sup> for the Brussels-Capital Region. One of the focuses of this plan is to achieve good neighbourhoods. These neighbourhoods improve the quality of life of their inhabitants by offering good access to active modes, public transport, and large areas free of transit traffic. In addition, these neighbourhoods strive for the safety and comfort of all citizens to reduce the number of accidents and ensure smooth interaction of different users on the road such as pedestrians, people with reduced mobility, cyclists, motorists, etc.<sup>19</sup>. The promotion of active transportation modes and the implementation of comprehensive road safety measures are closely intertwined.

Expected outcome
<ul style="list-style-type: none"> <li>• More physical activity and thus health benefits</li> <li>• Enhanced social interaction with the neighbourhood</li> <li>• Reduced energy use for e-mobility by using local and sustainable production</li> <li>• Connected neighbourhood by sharing good practices and energy needs of mobility</li> <li>• Improved sense of safety</li> <li>• Increased pedestrian and road use awareness as a whole</li> <li>• Increased use of active transportation</li> </ul>

Table 4: Overview of expected outcomes of mobility schemes of Brussels LL' GBN

<sup>18</sup> <https://mobilite-mobiliteit.brussels/en/good-move>

<sup>19</sup> <https://mobilite-mobiliteit.brussels/fr/good-move/good-neighbourhood>

### 7.3.4 Indoor Environmental Quality Experiment

The importance of a good, physical learning environment is widely recognised in research, although there is still uncertainty about the actual, measurable impact of indicators such as temperature, humidity, light and air pollution on the performance of students in various subjects (for a brief summary, see [IIEP Learning Portal \(2021\)](#)). Furthermore, the indoor environmental quality (IEQ) has been identified as an object for improvements by the school staff, reporting on issues with classrooms being either too warm or too cold.

This can be mitigated through physical and technological improvements but, with a limited budget we are approaching the improvements through testing various behavioural changes, targeting an improved IEQ. This behavioural study will take advantage of the sensors developed by Telcoserv (see 10.1), measuring the temperature, the CO<sub>2</sub> level and, number of windows and door openings. In practice, the sensors will be installed over the summer of 2023, allowing for the establishment of a baseline for a year. This period is necessary, as seasonal changes naturally impact the indoor natural environment.

In practice, four classrooms will be identified; two on the South-side of the building and two on the North-side of the building as they pose very different physical challenges in terms of temperature. The classrooms should be on the same floor as floor level plays a significant role in thermal comfort. This setup will allow for one control-classroom and one testing-classroom on each side of the building to test interventions aiming at both over- and underheated classrooms.

In combination with the sensors measuring the chosen physical aspects of the IEQ (temperature and CO<sub>2</sub> level), we will be applying the BASIC toolkit, starting with a *behavioural reduction* (UNESCO (2019): p. 21), i.e., defining exactly what behavioural patterns we will be targeting with the interventions. For this purpose, a site visit is being planned in the spring of 2024 to perform the necessary observations establishing the context of the various behavioural patterns. Using the ABCD-wheel of the BASIC toolkit ((UNESCO (2019): p. 70) we can then define the best strategy(ies) to implement behavioural changes. During the implementation of the interventions, the control classrooms will allow us to account for changes in the IEQ caused by our interventions versus other impacting factors.

As such, this study will contribute with knowledge on appropriate behavioural change interventions to support an improved indoor physical learning environment on the indicators on *temperature* and *CO<sub>2</sub> levels*. Based on the findings, the interventions can be replicated in the remaining classrooms at ACE. Furthermore, there is also potential to test in the learning environments of the Aarhus and Prague universities.

#### 7.3.4.1 Stakeholders

Stakeholders involved in this study: Students, teachers, school staff and administration, parents for ethical approval.

#### 7.3.4.2 Contributions to a GBN

In terms of developing a GBN, the study brings insights on how to improve the *physical learning environment and wellbeing* of students and staff through behavioural interventions, which are *cost-effective and with a very limited environmental impact*.

## 8 Aarhus

Aarhus University (AU) is a major Danish university established in 1928. They have been working on the reduction of their energy consumption in the past two decades already and have managed to reduce it by 20% per full time employee since 2006. PROBONO will accelerate this progress by implementing new technologies, encouraging sustainable behaviour among teachers and students, and giving them an opportunity to use AU as a research case by using the university as a Living Lab.

PROBONO will support the campus's integration into the urban fabric, through mobility and connectivity, establishing connections with surrounding neighbourhoods, Katrinebjerg and Trøjborg as well as with downtown Aarhus and Aarhus Docklands. This will also involve bringing citizens to the campus outside of normal working hours, to have a complete integration between the university and the city. PROBONO is to be a steppingstone for the university not just towards a sustainable future and energy saving, but also create a great environment for students and teachers alike.

### 8.1 Summary of the Stakeholder Analysis

AU's goal is to create a future-proof, city-integrated campus with great student life and round-the-clock activities, that accommodate urban life, shops, businesses, housing, and institutions and establish links with the surrounding neighbourhoods and downtown. This vision is supported by a strong student council with forward-looking ambitions on student well-being, sustainability, and environmental protection. The collaboration between them and the AU management will be a great asset for the improvement of the campus.

Aarhus Living Lab's core contribution to the project is expected to be the development a of human-centred methodology that is meant to be incorporated into the evaluation framework of the renovation. This may also feed into their ambition of increasing the number of innovations and "research to business" initiatives developed in the university.

The stakeholder interviews provided us with an insight into a great deal of technological expertise, and ambition for the future of the Living Lab. They also revealed some experience with the engagement of the users of the area, which is a practice that needs to be further nurtured during the design and development of the GBN.

Based on the stakeholder analysis, areas that will be addressed through the social and behavioural activities are:

- The development of the campus
  - The university has an ambitious student council making their voice heard about some critical issues, such as safety and well-being of the students using the campus. There is a good practice involving the students in faculty decision making and research projects. There has been however no extensive research conducted on expectations and wishes regarding the development of the campus.

- Enhancing sustainable behaviour on and around campus
  - AU has taken strong initiatives to reduce their energy consumption, and continues to work toward this goal. The student council has expressed the need to further improve the university's sustainability measurements.

## 8.2 Living Lab Vision

The following text presents the vision for the Aarhus Living Lab. As described in section 2.1, this can be used for on-and offline communication activities to promote the PROBONO project and the Living Lab, for briefing stakeholders prior to engagement activities. For internal purposes, it is also a tool to ensure that activities are feeding into the development of a GBN. The vision will be translated to local language when needed.

*Aarhus University's Living Lab (LL) is paving the way towards a sustainable future with its ground-breaking initiatives!*

*The LL's overall purpose is to curate new research and apply evidence-based holistic action research, focusing on social sustainability concepts in real construction projects ultimately for contributing to the development of a modern sustainable city integrated Campus, known as Campus 2.0.*

*The Living Lab (LL) encompasses a diverse range of areas, including technological, social, natural, and physical aspects, all of which play crucial roles in the creation of a Green Building Neighbourhood (GBN). Here's how the LL is making a difference across various aspects:*

*Technological: The LL is at the forefront of developing and testing cutting-edge technologies and tools. We are working on an enhanced decision-support tool for architects and engineers, to facilitate better decision-making in the early phases of construction projects.*

*Social: Making the intangible social sustainability tangible and quantifiable is the LL's aim. We are creating social sustainability subcategories and generating valuable knowledge and experience that can be applied in real-world projects, fostering a more inclusive and sustainable society.*

*Natural: The LL is committed to achieving net-zero environmental sustainability. We are promoting functional architecture, testing and prototyping green deal transitional examples, and aiming for DGNB gold certifications for their sustainability goals.*

*Physical: Through the LL's efforts, the campus district is undergoing a remarkable physical transformation. We are deeply refurbishing existing buildings, adding new ones, and ensuring architectural and structural features are preserved while meeting the needs of the university and its users.*

*Looking ahead, the vision for the Aarhus Living Lab and Aarhus University's Campus 2.0 is to "Make the intangible qualities, tangible." We aspire to translate social sustainability concepts into concrete, measurable outcomes. By integrating our findings, the LL will contribute to a modern, sustainable, and vibrant University City connected to the University Park.*



### 8.3 Social and Behavioural Innovations in Aarhus

#### 8.3.1 Climate Change Awareness Assessment

The Climate Change Awareness Assessment survey will be prepared by Smart Innovation Norway colleagues over the course of summer 2023. It will be ready to be cascaded online with the help of Alchemer software in September 2023. In case of the Aarhus Living Lab, our target group is the students and staff of Aarhus University. We will appreciate the help of AU administration or the student council to reach as many respondents as possible. The survey will be translated to Danish to ensure the proper understanding of the questions by every participant. The results from this assessment are expected to be processed by December 2023 and will be used to inform communication activities and behavioural change interventions.

##### 8.3.1.1 Stakeholders

This activity will target students and faculty members of Aarhus University.

##### 8.3.1.2 Contributions to a GBN

The CCAA survey will give us information about the current stage of knowledge and attitudes when it comes to energy use and climate change in the Aarhus Lab. Based on this, we will be better equipped to engage the community in the green transition and advise them on effective energy related behaviours on campus and in their households as well. The plan is to distribute the survey through the AU management, using the university emails of students and staff. This will be done in the beginning of the semester, i.e., September 2023 to leverage the timing of **fix this**. We will aim to engage the vice rector to encourage teachers to dedicate ten minutes of their lectures for students and themselves to complete the survey, a practice which is already in place at the university for various evaluations.

Furthermore, in the case of Aarhus, we will collaborate with the work done in the project of *My Climate Plan* ("Min Klimaplan" in Danish), adding three questions to assess the importance students attach to a green profile of the university.

#### 8.3.2 Geodesign

After an evaluation of a set of challenges from Aarhus LL, a Geodesign Workshop was considered as a strategic approach for the needed transformations in the AU Viborg Campus from a research centre into a green campus that is attractive to students. Geodesign will bring together stakeholders into a negotiation process for contributions to be integrated into the plans for the new campus configuration. The planning for the workshop is in its early stages of preparation and incoming discussions will define the requirements such as categories of stakeholders to bring into discussion, forms of recruitment and resources for the Geodesign activities.

#### 8.3.2.1 Stakeholders

The stakeholders involved in these activities are students and faculty members of Aarhus University, plus other potential users of the campus, such as citizens or small business owners of the area as well as local authorities.

#### 8.3.2.2 Contributions to a GBN

The successful integration of Viborg campus into the main frame of AU is a critical aspect of creating a Green Building Neighbourhood. Due to the physical distance of the rural campus, creating a neighbourhood poses a great challenge. A Geodesign workshop will facilitate collaboration with all local stakeholders in order to create a neighbourhood that takes into consideration the community's priorities, thus the social aspects of a GBN. Furthermore, energy and environmentally friendly behavioural interventions will be planned based on the Climate Change Awareness Assessment survey, to ensure that the neighbourhood remains green on the long run, not only due to technological innovations but also individual contributions of the everyday habits of the community.

## 9 Prague

The Czech Technical University in Prague (CTU) is one of the largest and oldest technical universities in Europe with eight faculties and close to 19000 students. According to Methodology 2017+, it is the highest-rated Czech technical university. With the campus being the centre of the project, the neighbourhood includes the faculty, dormitories, and public roads with public transportation.

As part of the PROBONO project, building B, the faculty of civil engineering is planned for refurbishment as the building has seen over 50 years without any major reconstruction. Currently it causes major discomfort to the students and staff there, mainly because the insulation is insufficient, meaning that the temperature is far from ideal during the summer or winter. Specific renovation methods will be selected based on the progress with the Digital Twin models, which is the main focus of the Prague Living Lab.

The neighbourhood in a wider sense is Prague 6. Prague 6, formally the Municipal District Prague 6, in Czech “Městská část Praha 6”, is the largest self-governing Prague District, located in the north-west of Prague. The neighbourhood is quite newly formulated, dating to the late 19th, early 20th century, therefore it has far more parks and green spaces in general than the other side of the river. With mostly residential areas the district also has offices, schools, universities, and health centres. Prague 6 is an enabler in the project, because they participate in all development projects by issuing permits, providing ideas and suggestions, investing in building projects, and backing the sustainable agenda.

### 9.1 Summary of the Stakeholder Analysis

The Prague Living Lab offers a great example on different aspects of an environment that can affect user satisfaction of an area, in this case, a campus. Integrating the university campus into the wider fabric of a GBN in Prague 6 has tremendous potential, but it is clear that citizen involvement is inevitable for a sustainable outcome.

The faculty practice and the experience of the municipality appears to be in contrast when it comes to bottom-up solutions. The university seems to have a good practice involving students in the design of initiatives such as the community garden. Their opinion was also asked regarding the refurbishment project and there is no reason to doubt their wishes will be considered.

Based on the stakeholder analysis, the following areas of attention were recognised:

- Citizen involvement
  - The stakeholder analysis revealed a high interest from the citizens of the municipality of Prague 6 when it comes to urban planning, thus a high need for the development of a sustainable cooperation method. Currently their involvement is often seen as counterproductive or disruptive to the projects.
- Defining the neighbourhood

- The primary goal of the Prague Living Lab is the refurbishment of one of the campus buildings, and it has not been defined how will that link to a broader neighbourhood.
- Resources
  - There is extensive knowledge and experience in the faculty. Budget and staffing however needs to be secured.

## 9.2 Living Lab Vision

The following text presents the vision for the Prague Living Lab. As described in section 2.1, this can be used for on-and offline communication activities to promote the PROBONO project and the Living Lab, for briefing stakeholders prior to engagement activities. For internal purposes, it is also a tool to ensure that activities are feeding into the development of a GBN. The vision will be translated to local language when needed.

*The vision of Prague Living Lab involves the dissemination of GBN (Green Building Neighbourhood) through the application of present and future expertise in passive building solutions, smart energy management solutions aimed at improved efficiency, and advanced technologies such as digital twin. However, it is of utmost importance to maintain a clear understanding of what GBN truly entails.*

*It is crucial to identify the key stakeholders involved. GBN is not merely concerned with the technical aspects of buildings and their surroundings, but also emphasizes the engagement of citizens, the consideration of natural aspects, the significance of physical attributes, and the inclusion of the political dimension.*

*Policy makers play a pivotal role as they impact various aspects of public life within the district. Furthermore, the objective is to leverage the gained experience for future urban policy planning and provide support for subsequent adoption of innovative practices.*

*This approach offers numerous advantages. Firstly, it reduces the negative environmental impact, enhances the quality of life for the neighbourhood residents, boosts economic performance, and leads to reduced operating costs in the long run. The beneficial impact of a green building neighbourhood on society can be substantial, resulting in increased satisfaction with the quality of life and the relationship with nature in the surroundings. Additionally, it improves air quality, enhances the city's resilience to climate change, and promotes safety and health for residents. Such an area becomes more attractive for additional investments, thereby generating economic benefits and creating new opportunities. The objective of Prague Living Lab is to engage citizens in this emerging trend and showcase new options for future comfortable urban living.*

## 9.3 Social and Behavioural Innovations in Prague

### 9.3.1 Climate Change Awareness Assessment

The Climate Change Awareness Assessment survey will be prepared by Smart Innovation Norway colleagues over the course of summer 2023. It will be ready to be cascaded online with the help of Alchemer software in September 2023. In case of the Prague Living Lab our target group is the students and staff of Prague University. We will appreciate the help of the university administration or the student council to reach as many respondents as possible. The survey will be translated to Czech to ensure the proper understanding of the questions by every participant. The results from this assessment are expected to be processed by December 2023 and will be used to inform communication activities and behavioural change interventions.

### 9.3.2 User testing of the Digital Twin

One of the main focuses of the Prague Living Lab is Digital Twin development. Being the follower of Aarhus Living Lab, specific retrofit interventions will be determined according to the progress and development realised in Aarhus regarding the DT technology. The plan is to verify the proposed technology and planning tools through the DT and apply them later in the refurbishment of the selected building.

We propose to allocate some of the Living Labs WP2 budget to conduct professional user testing on the Digital Twin. Since this software will play a crucial role in the realization of the GBN, its usability and interface need to be tested and adjusted accordingly as part of the development process. The possible methods of testing include one-on-one interviews or focus groups with test-participants, whose feedback will be incorporated into the functionalities and design before final launch. The timeline of this activity will be determined in alignment with the stages of the development.

#### 9.3.2.1 Stakeholders

This activity involves potential users of the Digital Twin, such as relevant faculty members, or representatives of the urban planning department of Prague 6.

#### 9.3.2.2 Contributions to a GBN

As the main focus of the Prague Living Lab is the development of the Digital Twin, that will influence the refurbishment of the chosen campus building, usability of this tool needs to be of good quality. The Digital Twin will be a great asset in the future for planning the development of the neighbourhood and as such, its interface has to be sensible and intuitive to its future users.

### 9.3.3 Stakeholder Workshop: Financing the Green Transition

As it was discussed in our stakeholder analysis, securing the budget for the necessary refurbishments of the university is a challenging task in this Living Lab. We see a potential to aid

this challenge by combining the efforts of WP1 and WP2. WP1 has two subtasks pertaining to the financing of the green transition:

Subtask 1.2.2: *...Identify the context of specific financing options available to investors and developers of sustainable developments specially to understand the relation between the more traditional financing available, such as through either equity or through debt issuance (bonds) relative to the main drivers for incorporating ESG for investors, being financial performance and regulation.*

Subtask 1.5.3: *“enable the transition of green buildings and GBNs in the PROBONO LLs, by **determining how the different components are financed, commissioned, and procured**, considering, for example public/private partnerships, public procurement, and other types of green financial and investment levers”.*

We propose hosting a workshop in Prague, involving financial institutions and investors to identify possible further funding opportunities. This workshop would be combined with a site visit of WP1 and 2 leaders to the Prague Living Lab in September 2023.

#### 9.3.3.1 Stakeholders

This activity involves representatives of Prague 6 municipality and representatives of respective financial institutions and investors to advise on possible financing options.

#### 9.3.3.2 Contributions to a GBN

This activity will aid in the financial backing of the refurbishment of the chosen building of the university campus, which is at the heart of the Prague GBN. Furthermore, it creates connections between a wide range of stakeholders whose cooperation with each other will be invaluable for the long-term green development of the neighbourhood.

### 9.3.4 Framing Climate Messages and Policies – an experiment

As part of the green transition of a neighbourhood, legislative changes are inevitable. These changes need to be accepted, but preferably endorsed by the affected communities. Creating such policies is undoubtably challenging, as so many different interests need to be taken into consideration. Not to mention, that creating a good policy is only part of the task – communicating it in a way that ensures understanding and support is another crucial step towards the goal. While the Climate Change Awareness Assessment survey focuses on answering important questions about public awareness and attitudes that will help the construction of relevant interventions and policies, we would like to take our behavioural investigation one step further and find out, how to best communicate new environmental policies, once we have them. For this purpose, we propose a climate message and policy framing experiment in the Prague Living Lab.

In democratic models of governance, politicians are unlikely to put forward climate action policies without public support, even though it is acknowledged that countries across the world need to adhere to ambitious decarbonization goals. (Jordan et al., 2013). Since climate policies are often costly to individuals, e.g., by penalizing everyday activities and behaviours that are

harming the environment, people are often only initially supportive of climate action on a broad level but become less supportive when policies become a real effect on their lives (Walker, Kurz, Russel, 2018). As a result, more and more researchers investigate the strategies that could enhance public acceptance and support of such policies (Drews & van den Bergh, 2016).

Besides considering the channel, the sender, and the recipient of the communication of climate initiatives, a key aspect is the framing of the message (Nisbet, 2009). Studies have shown that messages containing factually the same content can provoke vastly different reactions from the recipients, depending on how the message was constructed (Bolsen & Druckman, 2018). Because humans are not purely information processing robots, but largely influenced by our emotional responses and cognitive biases, the phrasing and manner of our messages have great power on perception and consequent action (Tahler & Sunstein, 2008).

Although political orientation strongly effects the views on climate change (Dunlap and McCright, 2008), research suggests that this can be influenced by the salience of one's political identities – in an experiment conservatives disagreed with climate change statements a lot stronger, with their political identity was emphasized, but without this manipulation their opinions were a lot closer to their left-wing peers' (Unsworth & Fielding, 2014). This indicates that the political frame of an environmental message or policy has a huge impact on the support we can expect from different groups.

Researchers are constantly searching for alternative ways to convey messages related to climate change beyond the dominant approach of shock and fear. Some researchers even suggest that in an environmental setting the “carrot” works better than the “stick” – meaning that people respond better to incentives than disincentives when it comes to climate policies (Attari et al., 2009; Drews & Van den Bergh, 2016).

Using humour can be such an alternative. We can find several instances where using humour affected positively public responses, ranging from raising awareness to actual environmentally relevant behaviour change (Kaltenbacher & Drews, 2020).

These examples all suggest that to understand the science of policy making, we need to utilize behavioural scientific methods and insights. The idea of evidence-based policy making is naive and does not necessarily bring the expected results as long as we ignore evidence on how to enact change (Rossa-Roccor, Giang & Kershaw, 2021). The human factor therefore should always be considered – it is people who will have to abide by these policies after all. Our task as behavioural scientists is to investigate the drivers and barriers that shape human behaviour in order to understand the challenges of public policy making. As Hansen (2018) puts it, „the real prospect of behavioural science is not just an add-on to public policy – it is a rethinking of its foundations”.

An experiment inspired by previous literature will be designed by Smart Innovation Norway over the course of fall 2023. Participants (N~400) from the Technical University of Prague will receive a survey in early 2024 with the same policy recommendation but framed differently for different groups of participants. We will measure the level of acceptance and attitudes attached to each framing method and examine what are the most successful ways to communicate climate related messages. The results of this experiment will be processed over the course of 2024 and



will advise us how to approach the PROBONO communities with pro-environmental messages in any future engagement attempts.

#### 9.3.4.1 Stakeholders

The stakeholders involved in these activities are students and faculty members of Prague Technical University, plus other potential users of the area, e.g., visitors of the Technical Library.

#### 9.3.4.2 Contributions to a GBN

The creation of a Green Building Neighbourhood will need to be endorsed by the communities who use the neighbourhood. This might mean meaningful changes in their attitudes and behaviours which needs to be supported by research based behavioural scientific interventions. To ensure the future success of said interventions, this experiment will shed light on what messages the community are most receptive to, and what are their baseline attitudes on certain environmental issues and policies, that are inherent components to the creation of a GBN.

## 10 PROBONO Innovations

This chapter presents an overview of the PROBONO technological innovations needing stakeholder feedback and/or user testing activities. The ambition is to design a strategy for the collection of feedback from stakeholders and external experts and, to tailor these strategies meeting each partners' needs, answering to ST2.3.2. At this stage, it has proven difficult to define detailed strategies per innovation due to various maturity levels. But the initial mapping has taken place and, the process and next actions are outlined in the current section.

First step, presented in this deliverable, has been to collect information from the technological developers on their needs, the current state of the innovations and, whether a stakeholder engagement process has already been defined. For this purpose, a scoping questionnaire was developed and sent to all technology providers. The questionnaire aims at capturing partners' needs for stakeholder engagements and user testing activities. Prior to this, information about the value and benefits of this process and, a presentation of the various methodologies and tools (such as concept testing, serious games, qualitative interviews, focus groups, usability testing, UX testing and co-design processes) has been given to all partners at the General Assembly (M14), later circulated as a position paper and, through monthly WP2 and Technical Management meetings. The results from the scoping questionnaire are summarized in sections 10.1 to 10.7, with one section per innovation.

To ensure an overview of the stakeholder consultations and user testing processes for the PROBONO innovations, WP2 leader is using a *Stakeholder Consultation Tracker*, to monitor the progress and completion of stakeholder consultations. The tracker will be updated regularly and is located at the PROBONO Teams under WP2. A screenshot can be seen in Figure 10: Stakeholder Consultation Tracker. First actions to fill out the tracker will be for the WP2 leader to set up bilateral meetings with tech providers to detail the need for stakeholder consultations.

Innovation	Responsible developer	Task	Contact email	Scoping questionnaire received	Planned engagement date	Action required	Pre-engagement discussion status	Type of engagement	Plan ready y/n	Engagement status	Evaluation form
Sensors and Meters	ADAPTIF	WP4	Spyros Polychronopoulos / spoly@adaptit.gr	Yes	Uncertain						
Building Integrated Coloured PV modules	Fraunhofer	T4.3	Bruno Bueno, bruno.bueno@ise.fraunhofer.de	Yes	Uncertain						
Green Building Materials	SOPREMA	T3.2	Rémi PERRIN - rperrin@soprema.fr	Yes	Uncertain						
Ventilation Assessment Tool	INSTITUTO TECNOLÓGICO DE ARAGON	ST5.3.5	Asier ajuan@itainnova.es	Yes							
Comfort Virtual Sensors	INSTITUTO TECNOLÓGICO DE ARAGON	ST5.3.5	Asier ajuan@itainnova.es	Yes							
Energy Demand and Response Platform	TPF/STAMTECH	T4.2	Martin de Bellefroid / mbe@tpf.be	Yes			Invitation sent				
GBN Roofs	ANERDGY		Sven Koehler / sven.koehler@anerdgy.com	No							
Smart Charging for EVs	Bovlabs	T4.6	Adithya RAMANATHAN KRISHNAN / adithya.r@bovlabs.com	No							
RFB Systems	VISBLUE	T4.5	Marta Boaventura / mbo@visblue.com	No							
Circular Economy Products	Cidaut		Javier Romo / javrom@cidaut.es	No							
Integrated Infrastructure Mobility Energy	Cidaut	T4.6	Javier Romo / javrom@cidaut.es	No							

Figure 10: Stakeholder Consultation Tracker

Last, it is necessary to stress, that for some technological developers, stakeholder collaboration and engagement is an integrated part of the development process, and they have well-established practices. Some of these are not captured in this document, where we are focusing on the innovations where WP2 contributions are necessary.

### 10.1 Sensors and Meters

This innovation pertains to building state of the art *sensors and meters* (four electric meters, four CO<sub>2</sub> & temperature sensors, sixteen open/close sensors to measure number of window/door openings). They will transmit the data using machine-to-machine network protocol (MQTT) through WiFi. The work includes setting up the chain: 1) *collect* the data, 2) *receive* the data (using a gateway) and 3) *sending* the data to the cloud.

In addition to the technical prospects, the sensors will be utilized in the behavioural study described in section 7.3.4.

Sensors and Meters	
<b>Work Package/Task</b>	T4.2
<b>Responsible partner(s)</b>	Telcoserv
<b>Who are the stakeholder categories you need to engage in the design and development of the innovation?</b>	User experience with the sensors on site and viewing the data.
<b>Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)</b>	To be determined
<b>What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)</b>	Comments on the: a) user interface (viewing the data) and b) data (accuracy and expected results).
<b>When do you need the information obtained via the stakeholder engagements?</b>	6 months after our work is done
<b>Do you already have a plan for the stakeholder engagements?</b>	No
<b>Who are the end-users of the innovation?</b>	The teachers and the students of the school in Brussels.
<b>Do you have access to the end-users?</b>	Yes to one teacher
<b>What do you need end-user feedback on?</b>	Would be useful not mandatory.

What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)	A prototype of the sensors
When do you need the results from the user testing?	Would be useful not mandatory.
Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?	No
Which Living Lab(s) are you expecting to implement in?	Brussels

Table 5: Telcoserv Responses to T2.3 Scoping Survey

## 10.2 Building Integrated Coloured PV modules

This innovation involves coloured PV modules for building integration applications.

Coloured PV modules for building integration applications	
Work Package/Task	T4.3
Responsible partner(s)	Fraunhofer
Who are the stakeholder categories you need to engage in the design and development of the innovation?	Building planners, architects, building owner
Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)	A fluent communication has not yet been established
What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)	BIPV concept, building planning process for best integration of the technology, local building regulations
When do you need the information obtained via the stakeholder engagements?	In the early stages of the planning process
Do you already have a plan for the stakeholder engagements?	Not yet
Who are the end-users of the innovation?	Building owner
Do you have access to the end-users?	Not yet
What do you need end-user feedback on?	BIPV concept

<b>What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)</b>	Visualizations of the building with the future BIPV facade
<b>When do you need the results from the user testing?</b>	This year
<b>Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?</b>	Not yet
<b>Which Living Lab(s) are you expecting to implement in?</b>	Dublin, Madrid, Porto

Table 6: Fraunhofer Responses to T2.3 Scoping Survey

### 10.3 Green Building Materials

The Green Building Materials involve:

- Green Roof with High Evaporation.
- Cool Roof that should be combined with Bi Facial PV panels.
- Wood fibre insulation materials.
- Plastic foam thermal insulation panels with high recycled content.

All these innovations could be a part of innovative solutions mainly for roofs but not only. For instance, is it possible to combine wood fibre insulation materials with green roofs. In practice, this means that the solutions offered to each Living Lab must be tailored. With regards to the end-user feedback, a Post Occupancy Evaluation is suggested.

Green Building Materials	
<b>Work Package/Task</b>	T3.2
<b>Responsible partner(s)</b>	SOPREMA
<b>Who are the stakeholder categories you need to engage in the design and development of the innovation?</b>	Certification bodies, architects, building owners.
<b>Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)</b>	Yes
<b>What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)</b>	Technical validation either for durability & performances

<b>When do you need the information obtained via the stakeholder engagements?</b>	Before to launch industrialisation.
<b>Do you already have a plan for the stakeholder engagements?</b>	Yes
<b>Who are the end-users of the innovation?</b>	Building owners, Buildings occupants
<b>Do you have access to the end-users?</b>	Yes
<b>What do you need end-user feedback on?</b>	Confirmation of the added value of the solution
<b>What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)</b>	Free materials for job site tests
<b>When do you need the results from the user testing?</b>	In the conception phase of "Prototype Validation"
<b>Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?</b>	Yes
<b>Which Living Lab(s) are you expecting to implement in?</b>	Under discussion

Table 7: Soprema Responses to T2.3 Scoping Survey

## 10.4 Ventilation Assessment Tool

Development of a Computational Fluid Dynamics (CFD) tool to predict ventilation paths and air quality of a given building, to support the decision making in the process of a building retrofitting at the design stage.

Ventilation Assessment Tool	
<b>Work Package/Task</b>	ST5.3.5
<b>Responsible partner(s)</b>	ITAINNOVA
<b>Who are the stakeholder categories you need to engage in the design and development of the innovation?</b>	The technological innovation is being designed to be implemented on the retrofitting process in Aarhus living lab, which is the stakeholder. Different people from Aarhus are involved in the task, providing all the information, perspective and scope required for the development.



	However, additional engagements with construction companies, architects etc. would be valuable.
<b>Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)</b>	Yes
<b>What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)</b>	Implementation plans: To be aligned so the tool can be used for the retrofitting processes in Aarhus.  Expected outputs: Information to be obtained from the ventilation tool. Some of this feedback can be also related to legislative limitations to be fulfilled.
<b>When do you need the information obtained via the stakeholder engagements?</b>	During the development (periodic meetings)
<b>Do you already have a plan for the stakeholder engagements?</b>	Yes
<b>Who are the end-users of the innovation?</b>	Any person involved in the design phase of a building (Architects, designers etc.)
<b>Do you have access to the end-users?</b>	Yes
<b>What do you need end-user feedback on?</b>	Formats: Expected input-output formats to use the tool.  Usability: Periodic tool tests to validate the usability and applicability.
<b>What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)</b>	Prototype: Tool evolution is being shared. Different versions with its capabilities are defined in the workplan.
<b>When do you need the results from the user testing?</b>	During the tool development.
<b>Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?</b>	Yes
<b>Which Living Lab(s) are you expecting to implement in?</b>	Aarhus

Table 8: ITAINNOVA Reponse to T2.3 Scoping Survey

## 10.5 Comfort Virtual Sensors

This innovation pertains to the development of digital twins of the thermo-fluid dynamics of air inside the buildings to optimise its internal comfort. This kind of digital twins can be used as virtual sensors standing for an advanced support to energy management.

Comfort Virtual Sensors	
<b>Work Package/Task</b>	ST5.3.5
<b>Responsible partner(s)</b>	ITAINNOVA
<b>Who are the stakeholder categories you need to engage in the design and development of the innovation?</b>	<p>The technological innovation is being designed to be implemented in one of the new buildings of Aarhus living lab. Different people from Aarhus are involved in the task, providing all the information, perspective and scope required for the development.</p> <p>However, additional engagements with construction companies, architects etc, would be valuable.</p>
<b>Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)</b>	Yes
<b>What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)</b>	<p>Implementation plans: To be aligned so the comfort virtual sensor can be deployed on the new building.</p> <p>Expected outputs: Information to be obtained from the comfort virtual sensor. Integration with other parts of the system (Energy management)</p> <p>Legislative: Limitations to be fulfilled (Energy consumption, air quality etc.)</p>
<b>When do you need the information obtained via the stakeholder engagements?</b>	Some information should be provided at the beginning of the development, while some other could be added during the process.
<b>Do you already have a plan for the stakeholder engagements?</b>	Yes
<b>Who are the end-users of the innovation?</b>	<p>The comfort virtual sensor can be applied on any confined space to provide real time predictions of air quality and human comfort. There are different end users depending on where it is deployed.</p>

	<p>Individual use: If it is applied on private spaces or houses, end users are the people living in there.</p> <p>Public use: When applied to public spaces as offices, libraries, academic, malls etc., end users are the people in charge of it.</p>
Do you have access to the end-users?	Yes
What do you need end-user feedback on?	Expected outputs: Comfort virtual sensor interaction and visualization.
What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)	Dummy cases.
When do you need the results from the user testing?	During the development and after the deployment.
Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?	Yes
Which Living Lab(s) are you expecting to implement in?	Uncertain

Table 9: ITAINNOVA Responses to T2.3 Scoping Survey

## 10.6 Energy Demand and Response Platform

The objective of the platform is to help the GBN integrators in their investment and renovations decision making. First step is to fill in a few input parameters about the building and/or neighbourhood (localization, costs, actual demands and responses, investment ideas, ...). This information is then used to simulate the baseline situation and various investment propositions in order to help compare different scenarios with a good financial vision (CAPEX, ROI, NPV, ...).

Energy Demand and Response Platform	
Work Package/Task	T4.2
Responsible partner(s)	TPF
Who are the stakeholder categories you need to engage in the design and development of the innovation?	Building or site owners and/or managers, building investment decision makers, Energy communities
Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)	Yes, we have some contacts

<b>What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)</b>	Concept Interest in the platform, platform UX testing when ready
<b>When do you need the information obtained via the stakeholder engagements?</b>	Concept interest could from now as it is clearly defined. Platform UX testing should wait for a sufficiently advanced platform (probably between M36 - M50)
<b>Do you already have a plan for the stakeholder engagements?</b>	No
<b>Who are the end-users of the innovation?</b>	Building or site owners and/or managers, building investment decision makers, Energy communities
<b>Do you have access to the end-users?</b>	Yes we have some contacts
<b>What do you need end-user feedback on?</b>	Concept Interest in the platform, platform UX testing when ready
<b>What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)</b>	Concept note, platform UX when ready
<b>When do you need the results from the user testing?</b>	Concept interest could from now as it is clearly defined. Platform UX testing should wait for a sufficiently advanced platform (probably between M36 - M50)
<b>Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?</b>	No
<b>Which Living Lab(s) are you expecting to implement in?</b>	Brussels

Table 10: TPF Responses to T2.3 Scoping Survey

## 10.7 Smart Charging for EVs

Cidaut is responsible for advanced EV battery charging methods. In particular, three technologies are in focus: bidirectional (V2G) charging, wireless charging and battery swapping. Traditionally, EVs have only been able to consume energy from the grid. Thanks to the deployment of bidirectional charging technology, EV will be able to both consume and supply energy back to the grid. For its part, wireless charging is oriented to the Dublin Living Lab shared vehicles, with frequent utilization, so that users do not have to connect the vehicle to the grid. Finally, battery swapping technology is focused on small size vehicles (hoverboards, bicycles or motorcycles). Its main advantage is that it allows a complete charge in less than two minutes.

Smart Charging for EVs	
<b>Work Package/Task</b>	T4.6 Integrated Infrastructure Mobility Energy.
<b>Responsible partner(s)</b>	CIDAUT
<b>Who are the stakeholder categories you need to engage in the design and development of the innovation?</b>	<p>In general terms, they are the following:</p> <ol style="list-style-type: none"> <li>1. Power Distribution Companies</li> <li>2. Charging Solutions Providers (e.g. charging stations, hardware, software)</li> <li>3. Site Managers (DLR)</li> <li>4. Regulatory bodies</li> </ol>
<b>Do you have access to these stakeholders? (Meaning, are they already in your network or can you easily get in contact with them)</b>	We could have access to all of them either directly or with UCD/DLR support.
<b>What do you need stakeholder feedback on? (e.g., a concept note, legislative processes, implementation plans)</b>	<ol style="list-style-type: none"> <li>1. Power Distribution Companies: grid infrastructure in the LL buildings, evidence about the impact of EV charging on that grid</li> <li>2. Charging Solutions Providers: technical specifications</li> <li>3. Site Managers: implementation plan, existing EV fleets, energy consumption patterns of each building</li> <li>4. Regulatory bodies: required legislative procedures and applicable standards</li> </ol>
<b>When do you need the information obtained via the stakeholder engagements?</b>	Ideally we should have at least a first feedback by M24
<b>Do you already have a plan for the stakeholder engagements?</b>	We are waiting for D7.2 to be submitted. There we will be able to check the LL preferences regarding these technologies, and after that we'll contact UCD/DLR to start gathering more specific information.
<b>Who are the end-users of the innovation?</b>	Staff working at the involved public buildings
<b>Do you have access to the end-users?</b>	We could have access to them through DLR
<b>What do you need end-user feedback on?</b>	<ul style="list-style-type: none"> <li>• Mobility preferences</li> <li>• Use patterns of each kind of vehicle</li> </ul>

<b>What stimuli do you have to show end-users? (e.g., a concept note, a wireframe, a prototype)</b>	Right now we just have a concept note per each technology involved in this innovation.
<b>When do you need the results from the user testing?</b>	To be defined
<b>Do you already have a plan for the end-user engagement (e.g., user testing, usability testing)?</b>	<p>First, the technologies will be deployed and tested at Cidaut facilities by expert and non-expert users, so that we have first feedback on them.</p> <p>After that, they will be deployed at its final location, to be tested by the end-users in real (daily) conditions.</p>
<b>Which Living Lab(s) are you expecting to implement in?</b>	Dublin

*Table 11: CIDAUT Responses to T2.3 Scoping Survey*

## 11 Conclusion

This deliverable summarized the Social and Behavioural Innovation plans that were drawn up based on the findings of the Stakeholder Analysis of D2.1, and on the scientific literature on behavioural insights that can be utilized in the PROBONO Living Labs.

The activities are designed to meet the specific needs of the Living Labs based on their individual characteristics, cultural and socio-economic circumstances. However, we also aim to make sure that across all Living Labs we cover all the aspects of a Green Building Neighbourhood. This is why, certain interventions, such as the Climate Change Awareness Assessment survey will be administered in all Living Labs. Although the approach is uniform, it is designed to understand the different attitudes and levels of knowledge and awareness in the different Living Labs, to avoid a “one-size-fits-all” approach at later stages.

Other interventions, such as the Geodesign is only utilized where it has most relevance: Dublin and Aarhus. These are the Living Labs where this approach has most value, as the creation of the neighbourhood has the most potential to be co-designed with the respective communities.

The deliverable offers insight to all other individual technological innovations and engagement plans that are tailored to the needs and resources of each Living Lab. It is important to note however, that this is a living document – meaning that many of the activities (e.g., CCAA and the Prague Experiment) serve the purpose of discovering complex systems within which the users of the neighbourhoods develop their behaviours and attitudes. Once we have this understanding, we will plan the next steps of interventions that will be based on the evidence gathered by these measures.



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## Annexes

# Annex 1: Discovery Event Report [SERCO]

## Context

In order to better assess how to develop a GBN with local actors already in place and with the “De l’autre côté de l’école” school at its centre, a Probono Discovery Event was held on the 9<sup>th</sup> of June at the school.

Out of hundreds of people contacted and out of 11 people confirming their presence, the following stakeholders attended the event.

- 2 owners and managers of a residence near the school
- 1 member of the school’s executive board
- 1 ACE project lead
- 1 teacher from the school
- 1 échevin (or town hall council member) in charge of Urbanism and Environment
- 1 citizen very engaged in local associations and the Commune’s life
- 1 student’s parent
- 1 Serco representative
- 4 members of the Probono project
- 1 member of the Renewable Energy Community project in Brussels

It is important to mention that no economic player or student attended the workshop despite solicitations. One short circuit business supplied the offered refreshments without taking part of the event. It is important to point out that the principal objective of the Discovery Event was to establish a basis for further discussion with the neighbourhood around the renovation aims of ACE and involvement in the project.

## Presentation of the project

Despite slides in English, the presentation has been mainly led in French. It first described briefly Serco’s green and sustainability credentials and thus, interest in Probono before digging into Probono and the opportunity for Auderghem through interaction with the project. As the Vias team was present, after addressing the main points and challenges, the presentation emphasized the local mobility issues and potential opportunities. Rather than an academic lecture, the presentation was more of a discussion. Each one could interrupt at any point to ask questions or raise concerns. It is important to point out that the main objective of the Discovery Event was to establish a basis for further discussion with the neighbourhood around the renovation aims of ACE and involvement in the project.

## Feedback and contributions from participants

After introducing Probono, the floor has been given to attendees. Three themes were therefore explored.

## **Local Mobility**

### **Carpooling**

As 18% of students (about 100) go to the ACE by car, carpooling has been discussed as a way to diminish both traffic jams and pollution. The ACE claimed that students were coming from all around the school, making this system hard to put in place. “Bicycle Buses” could be one solution, actual buses were however refused by the school’s principal.

### **Bicycling issues and pedestrian space**

Although there is an existing bicycle lane passing on Chaussée de Wavre, it is interrupted a bit before the school and continues a bit further. This interruption forces cyclists to either go on the crosswalk or on the road. Therefore, it represents at least an inconvenience and at most a hazard for cyclists.

In addition, the lack of pedestrian and green spaces has been mentioned as an issue. residents really want to report and address on both Chaussée de Wavre and its nearby streets.

### **Brussels entrance**

Auderghem is one of the main entrances in Brussels, which leads to lots of traffic. This represents a big discomfort for Auderghem residents due to a negative impact on noise and air quality. Some people proposed to create parking lots for people to leave their car at Brussels’ periphery and take public transport. However, as for the Chaussée de Wavre, the mobility plan is managed by the Region and not the Commune. Traditionally, which was emphasized in the discussion, there is often an impasse between the Region and the Commune on many issues.

### **Sanctions for speeding**

According to inhabitants, car drivers exceeding the speed limit on Chaussée du Wavre and Boulevard du Souverain are not really sanctioned.

### **Education**

Educating children and parents on the use of public transport by students was another way proposed to reduce car travels. Furthermore, in parallel with the school's pedagogy, co-creating with students will be essential in their education on the subject and the motivation in the project they will gain from their involvement.

Taking part in activities organized by Bruxelles Mobilité was recommended as a way of educating students and getting teachers involved. This is already foreseen by the school in the PDS programme (“Plan de déplacement scolaire”).

### **Green energies**

This topic has not been much explored by citizens and public authorities were not present anymore to discuss the subject. REC was not a concept people were aware of. Two topics have however been discussed:

### Photovoltaic panels

The implementation of photovoltaic panels on residents' roofs was described as not relevant. They declared energy would need to be used only for shared purposes which would be too low consumption to require a significant investment. Moreover, reselling energy produced by reintegrating it in the general energy alimentation network would be too costly. This might be more interesting for local businesses having a higher and personal electricity consumption.

### Local actions for cheaper energy

On the principle, the school and Palladio residence representatives agreed on the mutual interest local players could have to buy the other's surplus produced energy at a lower price than the market. Ways to diminish overall energy consumption could also be explored through deeper collaboration and coordination between neighbors around the school. This approaches the REC concept.

### Social synergies and conflicts

#### Relationship between Probono, the school and the neighbourhood

It has been clearly mentioned during the event that English was a barrier for some people to get involved in the Probono project. In addition to a limited comprehension of the Project itself, the use of a non-local language gives an impression of distance between a transnational programme and the local situation. It appeared to be not inclusive towards non-English speakers. It has also been said that the integrator, or the local project leader, should be a local, a Belgian, or at least a French speaker so they understand local challenges. To this it had been replied that because of its dimension, it was essential and was the only way that the integrator could work on such an international project.

Involving Auderghem's residents in the project through direct communication channels appears to be a major challenge.

In addition, the clarity of EU funding for the project was deemed insufficient by some.

Nevertheless, the few attendees present were convinced of the Probono benefits on the neighborhood. Therefore, they communicated their contacts, in accordance with the GDPR permission and ensured they desired to continue being part of the project. Moreover, most of them have social leverage power as members of associations or because of their personal contacts.

### Conflicts to overcome

The matter of student disturbances on the Commune Plaza did not seem to be a barrier to the collaboration between ACE and the Palladio residence surprisingly.

However, out of the 3 échevins and the town hall official expected, only one came despite priorly confirming their presence. At this stage, it seems that the Commune, although not opposed to the project, is reluctant to provide major help or support. Prior discussions have shown a concern towards private actors and projects which are not issued by local public authorities.

Finally, the Commune has no power of action when it comes to regional roads such as the Chaussée de Wavre and overall mobility plans. Finally, the reduction of green spaces in favor of

the construction of new buildings is a regional and national political choice aimed at lowering housing prices in Brussels. With these issues in mind, it will be even more important to involve them in future workshops with the various stakeholders, as the project will carry more weight with their support.

### Various social synergy opportunities

In the long run, nearby associations such as Le Potageois (a shared kitchen garden), Kid senders, Babelzin, Réseau Santé or the retirement house Domitys seemed to have the potential to become major partners for the ACE school in their green and social commitment. If there is a win-win situation for all parties, the school and the various associations, this will help them to get involved on a voluntary basis.

The proposition of events held by the school and opened to the whole neighborhood was very much appreciated by all attendees. The preferred event was a frippery opened to the neighbourhood. ACE has already organized some, but until now none have been open to neighbours.

The question of including Dutch-speaking neighbours in local events was also raised by participants. They indeed represent a quite significant part of the Auderghem people.

## Conclusion

As GBN starts with a community, this first event allowed us to make the first step towards a GBN in Auderghem. Neighbours who don't usually communicate directly and hardly ever collaborate were able, for the first time, to sit down together and see that they had common interests in shared mobility, a renewable energy community, preserving green spaces and creating social events in the neighborhood. It was discussed with the ACE principal and ACE project lead, with Serco and with others that a valuable and logical route forward for the Auderghem GBN with ACE at its centre, is for the current schedule of ACE events for the remainder of the school curriculum/year, should be used and extended to embrace wider and more useful neighbourhood dialogue and participation; the purpose being, establish a robust and sustainable mechanisms to build community and thus, build a GBN. This needs further and more detailed discussion and turning into hard actions. This is our next step for the Brussels LL.