periASTY

The periASTY LLs solutions and prototypical BIGMs and KPIs – the inception report

Project Deliverable D1.1



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Executive Summary

Deliverable 1.1 establishes the initial methodological and analytical basis for developing, demonstrating and evaluating climate-neutral solutions across the nine periASTY Living Labs (LLs). It integrates the review of peri-urban transition measures, the initial territorial and functional characterisation of the LLs, the first co-design cycle, the preparation of locally adapted Solution Concept Designs (SCDs) and prototypical Business, Innovation and Governance Models (BIGMs), and the preliminary Impact Evaluation Framework (IEF). Together, these outputs provide a common reference for the development of periInnovations in WP2 - periInnovate: Mobility, Energy, Industry, Governance, implementation and demonstration activities in WP3 - Implement, Demonstrate & Evaluate: the periASTY initiator LLs, and WP4 - Multiply, Demonstrate & Evaluate: the peri-ASTY responder LLs, and subsequent impact assessment, cross-fertilisation and replication in WP5 - Foster peri-urban cross-sectorial Governance, planning & capacity; Inspire, Disseminate & Exploit.

The territorial analysis identifies substantial differences in spatial structure, infrastructure provision and governance across the LLs. A common 250-meter grid and harmonised land-use categories support comparison, although differences in geographical boundaries and data completeness require cautious interpretation. The results can be clustered by sector according to the four periASTY categories:

- Mobility: Public Transport (PT) infrastructure is unevenly distributed, with concentration along urban centres and transport corridors. Stop density alone does not establish service accessibility, highlighting the need to consider network connections and travel needs.
- Energy: Recorded electric vehicle charging density ranges from 0.04 to 9.06 points per km2 across the assessed territories. Relevant energy assets also lie outside some LL boundaries, which indicates that local planning must consider infrastructure and dependencies in the wider regional area.
- Industry: The mapped evidence identifies spatial mismatches between industrial activity and circular-economy, particularly in Marseille and Kalamata. Information on net-zero technology deployment is available only for one LL, limiting therefore the assessment of industrial decarbonization.
- Governance: The analysis identifies responsibilities distributed across municipal, regional and national authorities, often without a dedicated peri-urban governance structure. Implementation therefore requires coordination across administrative boundaries and sectors, supported by clearly defined responsibilities.

To translate the measures initially defined in the Grant Agreement into locally grounded solutions, a common co-design methodology was applied across all LLs. The methodology combined accessible workshop canvases with extended post-workshop templates covering the solution concept, user journey, implementation pathway, stakeholder ecosystem, governance, financing and risks. The first cycle clarified target users, expected operation, implementation requirements and actor responsibilities, while making unresolved assumptions and dependencies visible. The workshops also generated practical methodological lessons. Their effectiveness depended on the maturity of the measures, the number of interventions addressed, the availability of relevant stakeholders and technical information, and the time allocated to measure-specific discussion. Across the LLs, implementation readiness was found to depend on more than technical feasibility. Permits, operator commitments, data-sharing arrangements, financing, infrastructure ownership, maintenance responsibilities and user acceptance frequently remain decisive enabling conditions. The BIGMs provide a structured basis for addressing these organisational, governance and financial dependencies alongside technical development.

The preliminary IEF translates the expected results of the measures into LL-specific KPIs covering mobility, energy, industry and governance. It defines consistent baseline, mid-term and final measurement stages and combines official statistics, operator records, Geographical Information System (GIS) analysis and stakeholder surveys. Preliminary baselines have been calculated where sufficiently reliable information was available. Additionally, nine tailored questionnaires have been

developed to assess social acceptance, behavioural change, user experience and organisational readiness before and after implementation.

Overall, D1.1 establishes a traceable connection between territorial evidence, stakeholder-informed solution design, implementation arrangements and measurable outcomes. The SCDs, BIGMs and IEF will remain evolving working references, refined through technical development, targeted stakeholder follow-up, demonstration experience and monitoring.

Key words

Peri-urban climate neutrality; Co-designed solutions; Impact evaluation.

List of Abbreviations and Acronyms

Acronym	Meaning
AI	Artificial Intelligence
AVL	Automatic Vehicle Location
BIGMs	Business, Innovation and Governance models
BIOPA	Biotechniko Parko
BMs	Battery Management Systems
BZOB	Bedrijventerrein Zuid-Oost Brabant
cap	capita
CCAM	Connected, Cooperative and Automated Mobility
CCC	Climate City Contract
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CH_4	Methane
CMO	Contexts, mechanisms and outcomes
CO_2-eq	Carbon dioxide equivalent
Codema	City of Dublin Energy Management Agency
CRS	Coordinate Reference System
D	Deliverable
dmnl	dimensionless
DRT	Demand-Responsive Transport
DUJPP	Družba za Upravljanje Javnega Potniškega Prometa
E	periASTY energy measure
EAC	Electricity Authority of Cyprus
EEA	Environmental European Agency
EMEL	Eteria Metaforon Lemesou
EMS	Electronics Manufacturing Services

E-PRTR	European Pollutant Release and Transfer Register
eq	equivalent
EV	Electric vehicle
FDI	Functional Diversity Index
FODSA	Foreas Diacheirisis Stereon Apovliton
FUA	Functional Urban Areas
G	periASTY governance measure
GA	Grant Agreement
GDPR	General Data Protection Rule
GHG	Greenhouse Gas
GIS	Geographical Information System
GPS	Global Positioning System
GTFS	General Transit Feed Specification
hh	household
HILUCS	Hierarchical INSPIRE Land Use Classification System
ICT	Information and Communications Technology
IEF	Impact Evaluation Framework
IN	periASTY industry measure
IoT	Internet of Things
kg	kilogram
km	Kilometre
KPI	Key Performance Indicator
kWh	Kilo-Watts per hour
LEC	Local Energy Communities
LGDs	Local Green Deals
LL	Living Labs
ln	Napierian Logarithm

LUR	Large Urban Region
M	periASTY mobility measure
MaaS	Mobility as a Service
Min	minute
MOP	Ministrstvo za Okolje in Prostor
NO_2	Nitrous dioxide
NDA	Non-Disclosure Agreement
NGO	Non-Governmental Organisation
org	organisation
OSM	OpenStreetMap
PT	Public Transport
PV	Photovoltaic
RP	Reporting Period
SCD	Solution Concept Design
SEAI	Sustainable Energy Authority of Ireland
SMEs	Small and medium-sized enterprises
SUMP	Sustainable Urban Mobility Plan
t	tonne
T	Task
TTI	Time Travel Index
VRUs	Vulnerable Road Users
WP	Work Package

1. Purpose of the Deliverable

1.1. Attainment of the objectives and explanation of deviations

1.1.1. Objectives of the Deliverable 1.1

D1.1 directly contributes to periASTY Objective O1, which aims to set the ground for understanding urban-peri-urban dynamics and to engage citizens and stakeholders in the co-design of mobility, energy and industry concepts together with the business and governance arrangements needed for climate-neutral transition. The deliverable operationalises this objective by combining the evidence assessment and Living Lab characterisation with measure-level co-design, SCD and BIGM development, KPI definition and baseline setting. In doing so, it provides the common reference required for the subsequent advancement of periInnovations in WP2, their implementation and demonstration in WP3 and WP4, and their monitoring, evaluation and replication in WP5. D1.1 therefore functions as the first integrated checkpoint linking the initial WP1 analytical work with the project's later Innovate-Demonstrate-Scale-up stages.

The report consolidates the work carried out during the first project months to establish the methodological and analytical basis for the periASTY Living Labs: the stock of climate-neutral measures, the initial analysis of the Living Lab contexts, the common co-design methodology and supporting tools, the first co-designed solution concepts and prototypical BIGMs, and the preliminary impact-evaluation framework including KPI definitions and baseline calculations. Where individual measures, datasets or Living Lab inputs are not yet sufficiently mature, these are explicitly identified as work in progress and will be completed through the iterative development and validation activities foreseen in the project. The objectives associated with D1.1 have therefore been substantially achieved in accordance with the inception scope of the deliverable.

1.2. Intended audience

This deliverable is primarily addressed to both internal consortium members and external stakeholders involved in the planning, implementation, and replication of peri-urban climate neutrality solutions. Within the consortium, the main audience includes all partners contributing to WP1 (Shed light & understand the periASTY LLs & multisectoral governance complexity), as well as those involved in WP2–WP5, who will use the outputs of this deliverable as a foundational reference. In particular:

- LL partners (WP3 and WP4) will rely on this document to guide the co-design and implementation of solutions.
- Technical partners (WP2) will use the initial solution concepts and BIGMs as a basis for further development of periInnovations
- Impact and evaluation partners (WP5) will build upon the preliminary KPIs and IEF defined herein.

Beyond the consortium, this deliverable is relevant to a **broader set of stakeholders**, including:

- Local and regional authorities in peri-urban areas, particularly those involved in the EU Mission on Climate-Neutral and Smart Cities.
- Urban planners, mobility and energy agencies, and public service providers engaged in sustainable transition processes.
- Industry stakeholders and SMEs interested in business and governance models for peri-urban innovation.
- Research and academic communities working on climate neutrality, integrated urban-peri-urban systems, and Living Lab methodologies.
- Replication cities and territories, especially the periASTY "Responder" Living Labs, and observer cities and other European regions seeking to adopt similar approaches.

Furthermore, this deliverable contributes to **knowledge transfer and policy support**, providing structured insights into:

- Climate-neutral solution design in peri-urban contexts
- Integrated evaluation frameworks and KPI systems
- Co-creation and stakeholder engagement methodologies

As an inception and framework-setting document, D1.1 is intended to serve as a **reference baseline** for subsequent project activities and deliverables, ensuring alignment across work packages and facilitating the scalability and transferability of periASTY solutions.

1.3. Structure of the Deliverable and links with other work packages/deliverables

D1.1 ensures a coherent starting point for the project, aligning technical development, Living Lab activities, and impact assessment under a shared framework. It acts as a bridge between early-stage analysis and subsequent co-creation, implementation, and evaluation phases, ensuring consistency and traceability throughout the periASTY project lifecycle.

Table 1. Overview of section contributions and interdependencies.

Section	Content Focus	Related Task(s)	Main Outputs	Links to Other WPs / Deliverables
2	Stock of climate-neutral measures	T1.1	Evidence-based stock of measures, barriers and sectoral/cross-sectoral findings	Provides evidence and requirements for WP2 periInnovations and LL solution refinement
3	Analysis of the periASTY LL	T1.2	Initial FUA characterisation and urban-peri-urban interaction analysis	Contextual basis for WP2 development and WP3/WP4 implementation
4	Co-design methodology, workshop design and supporting tools	T1.3	Common co-design workflow, workshop guideline, SCD/BIGM templates and validation process	Methodological basis for LL co-creation in WP3/WP4 and solution development in WP2
5	Initial SCDs and prototypical BIGMs	T1.3	Measure-level initial SCDs/BIGMs and cross-LL findings	Input to WP2 technical refinement, WP3/WP4 demonstrations and exploitation/replication activities
6	Preliminary IEF	T1.4	IEF logic, KPI definitions, baselines and data-collection framework	Core monitoring reference for WP3/WP4 impact evaluation and WP5 assessment
7	Co-creation and social exploration plan	T1.3 / T1.6	Stakeholder-engagement logic and interface with social-embracement exploration	Supports continued co-creation in WP3/WP4 and feeds solution refinement and social evaluation
8	Monitoring, evaluation and adaptive framework	T1.6	Questionnaire-based monitoring of social embracement, behaviour and user experience	Feeds WP2 refinement, WP3/WP4 demonstration monitoring and WP5 impact/roadmap activities

9	Knowledge exchange and transferability framework	T1.7	Cross-fertilisation, replication logic and initial transferability framework	Supports peer learning, responder LLs adaptation and WP5 upscaling/replication
Annex	Inception Excel file and KPI datasets --- Questionnaire Example	T1.3 / T1.4 --- T1.6	Structured solution, KPI and baseline information plus supporting datasets --- Example based on the Helmond questionnaire	Reference dataset used across technical development, demonstrations and evaluation --- Feeds WP2, WP3, WP4 & WP5

1.4. Contribution of Partners

D1.1 integrates contributions from the partners responsible for the main WP1 methodological strands and from the Living Lab teams that supplied local inputs, workshop outputs, solution development information and KPI baseline data. The principal drafting and coordination responsibilities are summarised below:

Table 2. Contribution of Partners to D1.1

Role - Contributions	Partner
Lead beneficiary and responsible for D1.1. Coordinates T1.3 and T1.4 contributions, develops the common co-design methodology and SCD/BIGM reporting approach, consolidates Living Lab outputs, and develops the preliminary IEF, KPIs and baseline methodology. **Section 4, 5 & 6**	CARTIF
Contributes to the WP1 methodological framework and Living Lab application, supports the analysis and consolidation of responder-Living-Lab inputs (WP4), and contributes to monitoring, evaluation and cross-Living-Lab consistency. **Section 2**	TUE
Leads the FUA development and planning-model work and contributes the spatial and urban-peri-urban analytical perspective used to characterise Living Lab contexts and link the inception analysis with subsequent land-change and planning models. **Section 3**	UCD
Leads T1.7 and contributes the cross-fertilisation, knowledge-exchange, replication and transferability framework, including the organisation of peer-learning and exchange activities across the Living Labs. **Section 9**	EPF
Contributed to T1.1 and T1.2 analyses, supported the co-design and technical definition of LL solutions and BIGMs, and led T1.6 activities on social embracement, user experience and behavioural-change assessment through questionnaire-based tools. **Section 8**	NTUA

2. Stock of Climate-Neutral Measures

This section aims to provide a stock of effective climate-neutral measures for peri-urban areas. The first step begins by acknowledging that peri-urban areas are often marginalized because sustainable transitions or experimental governance initiatives often stop at the boundary between urban and peripheral areas. Although diverse initiatives have been proposed to address the climate crisis and make cities more sustainable and liveable, they are often tested in urban cores or highly populated residential areas. These areas provide a favourable test bed, as new technologies can be introduced relatively quickly among younger and highly educated populations and, over time, successful initiatives can be adopted more widely and scaled up. However, this tendency limits the potential for peri-urban areas to contribute to more fundamental and transformative changes in how we live, move, work, and consume.

Peri-urban areas are exposed to a range of environmental, social, and economic challenges that are closely linked to their specific characteristics. However, these impacts can vary considerably across individuals and neighbourhoods with different socio-economic backgrounds. For instance, the needs of those who choose to live in peri-urban areas in search of more affordable housing and convenient commuting options may differ from those who seek more spacious and quiet residences with access to green spaces. At the same time, industrial and logistical activities that occupy significant space and resources in peri-urban areas result in a disproportionate environmental burden to residents. To adapt and better tailor existing sustainable alternatives and innovations to peri-urban areas, firstly the common challenges associated with their transition towards more sustainable mobility, energy, industry, and governance systems were analysed. Following this sectoral analysis, both positive and negative societal outcomes for residents, commuters, and other population groups were identified. This analysis is essential to ensure that no one is left behind and that the transition does not create a socio-economic divide between those who can afford sustainable choices and those who cannot. Based on this screening, cross-sectoral issues and governance challenges, together with potential mitigation strategies were identified. In the following section, the methodology is explained, which is based on a rapid realist review.

2.1. Methodology for stock of measures

A Rapid Realist Review approach was adopted to identify the contexts, mechanisms, and outcomes (CMO) of the measures originally included in the project proposal and planned for implementation by the participating cities. In the following sections, the use cases in periASTY are referred to using the original codes of each measure assigned in GA across the nine LLs; Dublin (DU), Limassol-Kourion (KOUR), Marseille (MRS), Ljubljana (LJ), Guimarães (GM), Helmond (HM), Kalamata (KM), Sofia (SM), Sisslerfeld (SF). These measures are assessed not only in terms of their contribution to climate neutrality, but also with regard to their potential societal outcomes, including any anticipated benefits or burdens that may disproportionately affect specific population groups.

Table 3. Types of measures analysed in periASTY

Mechanisms	Definition
Behavioural	measures that seek to influence, shape, or shift the decisions, habits, and norms of end-users/citizens in a (semi-)voluntary manner through information campaigns, social and economic incentives or disincentives.
Technological	measures that promote or enable the development, deployment, or upgrading of technologies; including those relating to underlying economic and infrastructural conditions.
Governmental	measures that establish, modify or create institutional frameworks and operate through formal (public authority) structures, including legislation, regulation, governance arrangements, (citizen) participation and political decision-making processes.

Following the initial analysis, the cities were invited to review and validate whether the identified CMO configurations were adequately captured and to provide further input on any specific geographical contexts relevant to each individual city. Validated measures were then categorised into four sectors;

mobility, energy, industry, and governance to identify common challenges and risks across different living labs. Building on this, a second round of analysis was conducted by academic partners who have expertise in specific sector, to understand how similar challenges are addressed through different measures, as well as how comparable measures are conceptualised, planned, and evaluated in various ways (Section 2.2).

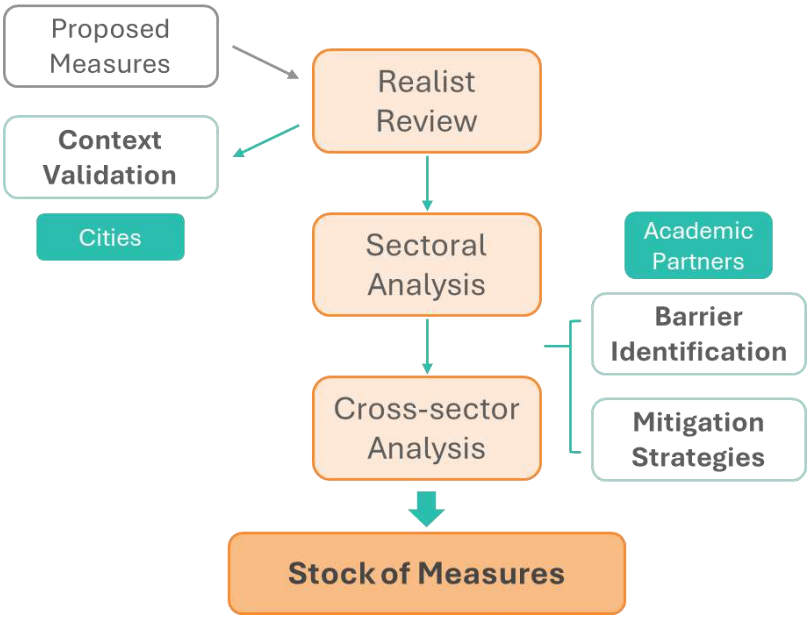


Figure 1. Measure analysis scheme

2.2. Sectoral Analysis

2.2.1. Mobility

One of the most pronounced mobility challenges in peri-urban areas is the high reliance on private cars. Across the Living Labs, a central climate-neutral mobility objective is to shift trips from private cars towards public transport and shared electric (micro)mobility. In the longer term, such a modal shift could reduce private car ownership and significantly lower transport-related emissions. However, achieving this transition requires addressing the structural conditions that currently make private car such a convenient or viable option. Commonly identified barriers to more sustainable travel in peri-urban areas include inadequate cycling and pedestrian infrastructure (2.2.1.1) and limited coverage and availability of public transport services (2.2.1.2). Improving connectivity between different transport modes and services is therefore essential to provide attractive alternatives for commuting and everyday mobility. At the same time, ensuring equitable access to essential services such as healthcare and education is critical for an inclusive sustainable mobility transition. In other words, providing mobility alternatives that offer comparable levels of flexibility and accessibility to private, mostly fossil-fuelled, cars are particularly important in peri-urban contexts.

These challenges become particularly critical in the context of persistent inequalities in infrastructure and investment between urban and peri-urban areas. Stricter environmental regulations are often introduced in urban centres (e.g. low or zero emission zones), while there is a risk that such measures may contribute to the relocation of more polluting activities towards peripheral areas, including industrial zones. At the same time, less restrictive conditions in peri-urban areas may reinforce reliance on fossil-fuelled vehicles. Such dynamics can create uneven environmental and mobility burdens across populations. Providing more coherent and effective sustainable mobility alternatives is therefore essential for strengthening integration between urban cores and peripheral areas. This includes improving the quality, coverage, frequency, and connectivity of public transport, as well as enabling smooth and reliable transfers between services.

Most importantly, technological solutions and policy interventions need to be tailored to the socio-demographic characteristics and mobility needs of peri-urban populations. Many proposed and tested measures for sustainable peri-urban mobility focus on increasing the uptake of cycling and micromobility, particularly for first- and last-mile trips to transport hub such as bus or train station. Yet, these interventions can encounter significant social, and behavioural barriers among both users and stakeholders. Financial support and incentives may help make cycling and shared mobility more affordable, particularly for lower-income households, and can contribute to mitigating transport poverty. However, affordability alone may not be sufficient to induce sustained behavioural change. Users need to be actively engaged with, and develop trust and confidence in, the new services and mobility options. On the one hand, adequate infrastructure that enables cycling and walking to be perceived as safe and viable alternatives is essential. On the other hand, the role of digital technologies in accessing flexible or on-demand mobility services needs to be understood as both an enabler and a potential barrier for peri-urban populations. While digital tools can improve access to and coordination of these services, overly complex or unreliable interfaces may discourage potential users who are otherwise willing to change their travel behaviour. User-friendly interfaces, clear information, and appropriate assistance are therefore important to ensure that digitalisation supports rather than constrains the uptake of more sustainable mobility options. Sustainable mobility transitions in peri-urban areas, in other words, require not only investment in infrastructure and new technologies, but also attention to usability, trust, accessibility, and behavioural adaptation.

2.2.1.1. Improve cycling and/or walking experience

This subsection presents the main challenges related to improving cycling and walking in peri-urban areas, together with the corresponding measures, implementation mechanisms, and intended objectives identified across the Living Labs.

Table 4. Cycling & Walking challenges – Associated Measures and their aims

Categories	Mechanism	Aim	Description	Relevant measures
Improve the Safety of Cyclists and Pedestrians	Technological	Aid safe navigation for pedestrians or cyclists	Passenger Routing Tool or crowdsourced software solution to examine and analyse pedestrian infrastructure.	DU-M3 KM-M3 GM-M2
	Technological; Infrastructural	Identify areas where infrastructural intervention is needed	Algorithmic or AI generative tool to unpick areas or intersections with higher accident rates	
	Infrastructural	Physical improvement of walking conditions	Priority setting among infrastructural intervention informed by data	
Improve the first/last-mile connectivity	Behavioural	Increase the uptake of cycling in functional urban areas (FUAs)	Extend the shared-mobility scheme such as e-bikes or e-scooters and its coverage outside city centres	DU-M1 MRS-M1 SM-M1
	Behavioural; Technological	Address mobility poverty by providing affordable mobility alternatives to private vehicles	Promote multimodal trip combining micromobility fleet and improving the coverage and timing of existing bus services.	LJ-M3

2.2.1.2. Fragmented Transport-Connectivity

Main challenges related to improving transport connectivity in peri-urban areas, together with the corresponding measures, implementation mechanisms, and intended objectives identified across the Living Labs.

Table 5. Transport Connectivity challenges – Associated Measures and their aims

Categories	Mechanism	Aim	Description	Relevant measures
Optimize Public Transport scheduling	Technological	Improve the connectivity of existing public transport services for peri-urban area	Simulation models to assess the fixed routes and bus stops and optimize reliability and coverage of public transport.	KOUR-M3 KM-M2
Transit hubs to enable easier and seamless multimodal trips	Technological	Provide reliable transfers between transport modes and make them into a coherent and connected journey	Synchronize the schedule between urban and peri-urban routes with the regular update of multimodal demands and availabilities.	HM-M2 DU-M2 SM-M2 LJ-M2 KOUR-M3
Demand-Responsive Transport (DRT) to fill the gap in public transport services	Technological; Behavioural	Improve the frequency and flexibility of fixed routes connecting urban and peri-urban	A local micro-transit for commuters and tourists, providing regular and reliable connection between centre and industrial zones.	KOUR-M4
	Technological; Governmental	Provide access to healthcare or educational services	(Shared) On-demand transit services for people with disabilities, families with care duties, or lower-income households	KM-M1 KOUR-M1 LJ-M1
	Technological	Enhance integration of DRT with the broader transport network	DRT complements regular transport services by reducing system fragmentation.	GM-M1
Connected, Cooperative and Automated Mobility (CCAM) Shuttle	Technological; Governmental	Integrate CCAM into existing road infrastructure and multimodal trips	Expand the coverage of CCAM from a specific route to a larger area, connecting city centre and various mass transit hubs including train stations	HM-M1 HM-M3

2.2.2. Energy

The overarching climate-neutrality goal of the energy transition is to reduce fossil-fuel consumption while encouraging and incentivising more efficient use of locally generated renewable energy. In peri-urban areas, this involves both community-based approaches to sharing and balancing energy across the local grid and more conventional, technology-driven approaches to optimise grid use and reduce peak-load stress, especially for industrial activity. Both approaches are important for accommodating variable renewable energy sources and the increasing deployment of individually owned or maintained solar panel systems. Better integration of these distributed resources also has the potential to reduce the need for disproportionate expansion of energy infrastructure in peri-urban areas. Despite the potential of these measures to support climate-neutral energy transitions, their implementation in peri-urban areas may face economic, social, and behavioural barriers. These challenges are particularly important in ensuring that the benefits and costs of the transition are distributed equitably between urban cores and peripheral communities.

First, community-driven decarbonisation and local renewable energy initiatives may encounter unequal participation and slow uptake. This highlights the importance of assessing not only the technical and economic feasibility of energy transition measures, but also systematically identifying who can participate, who benefits, who bears the costs, and which groups may be unintentionally excluded. Contemporary ‘smart’ energy technologies can themselves become barriers for some residents, including older people, migrants, and others with limited digital literacy or familiarity with new

technologies. This could reinforce existing inequalities in energy performance as well as inequalities in residents' capacity to participate in and influence decarbonisation processes. Simplified onboarding processes, accessible information, and non-digital participation channels with local facilitator can therefore be important for ensuring broader engagement. These considerations are also important in relation to energy sufficiency. Decarbonisation should not shift the burden of transition onto those with the least capacity to reduce consumption. Energy sufficiency measures therefore need to be designed around maintaining adequate access to essential energy services rather than simply imposing reductions in energy use. This is particularly relevant for vulnerable households, older residents, people with health-related energy needs, and small businesses with limited flexibility in their energy demand.

The pursuit of more self-sufficient local energy systems and additional energy-sharing or trading schemes, in other words, should not inadvertently create new forms of exclusion. Alternative governance and redistribution mechanisms, such as social tariffs, solidarity shares, or explicit inclusion rules for underrepresented groups, could help address this risk. Given the demographic and socio-economic diversity of peri-urban areas, particular attention should be given to households that cannot afford to invest in renewable generation, energy storage, smart technologies, or energy-efficient buildings. Energy transitions often require relatively high upfront investments, creating a significant participation gap between already organised, property-owning, and higher-income actors and those with fewer opportunities to participate or benefit, including tenants and lower-income households. Shared ownership schemes, collective self-consumption models, and dedicated support for households without rooftop access could help broaden participation. Persistent inequalities between urban and peri-urban areas, as well as within peri-urban communities themselves, can otherwise result in low uptake, particularly where the success of local energy communities depends heavily on existing social networks, property ownership, or individual investment capacity.

Second, peri-urban areas differ from more compact urban areas in their lower population density and heterogeneous building stock. The dispersed and diverse nature of buildings can increase the upfront and operational costs of deploying renewable energy and energy-efficiency infrastructure. The challenge should therefore be considered beyond retrofit costs alone. Tenants, low-income households, and hard-to-retrofit buildings may be at greater risk of being deprioritised. At the same time, the deployment of distributed renewable energy and new forms of energy sharing needs to be aligned with the physical capacity and reinforcement of the local grid. Rapid deployment without sufficient consideration of network constraints could create new bottlenecks rather than resolving existing peak-load pressures. A phased deployment linked to grid reinforcement and local capacity may therefore be necessary. In this context, reducing overall energy consumption and promoting energy sufficiency should complement technological decarbonisation through behavioural change and demand reduction.

Third, limited flexibility in energy demand represents another potential barrier. Businesses and other actors with rigid energy requirements may have limited capacity to shift consumption in response to dynamic pricing, local renewable energy availability, or shared energy schemes. Rather than assuming that all users can provide the same degree of flexibility, participation models could differentiate between households, SMEs, public actors, and industrial users according to their energy needs (Kluskens et al., 2024), technical capacity, and characteristics of their building stock. Different forms of compensation for flexibility could also be considered to reflect these differences. Such arrangements would need to be communicated transparently to participating actors, particularly regarding how benefits and costs are allocated. Standardised contracts, transparent benefit-sharing mechanisms, and neutral intermediaries could help build trust and reduce the complexity of participation.

Overall, a transition centred primarily on technological uptake risks benefiting better-resourced households, property owners, and communities while leaving more vulnerable groups behind. Sustainable energy transitions in peri-urban areas, therefore, should be less about continuously increasing renewable energy supply to meet current or growing levels of consumption, and more about making the energy system more efficient, flexible, and integrated across generation, storage, sharing, and demand management. The effectiveness of local energy communities, distributed generation, flexibility mechanisms, and energy-efficiency measures ultimately depend on whether they can be embedded in governance arrangements that recognise the unequal capacities of different actors to participate and benefit.

Table 6. Energy challenges – Associated Measures and their aims

Categories	Mechanism	Aim	Description	Relevant measures
Local Energy Communities (LEC)	Behavioural; Governmental	Empower residents to transition to clean energy use by forming LEC.	Provide a platform to discuss energy needs and challenges and further support in collectively investing in clean energy	DU-EN1
Local Energy Sharing Scheme	Behavioural	Facilitate sharing the heavy grid connection of LEC with industrial actors and public entities	Promote BMs that integrate energy storage solutions and dynamic energy pricing for additional revenue	HM-EN2
Energy Optimization and Management	Behavioural; Technological	Reduce the peak load stress and enhance grid efficiency in peri-urban areas, particularly concerning industrial and business use	Balance between energy generation and consumption, using simulation modelling or dynamic pricing	SF-EN1 HM-EN3
Expansion of renewable energy supply	Infrastructural	Decarbonize the regional grid, loaded by heavy industrial use	Implement large-scale solar energy generation and battery energy storage solutions.	HM-EN1
Energy sufficiency strategy	Behavioural; Governmental	Reduce base energy demand and support peri-urban sustainable energy transitions.	simulation of sufficiency measures and scenarios, including within residential, industrial and business sectors	SF-EN2

2.2.3. Industry

Peri-urban areas, particularly those characterised by concentrated industrial activities, face several challenges in moving from conventional waste and resource management towards more circular systems. Existing practices often rely on awareness campaigns and educational initiatives to encourage better waste segregation and reduce dependence on landfill disposal. However, awareness alone does not necessarily translate into sustained circular practices, as stakeholders have limited tools and mechanisms to facilitate the retention of materials within local or regional supply chains. Fragmented coordination, limited information on the availability and quality of reusable materials, and weak connections between material supply and demand can therefore hinder the uptake of circular economy practices. Clear safety, liability, and quality requirements, including appropriate certification or quality assurance procedures for recovered materials, therefore, can be effective to build confidence and facilitate reuse. Digital marketplaces and material-sharing platforms can further help address these information gaps by making material flows more visible, traceable, accessible, and predictable. Yet, their effectiveness depends on establishing trust in the quality and reliability of secondary materials.

To ensure that reusable materials reach potential users, it is essential to have stronger coordination between waste operators, businesses, and construction activities, particularly to align material availability with demand and minimise unnecessary transport, warehousing, and handling. In peri-urban areas, these challenges can be amplified by dispersed economic activities, fragmented infrastructure, and longer transport distances, which make coordination more difficult and increase both the environmental and economic costs. This may be particularly challenging for SMEs, which often have more limited financial, technical, and organisational capacity to invest in new sustainability practices, despite potentially having a strong demand for affordable secondary materials. Potential mitigation strategies could include conducting pre-demolition audits or developing material inventories to identify the type, quantity, quality, and expected availability of recovered materials in advance, thereby making coordination more feasible within timelines. The appointment of a trained reuse coordinator within an industrial area or cluster could further support the planning and coordination of material flows, connecting material suppliers with potential users and helping align reuse opportunities with construction schedules.

The transition also requires moving beyond technological solutions towards changes in organisational practices and capabilities (Raghu & Rodrigues, 2020). New waste management systems, circular economy models, and digital interfaces may require additional technical competences, staff capacity, and coordination, which can be particularly challenging for firms with limited financial, technical, or human resources. Similarly, the increasing use of digital platforms and Internet of Things (IoT) technologies, including apps, tagged bins, and web-based marketplaces, can improve efficiency and coordination (Lakhouit, 2025) but may create additional barriers for workers and organisations with lower digital competence or limited capacity to acquire the necessary skills. This creates a risk that circular economy practices become easier and more affordable for larger or better-resourced organisations to implement, while smaller firms face disproportionate costs and responsibilities. Skills and capacity-building for key personnel, combined with accessible on-site support, can help organisations engage more effectively with circular systems and reduce coordination difficulties or disputes between actors. Governance arrangements that link the use of industrial space with mobility patterns and energy consumption should further help coordinate these interdependencies, avoiding bottlenecks and preventing new requirements from shifting excessive responsibilities onto specific actors. The objective should therefore not simply be to increase recycling or introduce digital circularity platforms, but to establish reliable, inclusive, and economically viable systems in which materials can circulate with minimal additional environmental and organisational burdens.

Table 7. Industry challenges – Associated Measures and their aims

Categories	Mechanism	Aim	Description	Relevant measures
Smart Waste Management System	Technological; Governmental	Optimize waste collection and recycling processes in industrial and peri-urban areas	Develop and/or deploy digital technologies or IoT to improve the efficiency and routing of waste / bin collection	KM-IN1 KOUR-IN2
Circular Economy Marketplace	Governmental; Behavioural	Facilitate industrial actors to exchange or reuse industrial and commercial waste as valuable inputs	Private and public actors can exchange, sell, buy, or donate waste generated during construction projects or production process	KOUR-IN1 KOUR-IN4 MRS-IN1
Local Green Deal	Governmental; Behavioural	Turn high-level environmental targets into practical, collaborative actions co-created by local governments, businesses, and citizens.	Co-design the climate-neutral pathway with local actors including chambers, utilities, worker representatives and other public and private entities.	KOUR-IN3 MRS-IN2 GM -IN1 KM-IN2

2.2.4. Governance

Peri-urban areas face a combination of institutional gaps, differences in access to data and technical capacity, and difficulties in planning and implementing sustainable transitions while ensuring meaningful citizen/stakeholder engagement. Local governance capacity can be more limited precisely in those areas where place-based approaches are most needed, particularly at the boundaries between different administrative authorities. At the same time, national and regional policies often apply standardised approaches that do not fully account for territorial differences. At the FUA level, this can create an imbalance between urban and peri-urban areas in terms of decision-making capacity and their ability to negotiate and shape shared priorities. Without clear mechanisms to ensure the representation of peri-urban areas, and cooperation frameworks that recognise their different demographic, socio-economic, and spatial characteristics, sustainable initiatives may unintentionally reproduce existing inequalities. In particular, there is a risk that urban-core priorities take greater prominence in joint agendas, while peri-urban areas are mainly consulted or treated as functional spaces supporting the needs of the urban core. Strengthening governance capacity is therefore important to ensure that peri-urban authorities and communities have a genuine role in shaping priorities and decisions, through approaches that are appropriate to the peri-urban context and can be scaled across different areas.

One of the most prominent challenges is the unequal access to data, technical expertise, and institutional resources needed to inform sustainable decisions across sectors. Larger municipalities are often better equipped to adopt data-driven planning, manage and participate in cross-sectoral governance, while smaller municipalities and community organisations may struggle to collect, store, and process data that adequately represents the diverse profiles of households and businesses in their areas. Without careful consideration of the heterogeneity between urban and peri-urban areas, there is a risk that data-driven approaches reproduce existing inequalities. For example, through straightforward comparisons of numerical indicators, the use of algorithms to predict future demand, or the integration of AI into planning and governance, underlying data gaps only get reinforced. Alternative ways of understanding and representing peri-urban areas are therefore needed, not only to ensure that planning responds to the current and future needs of residents and businesses but also to better engage citizens who play a central role in behavioural change and the transition. At the same time, it should be noted that community-led approaches require considerable time and resources to build relationships, develop local capacity, and support meaningful participation.

This also changes how low stakeholder engagement should be understood. Limited participation should not necessarily be interpreted as a lack of interest or willingness to engage. In some peri-urban areas, it may reflect practical barriers associated with dispersed residential areas, mobility constraints, digital exclusion, or limited organisational capacity, but it may also reflect distrust resulting from previous experiences of being planned 'for' rather than planned 'with'. There is also a risk that participatory platforms primarily attract well-organised actors, such as developers, utilities, and large employers, while precarious tenants, informal workers, or recently arrived (im)migrants remain underrepresented. Inclusive participation therefore needs to be built into governance processes from the beginning, with accessible offline participation routes integrated alongside digital channels, proactive outreach to underrepresented groups, and clear feedback on how stakeholder input has influenced decisions. In this way, cross-sectoral governance can move beyond simply coordinating existing actors and instead help address the institutional, territorial, and social inequalities that influence who has the capacity and opportunity to shape the transition.

Table 8. Governance challenges – Associated Measures and their aims

Categories	Mechanism	Aim	Description	Relevant measures
AI cross-sectoral data warehouse	Technological; Governmental	Integrated governance across FUA	A digital twin platform integrating data from mobility, energy and other available sources from the peri-urban and urban areas	KOUR-G1
Data-Driven Decision-Making and Monitoring Framework	Governmental	Governance framework to ensure fair and just decision making for sustainable peri-urban areas	Develop algorithms or platform in which real-time data is accessible to support data-driven decisions	HM-G1

2.3. Cross-sectoral Analysis

2.3.1. Digital as a Facilitator and Barrier across sectors

Across the proposed measures and sectors, digital and "smart" technologies increasingly function as an important enabler of sustainable transitions in peri-urban areas. Digital tools can improve the coordination and efficiency by streaming real-time data, particularly in mobility and energy systems. Common examples are enabling multimodal trip planning, on-demand transport services, shared micromobility, dynamic energy management and local energy trading. In some cases, digitalisation operates mainly as a backbone infrastructure that supports system optimisation without requiring continuous interaction from end users. In other cases, however, access to the transition is much more

directly mediated through digital interfaces. It is important to consider that the benefits of twin transition – green and digital – may depend not only on whether the technology is available, but also on whether residents and targeted users are able and willing to use it. When digital interface is deeply embedded in adopting and using sustainable technology, rather than merely an additional convenience, the risk is not simply lower uptake but the exclusion of particular groups from the transition process.

A digital barrier exists in participation and access to sustainable peri-urban transition, interacting with existing inequalities in mobility, infrastructure, income, and access to services. This is critical, particularly given heterogeneous socio-demographic characteristics of residents, including elderly and people with lower levels of digital literacy, or limited access to appropriate devices and connectivity. Digital booking systems for shared micromobility or on-demand transport, for instance, may improve multimodal connectivity but can simultaneously make access to these services conditional on using an app or online (payment) platform. Similarly, dynamic pricing, local energy trading and other digitally mediated energy-management technologies may reduce costs and improve energy efficiency – or for some, increase the engagement level – while making these benefits less accessible or indecipherable to residents who are unfamiliar with digital interfaces. Systems perceived as overly complex, unreliable, or insufficiently transparent may undermine users' willingness and trust, potentially resulting in technology fatigue, disengagement, or opting out. In the mobility context, this could reinforce continued reliance on private cars where users do not need to change their mobility patterns nor the use of digital technologies. In the energy context, households that are less able to engage with smart meters are less likely to benefit from flexible tariffs or energy-sharing schemes. In other words, digitalisation should not be treated as inherently 'smart' or 'simple' way of optimisation.

A just transition therefore requires digital technologies to be designed around accessibility and procedural fairness, rather than assuming universal digital competence. Practical mitigation strategies include default easy-to-use settings, alternative non-digital access channels where appropriate, and override functions that allow users to retain control over automated decisions or system recommendations. Greater transparency regarding how algorithms determine pricing, prioritisation, or access can also help users understand and contest outcomes, while a fairness lens can be used to identify and limit systematically unequal impacts. Importantly, monitoring should extend beyond overall system performance to examine who is benefitting, who is participating, and who is being left behind. Such monitoring can provide an early warning when digitalisation unintentionally reproduces existing peri-urban inequalities. The objective should therefore be not to avoid smart technologies, but to ensure that digitalisation remains an enabling layer of the sustainable technologies, rather than an embedded condition for participation.

2.3.2. Different target groups / mechanisms per policy sector

Sustainable transition measures differ considerably in their target groups and mechanisms across the four sectors of periASTY project; mobility, energy, industry, and governance. In the mobility sector, interventions are primarily directed towards individuals and households, with the transition often depending on changes in everyday travel behaviour and choices. Measures aimed at modal shift, electric vehicle adoption, or shared mobility, therefore, require users to recognise the relevance and convenience of alternatives and, in many cases, to change established mobility practices. The scale of intervention may be local, but intended outcome is often aggregated from changes in individual or household decisions, affecting the broader FUAs. By contrast, energy and industry-related measures typically involve businesses, local economic actors, industrial stakeholders, and infrastructure providers. These actors operate with different decision-making structures, operational constraints, and energy demands, meaning that their responses cannot necessarily be understood through the same behavioural lens as individual mobility choices. The transition in these sectors therefore requires coordination of resources, infrastructure, and production processes at a larger spatial and institutional scale, addressed with governance measures.

The different sectoral logics are particularly evident in measures related to electrification, even where the underlying technological objective is similar. For example, the electrification of mobility through electric vehicles (EVs) primarily involves individual purchasing, charging, and travel decisions, whereas electrification in energy-intensive businesses or industrial activities may require substantial investment in grid capacity, charging infrastructure, production systems, or industrial equipment. The table below

illustrates how a common transition objective can consequently translate into substantially different intervention designs, and target groups across sectors. This highlights the importance of governance as a coordinating mechanism that can connect otherwise fragmented sectoral interventions, align infrastructure and investment decisions, and ensure that measures do not work against one another. At the end-user level, however, this differentiated approach can make the overall transition difficult to understand, particularly when residents – i.e. commuters – and businesses encounter different rules, incentives, technologies, and responsibilities across sectors. A governance approach that provides clear communication while maintaining sufficiently targeted interventions can therefore help reduce this complexity. Targeted policy approaches, combined with adequate and differentiated financial support, can address the specific capacities and barriers of different actors while improving the overall uptake and effectiveness of the transition.

Table 9. Mechanisms and target group per policy sector

Categories		Mechanism	Aim	Description	Relevant measures
Energy x Mobility	Optimise EV charging to comply with grid constraints	Technological; Behavioural; Governmental	Incentivise when and where EVs should charge to avoid grid congestion and inefficient energy use	Coordinate EV charging with periods of renewable energy generation and lower electricity demand to reduce grid congestion and make better use of locally available renewable energy with dynamic pricing	HM-EN3 SF-M1 SF-M2 SF-M3
Mobility X Industry	Reduce CO_2 emissions within the industrial area by addressing gaps in commuting and logistics transport.	Technological; Behavioural; Governmental	Provide (shared) electric vehicles for passenger and freight transport	Integrate electric vehicles for industrial and commuting needs, improving access to sustainable mobility for low-income households and businesses.	HM-M1 MRS-M2 KOUR-M4
		Technological; Infrastructural; Governmental	Electrify (internal) industrial transport	Transition internal transport systems, including forklifts and reach trucks, from gas-powered to fully electric alternatives.	HM-IN1 HM-IN2
Energy X Industry	Share grid capacity between industrial actors	Technological; Infrastructural; Governmental	more efficient use of available grid capacity within the industrial area.	Enable the energy hub to share its existing grid connection with third-party industrial actor	HM-EN2 HM-IN3

3. Analysis of the periASTY Living Labs

This section presents the inception-stage analysis of the nine periASTY Living Labs (LLs), structured in three parts. Section 3.1 establishes the geographic, administrative, and role-based (Initiator/Responder) context for each LL, including boundary definitions. Section 3.2 presents the Functional Urban Area (FUA) analysis across six axes: land use and built environment, population and socio-demographics, mobility systems, energy systems, industrial ecosystems and circular economy, and governance structures. Each axis follows a standardized methodology, with cross-LL comparison tables, composite maps, and stated limitations. Section 3.3 synthesizes findings across these axes into an urban-peri-urban interactions analysis, examining flows (energy, mobility, goods) and dependencies between each LL.

Data completeness varies by axis and LL, with specific gaps disclosed rather than left implicit where applicable; this is stated explicitly rather than concealed. Furthermore, where boundary definitions differ across axes for the same LL (notably Ljubljana), this is stated explicitly at first occurrence and referenced thereafter.

3.1. Overview of Living Labs

a. Initiators vs Responders (brief reference)

Initiator and Responder Living Labs are distinguished by their roles in the project: Initiators (WP3) are the first to implement and demonstrate periASTY solutions, while Responders (WP4) also implement and demonstrate, with a focus on adapting and replicating solutions informed by cross-fertilization with the Initiator LLs. This distinction is role-based, not a marker of maturity, priority, or size, as shown in Table 10, and it should not be read as sequencing either, since periASTY's replication approach allows any LL to draw on concepts from any other LL.

Table 10. Classification of each LL's focus areas.

#	Living Lab	Partner	Initiator/Responder	Topics Covered
1	**Dublin (Balbriggan)**	FCC	Initiator	Mobility, Energy, Governance
2	**Limassol (Kourion)**	KOUR	Initiator	Mobility, Industry, Governance
3	**Marseille**	MARS	Initiator	Mobility, Industry, Governance
4	**Ljubljana**	RRAL	Initiator	Mobility, Governance
5	**Guimarães**	GUI	Responder	Mobility, Industry, Governance
6	**Helmond**	HELM	Responder	Mobility, Energy, Industry, Governance
7	**Kalamata**	KAL	Responder	Mobility, Industry, Governance
8	**Sofia**	SM	Responder	Mobility, Governance
9	**Sisslerfeld**	EMPA	Responder	Mobility, Energy, Governance

b. Geographic and socio-economic context

To enable direct comparison across the nine Living Labs, indicators were mapped using a standardized 250m × 250m grid cell, consistent with the EEA reference grid (European Commission. Statistical Office of the European Union, 2021). Grid cells are clipped to each LL's administrative boundary; reported areas and cell counts reflect this clipped extent, applied consistently across all indicators in this deliverable for each LL. This method was applied uniformly across all nine LLs, so the resulting figures are directly comparable, with one caveat: the periurban boundary scope is not fully uniform across LLs. For example, some (e.g., Balbriggan, Guimarães) reflect a periurban-only area, while others (e.g., Marseille, Ljubljana, Kalamata) reflect the wider municipal or regional administrative unit due to the absence of a finer periurban-only boundary. This is noted as a limitation for direct density comparison and explored further where it materially affects specific indicators (see Ljubljana boundary caveat, Section 3.2a).

Table 11. Geographical properties of each LL's focus areas.

#	Living Lab	Boundary used	Population	Area (km²)	Density (/km²)	Total cell count (0.0625 km²)
1	**Dublin (Balbriggan)**	Admin boundary	24,322	4.45	5,465.16	115
2	**Guimarães**	Admin boundary	69,739	257.69	270.63	4123
3	**Limassol (Kourion)**	Municipality of Kourion	34,729	179.92	193.03	3,127
4	**Ljubljana**	LUR boundary*	581,197	2,555.96	227.39	41,833
5	**Kalamata**	Municipality admin boundary	72,340	444.83	162.62	7,380
6	**Marseille**	Admin boundary	771,339	235.31	3,277.93	3,765
7	**Helmond**	Admin boundary*	93,476	54.76	1,707.01	984
8	**Sofia***	Admin boundary *	Not available	209.551	—	3,584
9	**Sisslerfeld**	Admin boundary	6,609	16.11	410.26	268

See **Ljubljana boundary caveat, Section 3.2a computed on the LUR regional boundary rather than the LL's four core municipalities.*
District-level, not the common grid, per source data constraints; corroborated by the GA's stated **Helmond population (~96,000).*
****Sofia's** geospatial/population data not provided for this deliverable, remains outstanding.*

3.2. Functional Urban Area analysis methodological approach

a. Land use & built environment

All Living Labs follow the Hierarchical INSPIRE Land Use Classification System (HILUCS) (European Commission, n.d.) as defined in the European Commission's INSPIRE Registry, to map local land-use data, ensuring interoperability and a consistent functional nomenclature. The standardised European Environment Agency (EEA) 250m × 250m grid cell is adopted, projected in the ETRS89-extended/LAEA Europe Coordinate Reference System (CRS), EPSG:3035 (EPSG Geodetic Parameter Dataset, n.d.), to capture both high-density functional amenities in the urban core and expansive land-use patches characteristic of peri-urban environments. In Figure 2, the map shows: Very Low Footprint (0–20%) = pale yellow, Low Density (20–40%) = orange, Medium Density (40–60%) = magenta, High Density (60–80%) = purple, Completely Built (80–100%) = black.

Built-up share (percentage of a grid cell's area that is covered by built structures):

$$\frac{Residential + Commercial + Industrial}{total\ cell\ area}$$

Classified into five tiers:

- Very Low Footprint / Rural & Parks (0–20%),
- Low Density / Suburban Green (20–40%),
- Medium Density / Standard Urban (40–60%),
- High Density / Town Core & Industrial (60–80%),
- Completely Built Environment (80–100%).

Table 12. Built-up share by Living Lab

#	Living Lab	0-20%	20-40%	40-60%	60-80%	80-100%
1	Dublin (Balbriggan)	14.78%	2.60%	4.34%	21.73%	56.52%
2	Guimarães*	58.76%	17.22%	11.44%	0.07%	0.05%
3	Limassol (Kourion)	78.95%	1.88%	1.92%	1.37%	15.86%
4	Ljubljana*	98.5%	1.44%	0.05%	0%	0%
5	Kalamata*	-	-	-	-	-
6	Marseille*	-	-	-	-	-
7	Helmond	48.17%	5.08%	4.77%	5.18%	36.78%
8	Sofia	29.65%	11.10%	11.77%	16.63%	30.83%
9	Sisslerfeld	60.80%	10.82%	7.82%	8.20%	12.31%

*Some LLs do not sum to 100% due to empty cells for example, **Guimarães** sums to 87.54%; ~12.5%.*

***Kalamata's** source data covers only the eastern/coastal half of the municipal extent, with the western half unclassified; both built-up share and FDI values derived from the available data are internally inconsistent (built-up shares exceeding 8,000% in places; entropy compressed near zero), indicating an unresolved units or polygon-overlap issue upstream that could not be independently verified within the reporting timeline. ***Marseille's** source dataset lacks the residential/commercial/industrial area fields the formula requires. ***Ljubljana boundary**: All **Ljubljana** figures are computed on the Ljubljana Urban Region (LUR) boundary (~2,556 km², 25 municipalities), not the LL's four core municipalities (Komenda, Menges, Trzin, Log-Dragomer). Built-up share and population density are substantially diluted by this scale mismatch; functional diversity is comparatively less affected (see FDI synthesis below). Recalculation on the LL's own boundary is recommended as a post-M9 update.*

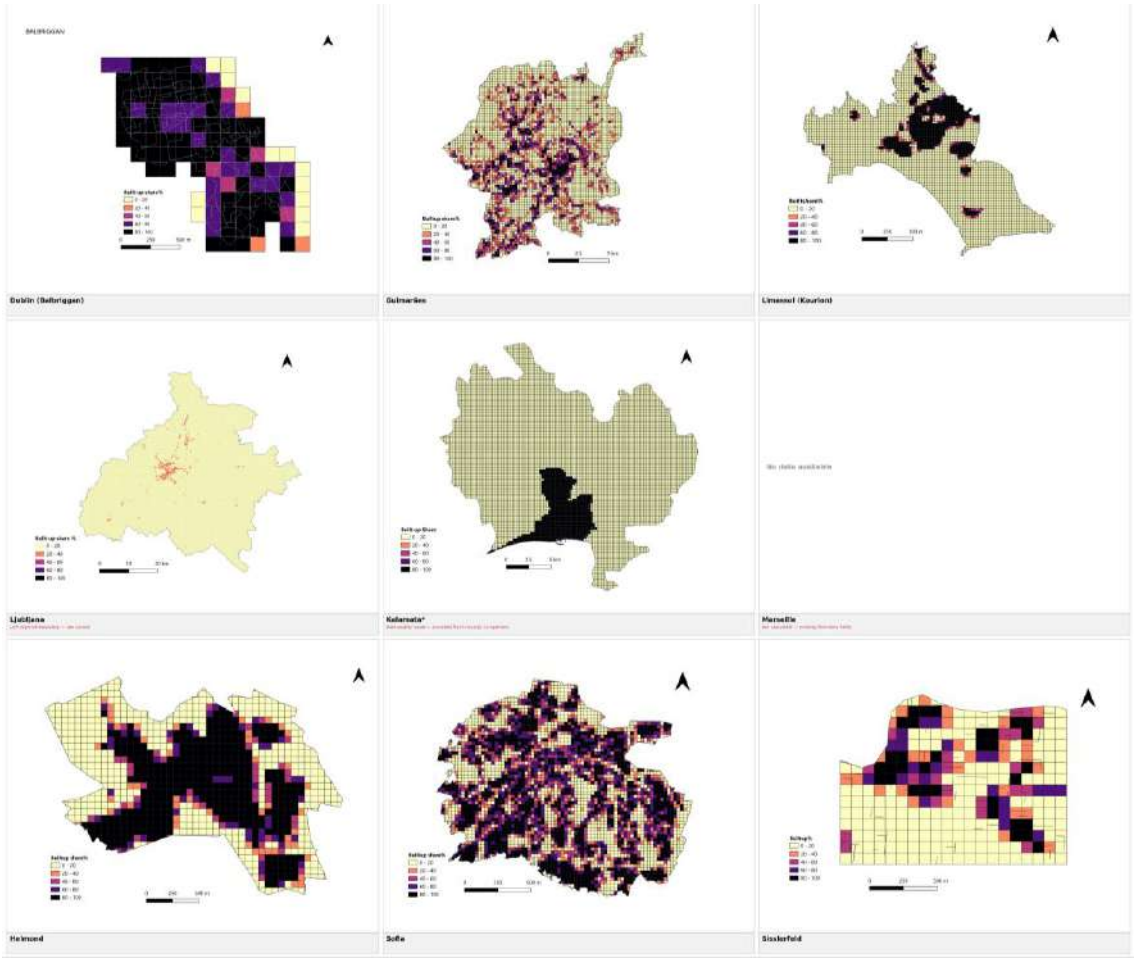


Figure 2. Overview of the composite built-up share map for all LLs mapped as 250m × 250m grid cell (EPSG:3035).

Functional Diversity Index (FDI): normalized Shannon entropy (Shannon, 1948) across six shared HILUCS categories (Residential, Commercial, Industrial, Agricultural, Urban Green, Natural Area):

$$FDI = \frac{H}{\ln(6)}$$

Classified into five tiers:

- Monofunctional/Very Low (0–0.2) = pale yellow,
- Low (0.2–0.4) = orange,
- Moderate (0.4–0.6) = magenta,
- High/Mixed-Use (0.6–0.8) = purple,
- Very High (0.8–1.0) = black.

This is an adopted convention for this deliverable following standard normalized-entropy practice in the land-use-mix literature, not an official HILUCS or ISO standard.

Table 13. Functional Diversity Index by Living Lab

#	Living Lab	Categories	0-0.20	0.20-0.40	0.40-0.60	0.60-0.80	0.80-1.00
1	**Dublin (Balbriggan)**	Ln(6)	20.00%	25.21%	44.34%	7.82%	0.00%
2	**Guimarães**	Ln(6)	37.73%	40.79%	18.55%	2.78%	0.12%
3	**Limassol (Kourion)**	Ln(6)	83.46%	2.87%	3.36%	3.86%	6.52%
4	**Ljubljana**	Ln(6)	53.46%	37.15%	8.40%	0.68%	0%
5	**Kalamata***	Ln(5)	-	-	-	-	-
6	**Marseille**	Ln(6)	25.55%	26.66%	33.59%	13.38%	0.82%
7	**Helmond**	Ln(6)	14.46%	51.01%	22.56%	11.78%	0.20%
8	**Sofia**	Ln(6)	69.94%	22.99%	6.52%	0.53%	0%
9	**Sisslerfeld**	Ln(6)	43.28%	38.43%	16.41%	1.86%	0%

**Non-comparable category set; excluded pending data-quality resolution alongside built-up share.*

The FDI findings across the LLs indicate that a High built-up intensity does not reliably predict high functional diversity. Marseille and Balbriggan show density and diversity co-occurring in their most built-up zones; Helmond, Sofia, and Sisslerfeld show the opposite as extensive high-density built cores paired with predominantly low diversity, indicating land-use specialization rather than integration. Sofia shows this most starkly, with intense, near-uniform built coverage across the grid paired with 69.94% of cells at Monofunctional diversity. This decoupling is directly relevant to T1.3's BIGM co-design, since density and functional mix may need to be addressed as separate design levers.

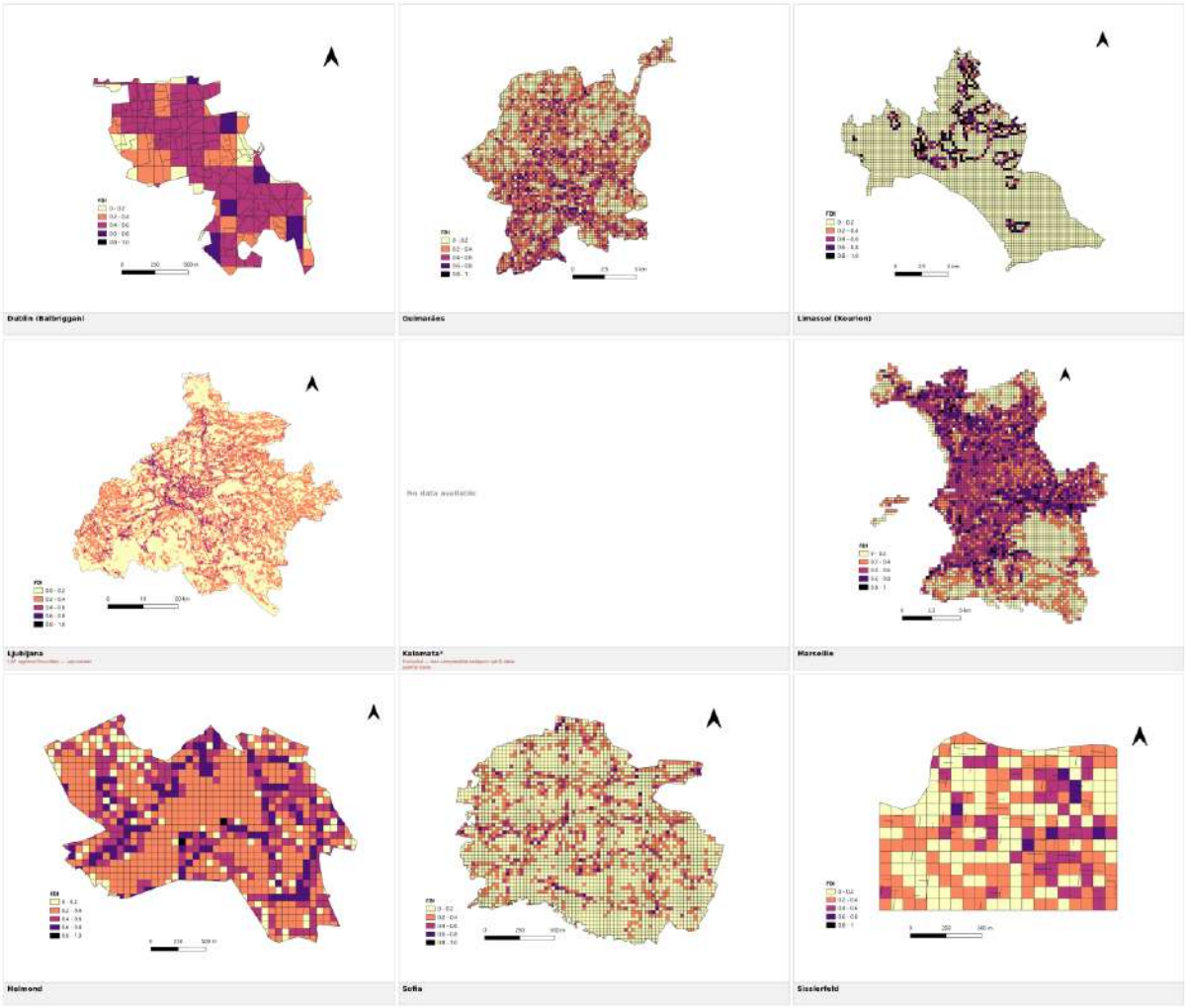


Figure 3. Functional Diversity Index (FDI) Classification of all LLs mapped as 250m × 250m grid cell (EPSG:3035).

b. Population & socio-demographics

Population density is classified using a standardized 5-tier scheme applied uniformly across all LLs:

- 0–50 (Very Low),
- 50–500 (Low-Density Peri-Urban),
- 500–1,500 (Medium-Density Suburban),
- 1,500–5,000 (High-Density Urban),
- >5,000 (Dense Urban Core)

Each map was validated by summing population and area across all grid cells and cross-checking against the administrative boundary totals in Table 11 (Section 3.1b).

Table 14. Observations on Population Density by Living Lab

#	Living Lab	Observation
1	**Dublin (Balbriggan)**	Substantial Dense Urban Core (>5,000/cell) concentrated across the northern and central portions, with High-Density Urban forming a broad surrounding band. Validated against Table 11 boundary totals.
2	**Guimarães**	Dispersed pattern of dominant Low-Density Peri-Urban with two small Medium-Density pockets; no Dense Urban Core present. Validated against Table 11.
3	**Limassol (Kourion)**	No Dense Urban Core or High-Density Urban class is present anywhere; the maximum classification reached is Medium-Density Suburban, despite a substantial built-up core (Table 12), indicating largely non-residential built floorspace in the core, plausibly linked to Limassol's coastal tourism economy. Validated against Table 11.
4	**Ljubljana**	Concentric pattern: Medium-Density Suburban core surrounded by an extensive Low-Density Peri-Urban ring; no High-Density Urban or Dense Urban Core anywhere, reflecting the LUR boundary's dilution effect (see caveat, Section 3.2a). Validated against Table 11.
5	**Kalamata**	Most extreme concentration of any LL: northern two-thirds Very Low density; population concentrated in a compact southern coastal strip with a Medium-Density Suburban core. Validated against the whole-Municipality boundary in Table 11 (see Section 3.1b on the two competing Kalamata boundaries).
6	**Marseille**	Most intensely urbanized pattern of any LL: a dense, near-continuous mix of High-Density Urban and Dense Urban Core spanning almost the entire central/northern extent, not a single concentric core. Densest LL overall. Validated against Table 11.
7	**Helmond**	Multi-nodal pattern: several distinct Dense Urban Core clusters across the central, southwestern, and eastern portions, rather than a single monocentric core. District-level resolution used, not the common grid, per source data format (see Table 11 note on GA corroboration and the failed grid-conversion attempt).
8	**Sofia**	Population data not currently available (see 3.1b)
9	**Sisslerfeld**	Fragmented, multi-nodal pattern: several discrete high-density nodes across the northern/central boundary, with no cell reaching Dense Urban Core anywhere, consistent with Sisslerfeld spanning four separate municipalities. Validated against Table 11.

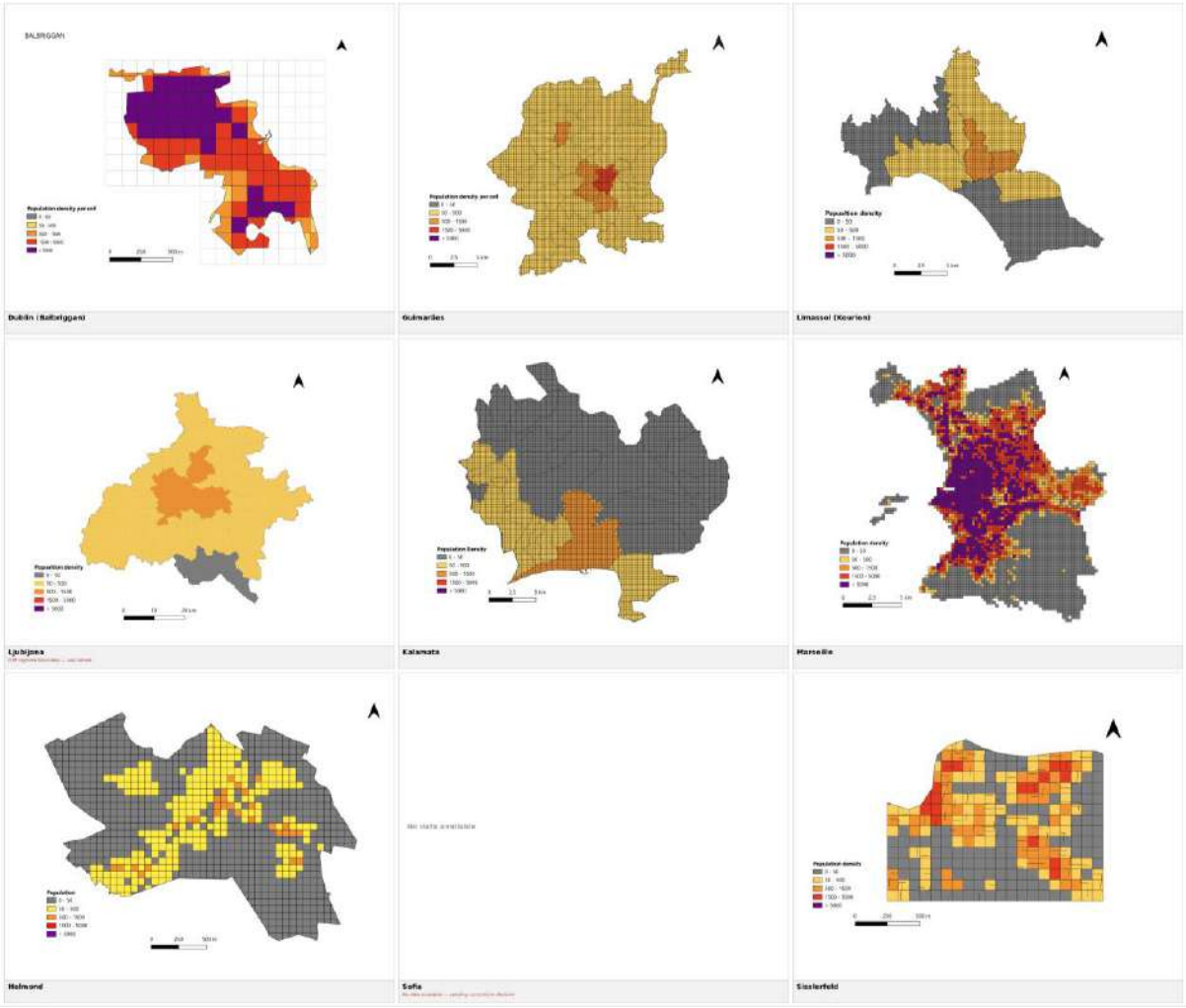


Figure 4. Population density across all periASTY LLs, mapped as population per 250m × 250m grid cell (EPSG:3035)

Classified as Very Low (0–50) = grey, Low-Density Peri-Urban (50–500) =light yellow, Medium Density (500–1,500) = orange, High Density (1,500–5,000) = Red, Dense Urban Core (>5,000) = purple.

c. Mobility systems

This section currently addresses only Public Transport (PT)-stop density as a partial proxy for transport options. Mode variety, accessibility (distance/time to services), and transport poverty for households and businesses are not assessed.

Methodology: PT-stop density is aggregated per 250m grid cell from bus and rail stop data, reported as stops/km² rather than the originally proposed fixed 5-tier scale, since that scale had no stated unit and was exceeded by the underlying data, making its class labels ("Low," "High") non-comparable across LLs of very different scale. For example, Ljubljana's boundary varies by axis across this section: area-based indicators (built-up share, population density, Sections 3.2 a-b) use the Large Urban Region (LUR) regional boundary; point/network infrastructure indicators (energy, mobility, Sections 3.2c and 3.2d) use the LL's smaller operational boundary (75.5 km²), since large regional extents dilute network features without a comparable dilution effect on area-based statistics.

Table 15. PT-stop density by Living Lab

#	Living Lab	Total stops	Area (km²)	Stops/km²
1	**Dublin (Balbriggan)**	28	4.45	6.29
2	**Guimarães**	1,491	257.69	5.79
3	**Limassol (Kourion)**	237	179.92	1.32
4	**Ljubljana**	1,471	75.5*	19.48
5	**Kalamata**	190	444.83	0.43
6	**Marseille**	2,521	235.31	10.71
7	**Helmond**	154	54.76	2.81
8	**Sofia**	2	209.55	0.01
9	**Sisslerfeld**	22	16.11	1.37

**LL-operational boundary, not LUR — see boundary note above.*

In Figure 5, on the LUR boundary, Ljubljana would appear to have the second-sparsest PT network (0.58/km²); on its actual operational boundary, it is the second densest (19.48/km², behind only Marseille), a difference resulting from boundary choice.

Marseille (10.71/km²) and Ljubljana (19.48/km²) anchor the high end, both showing networks tracing major road/rail corridors, consistent with their Energy-axis grid coverage patterns.

Sofia (0.01/km²) and Kalamata (0.43/km²) anchor the low end, Kalamata consistent with the same coastal-core concentration already found across population, built-up share, and industrial land use for this LL.

Helmond shows strong internal consistency across population, built-up share, and PT density, a useful validation checks after Helmond's earlier population data-quality issues.

Balbriggan illustrates why stop-count density alone is insufficient for transport-poverty claims: a mid-range density figure (6.29/km²) sits alongside the LL's densest built-up/population core, and a known rail link the OpenStreetMap (OSM) count likely undercounts. On this basis, the density figure should not be read as evidence of transport poverty; a fuller assessment would require the GTFS/rail data referenced by the Balbriggan LL partner.



Figure 5. PT stop density per 250 m grid cell, by Living Lab.

Sequential palette (dark = low, pale/yellow = high); class breaks are LL-specific, not a shared scale, see Section 3.3 text for comparability caveats.

**Sofia no data available.*

d. Energy systems

Methodology: Unlike Section 3.2a–b's fixed-tier classification, energy infrastructure indicators use LL-specific relative classification with absolute values reported alongside each map, since infrastructure density varies by orders of magnitude between residential and industrial-hub LL typologies; a shared fixed scale would compress most LLs into a single tier and obscure genuine differences. Energy indicators for Ljubljana specifically are computed on a smaller, LL-operational boundary (1,208 cells, ~75.5 km²) rather than the LUR regional boundary used in Sections 3.2a–b. This departure is necessary because energy infrastructure is a network/point feature concentrated in the built and peri-urban core; applying the LUR's ~2,556 km² regional extent would return infrastructure statistics dominated by genuinely under-infrastructured rural land.

Table 16. Energy infrastructure by Living Lab

#	Living Lab	Grid coverage (%)	Renewable installations	Type	Capacity (MW)	EV charging (pts/km²)
1	**Dublin (Balbriggan)**	68.7%	6 (5 solar, 1 waste)	Solar, Waste	Not available	0.449
2	**Guimarães**	34.7%	54	Solar	Not available	0.353
3	**Limassol (Kourion)**	15.7%	4 (3 grid-connected, 1 private)	Solar	59.15	0.04
4	**Ljubljana***	25.9%	0 (within LL); 11 nearby in wider LUR	—	—	0.159

5	**Kalamata**	3.08%	64	Solar	10.25	0.108
6	**Marseille**	40.55%	25	Solar	Not available	9.06
7	**Helmond**	4.67%	6 cells (4 solar, 1 wind, 1 gas)	Mixed	Not available	2.23
8	**Sofia***	1.93%	Not available	—	—	0.439
9	**Sisslerfeld**	59.70%	295 (294 solar, 1 biomass)	Solar, Biomass	19.63	0.869

**Ljubljana: Computed on LL-operational boundary (75.5 km²), not the LUR regional boundary used in Land Use see boundary note above.*
**Sofia has no renewable energy data available.*

The Grid coverage ranges from 1.93% (Sofia) to 68.7% (Balbriggan), a 35-fold difference. Three broad patterns emerge, distinct from the built-up/density typologies in Section 3.2a: thin single-corridor (Kourion, Ljubljana, Kalamata, coverage traces one transmission route through the boundary), transit/pass-through corridor (Sisslerfeld, high-voltage lines cross the LL without terminating within it, consistent with its position on the Zurich–Basel corridor), dense branching mesh (Marseille, Guimarães coverage reflects genuine local distribution network density), and hub-and-spoke/junction (Helmond the LL functions as a through-route node rather than an endpoint).

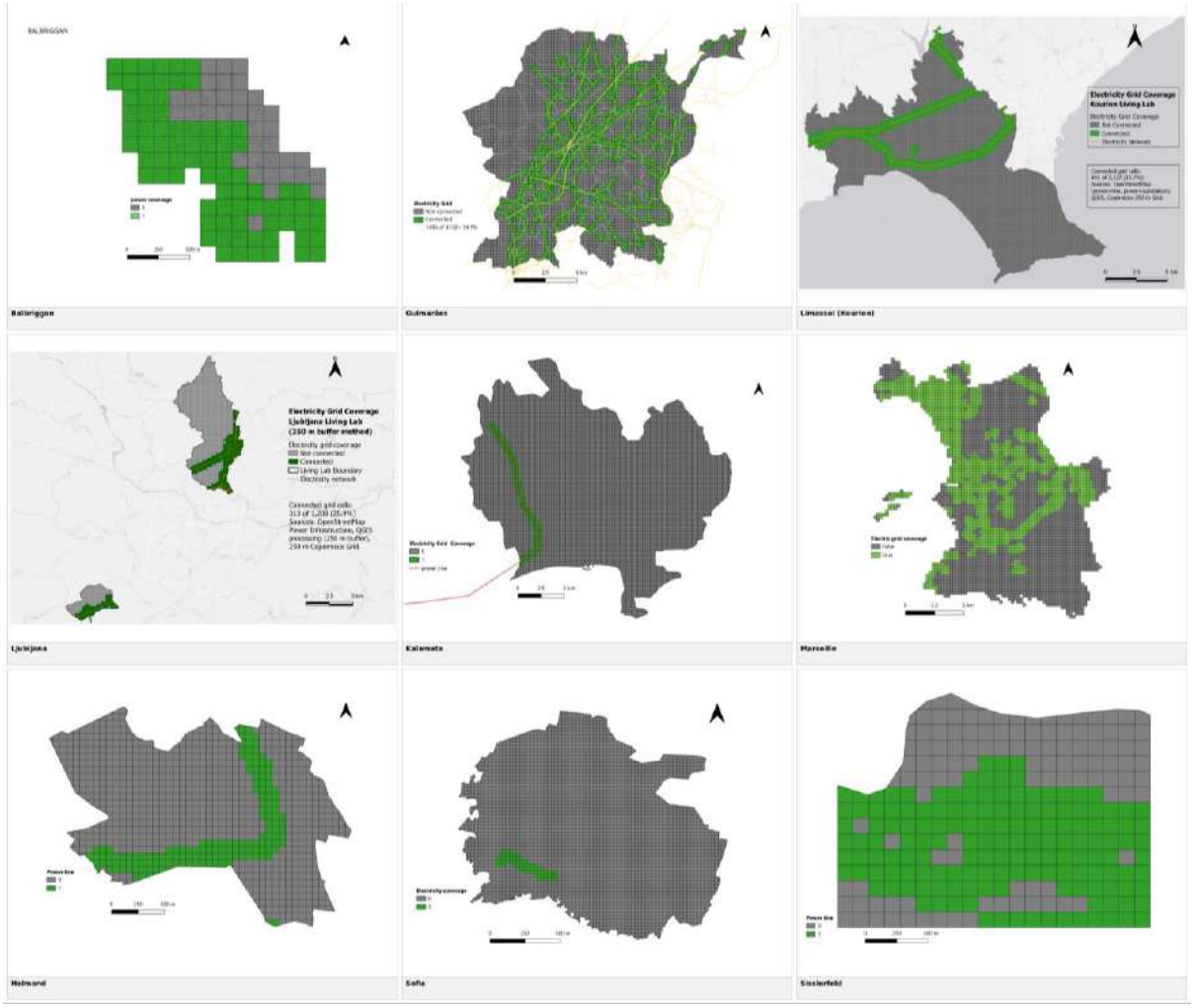


Figure 6. Overview of the Electricity grid coverage across all periASTY LLs, mapped as % of 250m × 250m grid cells within a 250m buffer of an OpenStreetMap power line or substation (EPSG:3035).

Grey/0 = not connected; green/1 = connected.

EV charging density varies from 0.04 pts/km² (Kourion) to 9.06 pts/km² (Marseille), a 225-fold range, with the highest three LLs (Marseille, Helmond, Sisslerfeld) also showing the widest geographic spread of charging points rather than single concentrated clusters.



Figure 7. Overview of the EV charging infrastructure across all periASTY LLs, mapped as charging points per 250m × 250m grid cell

Grey/0 = no charging point; green/1 (or higher shaded values where indicated) = charging point(s) present. Cross-LL density (points/km²) reported in Table 16.

Cross-indicator convergence repeats across multiple LLs: grid density, EV clusters, and renewable peaks consistently co-locate in the same functional core for Kalamata (coastal strip), Marseille (west-central), and Guimarães (central-north), reinforcing the same urban-core signal already seen in Axis 1's built-up and population patterns.

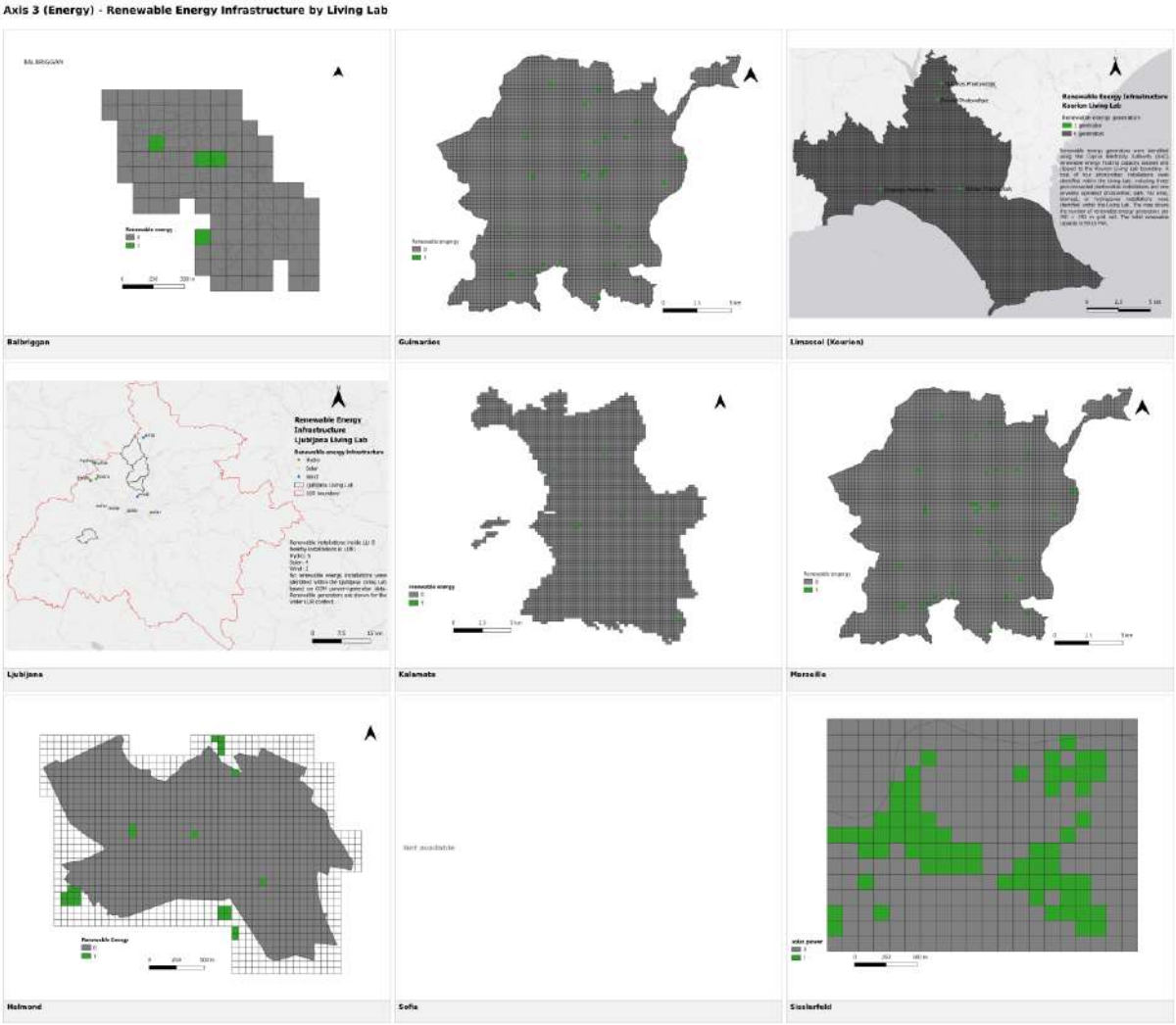


Figure 8. Renewable energy infrastructure across all periASTY LLs, by installation count and type (solar, wind, hydro, biomass, waste, gas) per 250m × 250m grid cell.

Grey/0 = no installation; green/1 (or higher shaded values, or labelled points, where indicated) = installation(s) present, by type per legend.

e. Industrial ecosystems and Circular Economy

Methodology: This axis covers three areas, CO_2 emissions, deployment of strategic net-zero technologies, and circular economy analysis via the urban metabolism framework (material, energy, and emission flows). As with Energy, indicators use LL-specific relative classification rather than a shared fixed scale, since industrial intensity varies by orders of magnitude between site types (e.g., Sisslerfeld's dedicated industrial hub vs. Guimarães' mixed peri-urban fringe). Four sub-indicators are tracked (European Environment Agency, 2024):

a) industrial land-use footprint (OSM landuse=industrial, Copernicus/CORINE);
b) industrial facility density (OSM building=industrial, craft=*, man_made=works);
c) waste and circular economy infrastructure (OSM amenity=recycling/waste_transfer_station);
d) industrial emissions (European Pollutant Release and Transfer Register, E-PRTR).

However, this deliverable measures the presence of circular economy infrastructure (recycling point counts and density) rather than the material/energy/emission flow volumes that the GA's urban metabolism framing calls due to unavailable data provided by LLs. Sisslerfeld is the exception, reporting genuine flow data (waste generation, recycling rate) from Swiss cantonal sources. Extending flow-

based metabolism analysis to the remaining 8 LLs is recommended as a part of the next related deliverable.

GIS analysis for Marseille uses the full municipal administrative boundary, not the district's 11–16 peri-urban scope referenced in some LL documentation. This is disclosed as a known scope inconsistency rather than corrected in this deliverable; comparisons involving Marseille's industrial figures should account for this wider boundary.

Table 17. Industrial Ecosystems and Circular Economy by Living Lab

#	Living Lab	Industrial land use (%)	Facility density	CE/waste assets	Net-zero tech	Industrial CO_2 (E-PRTR)
1	**Dublin (Balbriggan)**	10.1%	1.6/occupied cell	0 within LL	No data	No data
2	**Guimarães**	3.97%	Polycentric, max 4/cell	2.4%	No data	No data
3	**Limassol (Kourion)**	Not provided	Not provided	8 points	No data	No data
4	**Ljubljana**	Not provided	Not provided	17 points	No data	0 within LL; nearest facility just outside
5	**Kalamata**	23.1%	—	1 point	No data	No data
6	**Marseille**	5.0%	1–9/cell, two corridors	16.7%	No data	No data
7	**Helmond**	NA	NA	NA	No data	NA
8	**Sofia**	NA	NA	NA	No data	NA
9	**Sisslerfeld**	Not provided	Not provided	26 assets	2 facilities wood-fired CHP, renewable district heating	43,200 t/yr (DSM Sisseln, chemical sector)

In the Table 17 above, Net-zero technology deployment is reported for only 1 of 9 LLs. This is the GA's second explicit pillar for this axis, and its near-total absence is the single largest gap in this section due to lack of available data. Kalamata shows a genuine infrastructure mismatch: a single circular-economy asset sits at the southern tip of the boundary, disconnected from the identified industrial zone further north. Marseille shows the same pattern, at a larger scale: its industrial corridors (following transport/rail routes) sit largely outside its otherwise extensive circular-economy coverage (which follows population/urban-core geography instead), meaning the areas most likely to generate industrial waste are not the area's best served by recycling infrastructure. Ljubljana and Kourion both show a genuine, verified absence of higher-order circular economy infrastructure (repair/reuse centres, waste-to-energy, industrial symbiosis, sharing economy hubs) as seen in Figure 9.

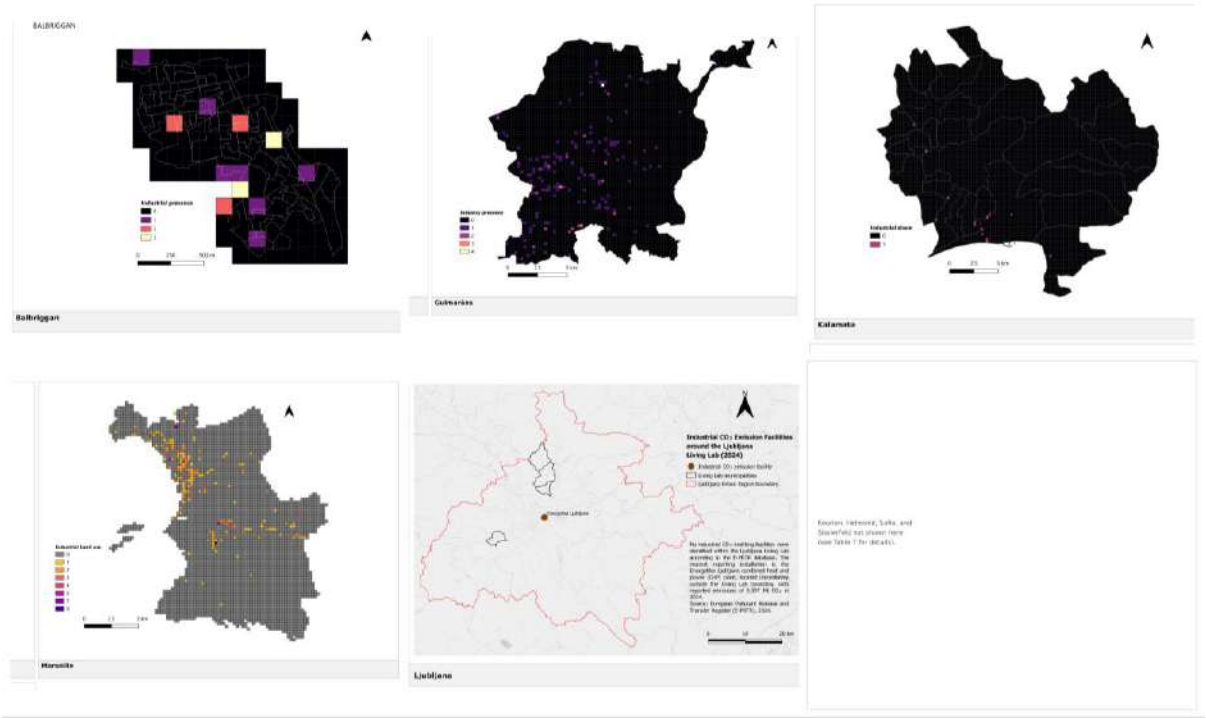


Figure 9. Industrial land-use presence across the periASTY LLS, mapped as feature count per 250m × 250m grid cell

(grey/black/0 = no industrial presence; colored/1+ = presence, scaled per legend). Not provided for Kourion, Ljubljana and Sisslerfeld; not assessed for Helmond and Sofia.

f. Governance structures

Unlike Axes 1–4, this axis is qualitative rather than GIS-based; no grid-cell mapping is planned. The method is desk research per Living Lab, drawing on each authority's Climate City Contract (CCC) and Sustainable Urban Mobility Plans (SUMPs), where available, to map how peri-urban areas are governed in relation to mobility, energy, and industry.

Each LL partner completes this template from their own authority's public CCC and SUMP documentation:

Table 18. CCC/SUMP Desk Review Template

Field	What to extract
Governing authority level	Municipal / regional / national responsibility for mobility, energy, industry in this LL
CCC status	Signed / drafting / not applicable; link or reference
CCC — mobility commitments	Named targets, policies, or infrastructure commitments
CCC — energy commitments	Named targets, policies, or infrastructure commitments
CCC — industry/circular economy commitments	Named targets, policies, or infrastructure commitments
SUMP status	Adopted / in development / not applicable; year, link
SUMP — key mobility governance mechanisms	Named plans, responsible bodies, funding mechanisms
Decision-making structure	Authority over peri-urban areas specifically, as distinct from the urban core
Cross-sector coordination	Any named body/mechanism coordinating mobility, energy, and industry governance jointly

Table 19. Per-LL tracking, ownership, and timeline

#	Living Lab	Partner	CCC	SUMP
1	**Dublin (Balbriggan)**	FCC	no CCC specific to Balbriggan	Local mobility strategy exists
2	**Guimarães**	GUI	Signed commitments pp.164 – 168	In development
3	**Limassol (Kourion)**	KOUR	Signed, 2023	Adopted, 2019
4	**Ljubljana**	RRAL	Signed, 2024	Adopted, 2018
5	**Kalamata**	KAL	Signed, 2023/24	Adopted, 2022
6	**Marseille**	MARS	Adopted in 2023	Adopted in 2021
7	**Helmond**	HELM	Signed	Adopted, late 2023
8	**Sofia**	SM	Not provided	Not provided
9	**Sisslerfeld**	EMPA	Not applicable (not an EU Mission City)	No formal SUMP; two planning frameworks

[2]***Guimarães:*** ***CCC*** *— https://netzerocities.app/resource-4181 ,* ***SUMP*** *— https://www.cm-guimaraes.pt/estudos-planos?folders_list_53_folder_id=1377*
[6]***Marseille:*** ***CCC*** *— NetZeroCities - Marseille Climate City Contract: Action Plan and Commitments,* ***SUMP*** *— In development earlier version ampmetropole.fr/wp-content/uploads/2022/08/2_Plan_de_Mobilité.pdf*
[9]***Sisslerfeld:*** ***CCC*** *— Not available,* ***SUMP*** *— Planning frameworks: Verkehrskonzept_ESP_Sisslerfeld_(2022) Regionaler Sachplan Sisslerfeld (approved 2025)*

Balbriggan

Not an EU Mission City (NetZeroCities, n.d.) no CCC exists. No standalone SUMP; mobility governance runs through town-level documents commissioned by Fingal County Council: The Balbriggan Active Travel and Transportation Strategy prepared to support the Balbriggan Rejuvenation Plan (DBFL Consulting Engineers, n.d.) with the regional-tier link (NTA Greater Dublin Area Transport Strategy). Distinct peri-urban governance exists via Balbriggan's designation as a Decarbonizing Zone within Fingal's Climate Action Plan 2024–2029 (Fingal County Council, n.d.), and cross-sector coordination runs through the URBACT EcoCore Project, which Balbriggan leads, explicitly linking industry (Stephenstown Industrial Estate), circular economy, and sustainability (Fingal County Council, n.d.).

Guimarães

CCC signed (commitments at pp. 164–168 of the submitted contract); SUMP in development, with only an earlier version currently linked (Câmara Municipal de Guimarães, n.d.). Deeper commitment-level extraction (mobility/energy/industry targets, decision-making structure, cross-sector coordination) remains outstanding.

Limassol (Kourion)

Governance sits across three tiers: Kourion Municipality (local), the Public Works Department of the Ministry of Transport, Communications and Works (SUMP commissioning authority), and district/national bodies for spatial planning. The Limassol CCC (signed 2023) commits to sustainable mobility (public transport, micromobility, freight demand management), renewable energy transition (PV, energy communities, storage), and circular-economy/zero-waste principles (organic waste-to-energy, zero-waste production) which were explicitly built on SUMP implementation.

The Greater Limassol SUMP (adopted 2019, a 27-month process covering six municipalities and eleven communities, including areas now part of Kourion) assigns most interventions to municipal authorities, with national involvement where required (Cyprus Ministry of Transport, Communications and Works, 2019). Decision-making is shared by intervention type; the CCC adds participatory governance through the Lemesos Commons stakeholder mechanism. Cross-sector coordination spans mobility, spatial planning, and environment, though the CCC's broader coordination mechanisms belong to the wider Lemesos climate-neutrality framework rather than Kourion Municipality specifically.

Ljubljana

Governed across municipal, regional, and national tiers, coordinated by the Regional Development Agency of the Ljubljana Urban Region (RRA LUR). The CCC (signed 2024, EU Mission Label received October 2024) commits to green mobility and accessibility improvements, 100% renewable/zero-emission public buses by 2030, energy decarbonization and negative-emissions measures, and 75% separate waste collection by 2030. The SUMP LUR (adopted in 2018 and unanimously approved by the LUR Council) prioritizes public transport, active mobility, the 15-minute city concept, and accessibility outside the city centre for 2025–2032 and is explicitly linked to Mission 100 objectives (Regional Development Agency of the Ljubljana Urban Region (RRA LUR), 2018).

Decision-making is multi-level and cross-municipal: the City of Ljubljana governs its own territory, while RRA LUR coordinates peri-urban mobility across the wider region. The CCC's cross-sector coordination involves over 70 signatories. Boundary note: this governance profile applies at the LUR/city scale; as with Energy and Mobility (Sections 3.2 d–e), findings here should be read against the LUR-wide governance scope rather than the LL's smaller four-municipality operational boundary.

Kalamata

Municipal authority (Municipality of Kalamata). CCC submitted 2023, Mission Label received 2024, committing to a low-emission mobility pathway (walking/cycling infrastructure, low-emission zone in the Historic Centre, MaaS/digital mobility), building energy-efficiency upgrades and renewable self-production, and industrial/circular-economy measures including valorisation of olive-processing waste, a genuinely locally-specific circular-economy commitment worth flagging as a candidate concept given Kalamata's existing industrial-CE mismatch already identified in Section 3.3 SUMP adopted 2022 (Municipality of Kalamata, 2022). Three fields remain unresolved and still need definition: SUMP governance mechanisms, decision-making structure, and cross-sector coordination.

Marseille

Multi-level governance: Métropole Aix-Marseille-Provence is the sole Mobility Organizing Authority for all 92 constituent municipalities; industry is multi-level with the Métropole as lead; energy spans Metropolitan, Regional, and National tiers. CCC adopted April 2023 (Climate Neutral & Smart Cities label, March 2024), with four priorities: mobility (tramway/BRT expansion, 3,000 EV charging points by 2025 which is consistent with Marseille's already-observed EV infrastructure lead in Section 3.2d), energy (district heating/cooling expansion including marine thalassothermy, solar PV), and industry/circular economy (reuse networks, construction/demolition material recovery).

SUMP adopted 2021, implemented through 25 Local Mobility Plans across 6 mobility basins (Métropole Aix-Marseille-Provence, n.d.). No separate peri-urban mobility authority exists and the Métropole holds direct planning and funding authority; the City of Marseille sets local regulation.

Helmond

Helmond is a municipality (Gemeente Helmond) within the Metropoolregio Eindhoven (MRE) and the Brainport Eindhoven regional ecosystem. Helmond is its own road authority whereby the changes and adaptations to the urban environment and physical infrastructure, and the development of municipal mobility hubs for active mobility, fall under municipality responsibility, as local urban planning, zoning, and micro-mobility permits. Public transport concessions are the responsibility of the Province of Noord-Brabant, which acts as the Public Transport Authority that is regional and national rail connections fall under national authority (the Ministry) likewise the approval of automated vehicles for use on Dutch public roads is the responsibility of the national vehicle authority, RDW.

For energy, the City of Helmond is responsible for local spatial planning. Enexis operates the regional electricity and gas distribution networks, the Ministry, set national policy and the legal framework for the energy system.

CCC signed, identifying mobility as ~40% of municipal CO2 emissions (car-free centre, zero-emission zone underway) and industry as ~35% (heat networks and renewable supply targeted to cut industrial

emissions by roughly two-thirds by 2030). Energy commitments include building insulation, energy-label upgrades, and a shift to heat networks and all-electric supply.

Helmond's Mobiliteitvisie (Mobility Vision) 2040, adopted in late 2023, set the long-term mobility policy direction. Following this and driven by Helmond's expected growth to more than 100,000 inhabitants in the coming years, the municipality committed to developing a full Sustainable Urban Mobility Plan (SUMP), which is currently in development and not yet adopted.

Once adopted, SUMP alignment is intended to be maintained at both municipal and MRE regional level involving the Ministerie van Infrastructuur en Waterstaat, ProRail, and NS for the extended train network. Decision-making splits by geography: municipal authority covers the urban core and immediate peri-urban areas; MRE and the Province of Noord-Brabant hold authority over broader peri-urban and cross-boundary rural connections. Cross-sector coordination runs through Brainport regional development and the Automotive Campus Helmond, a joint public-private model uniting mobility technology, energy research, and industrial scaling.

Sofia

No governance data yet provided by the LL partner. To be included in next deliverable (D1.3)

Sisslerfeld

Not an EU Mission City, no CCC exists, no formal SUMP; governance instead runs through two named planning instruments: the Verkehrskonzept ESP Sisslerfeld (2022, transport concept) and the Regionaler Sachplan Sisslerfeld (approved 2025, regional structure plan).

Findings across all LLs

Two LLs sit entirely outside the EU Mission City framework (Balbriggan, Sisslerfeld) and instead rely on smaller-scale local planning instruments, a genuinely useful contrast against the seven CCC-holding LLs, since it shows periASTY's peri-urban concepts must work both within and outside the Mission City governance architecture.

Multi-level, cross-boundary governance is the norm, not the exception: every LL with complete data (Kourion, Ljubljana, Kalamata, Marseille, Helmond) explicitly splits authority across municipal/regional/national tiers, and four of five explicitly note that peri-urban areas have no dedicated governance tier of their own. Therefore, they are governed either as an undifferentiated part of the municipal core (Marseille) or through regional coordination bodies covering areas far larger than the LL itself (Ljubljana's RRA LUR, Helmond's MRE, Kourion's Ministry-level SUMP). This reinforces the flow-dependency findings identified in Section 3.3.

Named CCC commitments are directly cross-referenced against measured data elsewhere in this deliverable for two LLs: Marseille's 3,000-EV-charging-point target aligns with its observed EV density lead (Section 3.2d); Kalamata's olive-processing waste valorisation commitment is a concrete, locally specific answer to the industrial/circular-economy mismatch already flagged for this LL in Section 3.3.

3.3. Urban-Peri-urban interactions

This section synthesizes evidence inferred from infrastructure siting patterns identified in Sections 3.2a–e, not from direct flow measurement but of how each LL interacts with its surrounding urban core or rural hinterland. The synthesis below is preliminary and based on the axes and Living Labs assessed to date.

a. Flows (energy, mobility, goods)

Energy flows show a clear pattern among three Living Labs, Ljubljana, Helmond, Balbriggan consistently show relevant energy and waste infrastructure sitting immediately outside, rather than within, the periurban boundary: Ljubljana's nearest renewable installations and its nearest E-PRTR-registered CO_2 facility (Energetika Ljubljana) both sit just outside in the wider Ljubljana Urban Region; Helmond's two identified substations and Balbriggan's one identified waste disposal facility both sit

outside. This is a substantive finding rather than a data gap: each asset was identified but falls just outside the drawn boundary, indicating a genuine flow dependency. These LLs draw on energy and waste-management capacity located in the wider municipal or regional area rather than containing it themselves.

Sisslerfeld extends this pattern one step further: its wood-fired CHP plant supplies steam and electricity to DSM within the LL and to adjacent Syngenta and Novartis facilities, direct evidence of energy exchange across the peri-urban/urban industrial boundary, and its power network sits on the Zurich–Basel transmission corridor, with high-voltage lines entering and exiting at multiple points rather than terminating locally, the LL functions as a pass-through, not an endpoint, on the regional network.

Mobility flows show a comparable through-route pattern for Helmond, whose grid also converges centrally and continues beyond the boundary in two directions, and Balbriggan, which connects to Dublin via a mainline rail link a direct commuting link to the urban core.

Spatial concentration of flows. In Marseille, the west-central area holds the densest electricity grid coverage, the peak EV-charging cluster, and the radial centre of circular-economy infrastructure, three independent indicators agreeing on the same functional core. A comparable pattern appears at smaller scale in Limassol (Kourion), where a single settlement cluster is consistently the only meaningful infrastructure node across the solar PV, EV-charging, and circular-economy indicators, while the remaining ~99% of the boundary, including the entire southern coastal two-thirds, carries none of these. These convergences suggest that mobility, energy, and economic flows in these LLs are highly concentrated rather than diffuse, with clear implications for where periASTY demonstrations would have the greatest reach.

Goods flows remain the weakest-evidenced of the three. Marseille's industrial land use follows transport/rail corridors rather than population geography, consistent with goods-movement logic, but the LL's heavy industrial and port facilities are known to sit outside the boundary actually analysed (Districts 11–16 vs. the full administrative area used in this deliverable), so goods-flow relationships with the port/urban core cannot yet be characterized.

b. Dependencies and gaps

The clearest quantified gap identified concerns the mismatch between industrial land use and circular-economy infrastructure in **Kalamata**. Industrial land use presence is recorded in only 11 of 7,380 grid cells (0.149%, a count-based measure, not an area share), a scattered, negligible footprint (a small coastal cluster near the city core, isolated inland cells to the northwest, one southern outlier) rather than a large, concentrated zone. Kalamata's single recycling point sits at the opposite end of the LL from this coastal cluster. The gap is therefore not "a large industrial zone entirely unserved by recycling infrastructure," but a more modest finding: what limited industrial activity exists is dispersed and disconnected from the one point of circular-economy infrastructure in the boundary, still offering some support for periASTY's KM-IN1 (Kalamata: Smart Waste Management) concept.

Marseille shows a comparable pattern using the same count-based methodology: industrial presence is recorded in 187 of 3,765 grid cells (5.0%), with 322 individual features across those cells (averaging 1.7 per occupied cell, indicating some clustering). This is a meaningfully larger and more concentrated footprint than Kalamata's, following two linear corridors that lie largely outside the dense, radially distributed circular-economy coverage around the urban core, a reasonably solid, count-based substantiation of periASTY's MRS-IN1 (Marseille: Urban Mining for Construction) concept.

Balbriggan's industrial indicator shows a comparable pattern: presence in 12 of 119 grid cells (10.1%), 19 features (averaging 1.6 per occupied cell), scattered along the boundary rather than concentrated in a single zone.

The four LLs assessed for industrial land use to date all use the same count-based methodology and are therefore directly comparable: Kalamata's minimal, scattered footprint; Balbriggan's modest, scattered footprint; **Guimarães'** genuinely polycentric pattern (3.96% of cells, spread across many small clusters through the central and southern two-thirds, almost absent in the north); and Marseille's largest, most clustered, corridor-following footprint. These differing spatial logics, scattered/coastal,

two-cluster, polycentric, corridor-following indicate that a single, uniform circular-economy or waste-management concept is unlikely to transfer well across LLs without spatial adaptation.

4. Co-design methodology, workshop design and supporting tools

This section describes the co-design methodology developed under T1.3 to translate the measures outlined in the Grant Agreement into locally adapted SCDs and prototypical BIGMs. It presents the workshop approach, supporting tools, consolidation and validation process, and methodological lessons from the first round of activities. The resulting solutions and BIGMs are presented in Section 5.

4.1. Overall co-design methodology

The T1.3 co-design methodology provides a common framework for refining the mobility, energy, industry and governance measures defined in the Grant Agreement together with LL partners and local stakeholders. It combines two complementary perspectives: the SCD addresses solution operation, user needs and experience, technical dependencies and implementation requirements; the BIGM addresses the participating actors, their responsibilities and relationships, and how the solution creates, delivers and captures value. Governance is considered both through dedicated measures and as a requirement for implementing solutions across sectors.

The framework combines a common workflow and information structure with flexibility to accommodate local contexts, languages, stakeholder configurations and measure maturity. Accessible workshop templates support participation, while extended templates provide the detail required for subsequent technical development and implementation. Figure 10 presents the nine stages of this process.

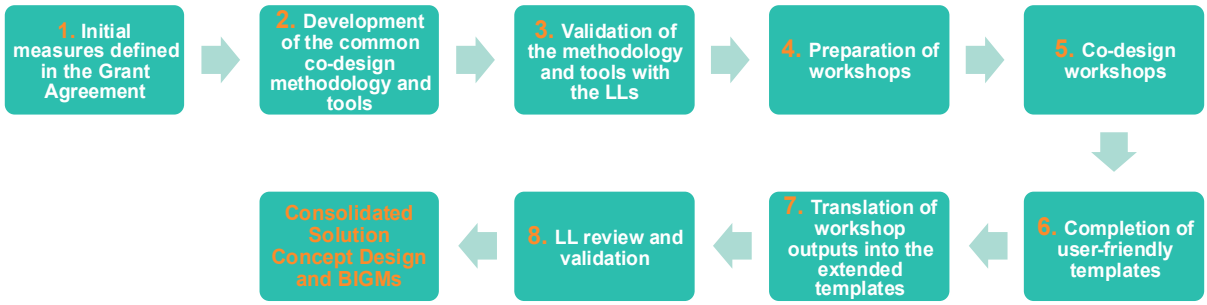


Figure 10. Common T1.3 co-design workflow, from the initial measures defined in the GA to consolidated SCDs and prototypical BIGMs.

The workflow, presented in Figure 10, consisted of the following consecutive but interconnected stages.

1. Initial measures defined in the Grant Agreement. The proposed measures were reviewed to identify aspects requiring further definition, including their operation, intended users, implementation conditions and organisational arrangements. These information needs informed the methodology and supporting tools.

2. Development of the common co-design methodology. The toolkit comprised user-friendly SCD, User Journey & Experience, Implementation Pathway and BIGM templates, together with corresponding extended versions. Workshop guideline, a common presentation and an informative flyer supported their use. LL leaders translated the English master materials where required.

3. Validation of the methodology and tools with the LLs. LL leaders reviewed the package for clarity, suitability for their measures and applicability to local workshop conditions. Their feedback informed refinements before implementation.

4. Preparation of the workshops. An online train-the-trainers session held on 1 June 2026 introduced LL leaders to the workshop sequence, facilitation approach and templates. It also clarified their responsibilities for preparation, delivery and post-workshop consolidation.

5. Co-design workshops. Face-to-face co-design workshops brought together stakeholders to examine how the measures would operate, respond to user needs and be implemented locally. The

format and scope were adapted where measure maturity or the availability of relevant information required a different approach.

6. Completion of the user-friendly templates. Participants documented the proposed solution characteristics, user interactions, implementation requirements and actor roles. The completed templates captured the workshop contributions and provided the basis for further elaboration.

7. Translation of workshop outputs into the extended templates. LL leaders synthesised the completed templates, discussion notes and relevant contextual information into structured SCDs and BIGMs. This step involved interpreting and consolidating stakeholder inputs, while identifying unresolved questions requiring follow-up.

8. LL review and validation. The extended descriptions were reviewed with the relevant LL partners to check their consistency with workshop contributions and local conditions. Clarifications and corrections were incorporated as required.

9. Consolidated Solution Concept Designs and BIGMs. The resulting descriptions provide an initial reference for periInnovation development in WP2 and demonstration preparation in WP3 and WP4. Their completeness reflects the maturity of each measure, with further refinement expected through technical development, stakeholder engagement and implementation experience.

Overall, the **methodology combined five central principles**: a standardised process across all nine LLs; accessible tools for stakeholder participation; progressive elaboration from user-friendly to extended formats; local ownership through LL-led consolidation and validation; and a common multi-sectoral structure. The resulting workflow created a traceable path from the initial measures to the consolidated, locally validated SCDs and BIGMs.

4.2. Design and implementation of the LLs co-design workshops

4.2.1. Workshop objectives and design

The co-design workshops enabled LL partners and local stakeholders to refine the measures proposed in the Grant Agreement through structured discussion of their operation, users, implementation requirements and associated business and governance arrangements. They generated practical inputs, preliminary agreements and outstanding questions for subsequent consolidation in the extended SCD and BIGM templates. The specific objectives were to:

- clarify the local peri-urban challenge, target users and expected contribution to climate neutrality;
- refine the solution's functions, operational model, geographical scope and links with existing services or infrastructure;
- examine user interactions, accessibility, affordability and potential acceptance barriers;
- outline implementation phases, resources, responsibilities, dependencies and risks; and
- identify the actors, value proposition, governance arrangements and financing conditions required to deliver and sustain the measure.

The design followed a measure-centred approach, with each intervention examined through four complementary perspectives: solution operation, user experience, implementation and the organisational ecosystem. Discussion progressed from the local challenge and user needs towards the proposed solution, its deployment and the arrangements supporting its delivery.

Participation combined institutional, technical, operational, business and user perspectives, according to the requirements of each measure. User-friendly templates provided an accessible structure for recording contributions from stakeholders with different backgrounds. The common analytical framework supported consistency across LLs, while allowing adaptations to local conditions, stakeholder availability and measure maturity.

The overall workshop design can therefore be summarised as a structured transition from initial measure description towards a more mature and locally grounded concept. Each workshop concluded with a collective review of the main findings, assumptions and unresolved issues. This review checked that participants' contributions had been accurately captured; it did not constitute formal approval of the measures. Further clarification and validation were undertaken during post-workshop consolidation.

The detailed operational guidance supporting this design, including the recommended workshop structure, facilitation process, stakeholder categories, discussion questions, use of the co-design templates and expected outputs, is presented in Section 4.2.2.

4.2.2. Workshop guideline

A common workshop guideline supported LL leaders in preparing, facilitating and documenting the co-design activities and consolidating their outputs. It provided a reference agenda, working-group instructions, stakeholder categories, facilitation roles and guidance for completing the user-friendly templates. Figure 11 presents an overview of the guide:

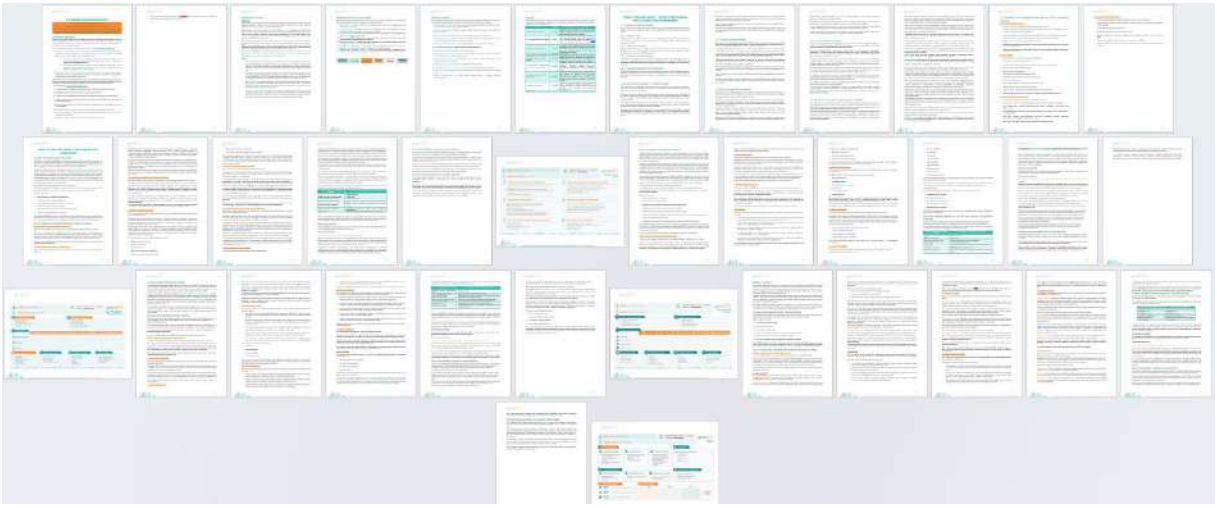


Figure 11. Overview of the co-design workshop guideline provided to LL leaders.

a. Preparation and participation

Before each workshop, LL leaders were expected to select the measures, define the local challenges, identify relevant stakeholders and organise the working groups. Basic information, including the measure code, title, location and known actors, could be entered in advance to focus discussion on aspects requiring stakeholder input.

The guideline recommended approximately 30 participants where feasible, divided into groups of no more than eight people. Participation was to combine public authorities, operators, infrastructure owners, businesses, technical experts, users and community representatives as relevant to the measures. The composition was intended to represent both decision-making perspectives and practical implementation and user perspectives. Particular attention was given to groups with accessibility, affordability or digital-literacy needs. LL leaders were also encouraged to record missing stakeholder perspectives for subsequent follow-up.

The organising principle was one working group, one measure and one completed set of user-friendly templates. This principle was intended to prevent the discussion from combining measures with different target users, operational models, technical requirements, implementation conditions or governance arrangements. Groups could examine different measures in parallel or separate user profiles for the same measure, with findings compared during the plenary discussion.

b. Workshop sequence and timing

The reference format was approximately three hours, including a break, with timings adapted to the number and complexity of measures. Figure 12 illustrates the common sequence:



Figure 12. Reference sequence for the periASTY co-design workshops.

The **workshop sequence followed a progressive logic**, moving from local problem towards the practical, user-related and organisational definition of the measure:

1. Introduction and key concepts: present periASTY, the LL context, workshop objectives, agenda and expected outputs.
2. LL challenges, users and needs: identify the problem, intended users, current practices and principal barrier.
3. Solution shaping: refine the measure's functions, operation, coverage, expected benefits and connections with existing services.
4. User Journey & Experience: examine interactions before, during and after use, including touchpoints, barriers and opportunities for improvement.
5. Implementation Pathway: identify deployment phases, prerequisites, resources, responsible actors, timing and risks.
6. Business, innovation and governance model: discuss value creation, actor relationships, decision-making, ownership, financing and incentive.
7. Wrap-up and preliminary validation: present group findings, record unresolved issues and agree follow-up actions.

The indicative agenda allocated 10 minutes to the introduction, 20 to local challenges and user needs, 30 to solution shaping, 20 each to the User Journey & Experience, Implementation Pathway and BIGM, and 30 to the final review, alongside a 30-minute break.

c. Facilitation and supporting materials

Facilitators guided discussion, managed time and encouraged balanced participation. A **rapporteur** for each group recorded contributions, while **technical experts** helped assess feasibility and identify dependencies. **Participants** contributed local knowledge, practical experience and user or institutional perspectives.

The supporting materials included A2 or A3 user-friendly templates, post-its, markers, a common presentation, an agenda and attendance records. Maps, local data and user profiles could support discussion where relevant, whilst digital template versions were provided for subsequent consolidation, together with applicable consent and data-protection forms where personal information, photographs or recordings were collected.

d. Template completion

The SCD package covered the solution concept, User Journey & Experience and Implementation Pathway. The BIGM template addressed value creation, stakeholder roles, governance, operational responsibilities and financing. Detailed descriptions of these tools are provided in Sections 4.3 and 4.4.

The User Journey & Experience Template focused on the experience of one principal user or user profile. The groups were asked to identify who the user was, what the user was trying to achieve and

the specific use case in which the interaction with the measure would occur. The user journey was then mapped across five stages: before use, access or start, during use, after use and long-term use.

Participants used concise statements, diagrams, actor maps and indicative timelines to record concrete information about each measure. Facilitators encouraged the identification of specific organisations, responsibilities and implementation conditions, while distinguishing agreed elements from assumptions, missing information and questions requiring further validation.

e. Documentation and follow-up

The expected output for each measure was a set of completed user-friendly templates, accompanied by the main agreements, unresolved issues and follow-up actions. Completed templates, notes and supporting materials were collected or photographed before the workshop closed.

LL leaders or responsible partners subsequently consolidated these inputs into the extended SCD and BIGM templates. This involved developing concise notes into explanatory text, merging repeated contributions, clarifying inconsistencies and flagging missing information. The consolidated descriptions were then reviewed with relevant LL partners and experts, following the translation and validation procedures described in Sections 4.5 and 4.6.

Methodological consistency was ensured through the use of a shared workshop sequence, common analytical questions, standard roles and equivalent expected outputs. At the same time, flexibility was maintained by allowing each LL to adjust the agenda, participant composition, working-group allocation, supporting information and level of emphasis placed on the different templates according to its local circumstances and the characteristics of each measure

4.2.3. Workshop implementation across the LLs

Eight LLs held in-person co-design workshops between 8 and 30 June 2026: Dublin, Limassol, Marseille, Ljubljana, Guimarães, Helmond, Kalamata and Sofia, while Sisslerfeld has established an adapted, phased engagement approach reflecting the specific maturity and governance conditions of that LL. The sessions followed the common methodological framework, with adaptations to local languages, stakeholder availability, measure portfolios and implementation readiness. Figure 13 illustrates the materials prepared to support stakeholder invitations.



Figure 13. Flyer and 'save the date' created to enable the LLs to engage stakeholders and participants in the co-creation activities.

The eight workshops recorded 160 attendees, representing an interim contribution towards the project-level target of at least 400 participants across nine or more co-design workshops. This total excludes the planned Sisslerfeld stakeholder workshop and subsequent follow-up sessions. Participant profiles included public authorities, operators, businesses, users, community representatives and research partners, although a harmonised breakdown by stakeholder category was not available.

Table 20 summarises workshop dates, participation, initial measure portfolios and implementation observations. The number of proposed measures represents each LL's initial portfolio and does not necessarily indicate the number for which complete workshop templates were produced, as three LLs required specific adaptations:

- In Marseille, the industry measures MRS-IN1 (Urban Mining for Construction) and MRS-IN2 (LGD Action Plan) were deferred because the LL reported insufficient readiness and no project funding allocated to local partners for these measures. Relevant industry information was to be collected later, with the City of Marseille indicating that construction and reuse-sector data and experience from previous projects could support subsequent work.
- In Helmond, all working groups discussed the full portfolio of ten measures. This supported discussion of common issues and interdependencies but limited the time available for detailed work. User-friendly templates were completed for only two measures during the workshop, leaving the remaining measures subject to further consolidation or engagement. This experience confirmed the importance of matching the number of measures addressed to the duration of the workshop and, where the portfolio is extensive, of allocating individual measures to specific groups or organising additional sessions.
- Sisslerfeld adopted a phased approach because concrete energy and mobility solutions depended on ongoing modelling, while local stakeholder participation remained voluntary and the municipality was not a direct project partner. An exploratory workshop on energy and mobility sufficiency was developed and piloted with academic, public-sector and private-sector participants. Its delivery with Sisslerfeld stakeholders was planned for early autumn 2026, subject to availability. Discussions with core Reallabor representatives and subsequent application of the measure-specific T1.3 templates were foreseen as the solutions became sufficiently defined.

These differences qualify the completeness of the first-round outputs presented in Section 5. Outstanding work will be addressed through further engagement, consolidation and validation, while the methodological lessons are discussed in Section 4.7.

Table 20. Overview of the implementation of the T1.3 co-design workshops across the periASTY LLs.

Living Lab	Workshop date	Stakeholders/ partners invited	Attendees	Initial proposed measures	Main implementation observation or adaptation
LL1. Dublin (Balbriggan)	24 June 2026	Not reported	21	4	No specific adaptation to the common methodology was reported.
LL2. Limassol (Kourion)	22 June 2026	88	30	9	No specific adaptation to the common methodology was reported.
LL3. Marseille (11-16 districts)	8 June 2026	9	9	4	The complete initial portfolio could not be addressed because the industry-related co-creation activities were deferred.
LL4 – Ljubljana (Urban Region)	8 June 2026	18	16	3	No specific adaptation to the common methodology was reported.
LL5 – Guimarães (Surrounding Communities)	30 June 2026	68	17	3	No specific adaptation to the common methodology was reported.
LL6 – Helmond (BZOB)	30 June 2026	25	20	10	All groups discussed the complete portfolio of measures. Owing to the number of measures and the time available, templates were completed for only two measures.
LL7 – Kalamata (Surrounding Communities)	18 June 2026	28	24	5	No specific adaptation to the common methodology was reported.
LL8 – Sofia (Surrounding Communities)	18 June 2026	Not reported	23	2	No specific adaptation to the common methodology was reported.
LL9 – Sisslerfeld	Early autumn 2026, planned; date to be confirmed	Not yet available	Not yet available	5	Initial engagement focuses on energy and mobility sufficiency and will be followed by measure-specific co-design once the modelling and analytical work has generated sufficiently concrete solutions.
Total for workshops completed by 30 June 2026	—	—	**160**	—	Sisslerfeld was not included in the attendance total because its local stakeholder workshop remained pending

4.3. Development of the Solution Concept Design templates

The SCD toolkit was developed in two complementary formats: user-friendly canvases for stakeholder discussion and an extended template for post-workshop consolidation. Together, they support the progressive definition of each measure's purpose, users, operation and implementation requirements. The common structure enables consistent documentation across LLs while accommodating differences in sector, local context and solution maturity.

4.3.1. User-friendly SCD Template

The user-friendly SCD package comprised three complementary canvases: the core Solution Concept Design, User Journey & Experience and Implementation Pathway. Each package referred to a specific periASTY measure and used a common identification header linking the inputs to the relevant LL and measure code. Short questions, examples and open visual spaces enabled participants to contribute through notes, post-its, diagrams and timelines.

a. Core Solution Concept Design

The **core SCD template** showed in Figure 14 established an overview of the measure through six dimensions:

- target users and stakeholders;
- the peri-urban challenge; solution characteristics;
- expected changes;
- relationships within the local ecosystem;
- and deployment requirements.

Participants defined what the intervention would provide, where and how it would operate, and how it would connect with existing services, infrastructure and actors. The canvas linked the proposed functions to local needs and expected benefits, while identifying issues requiring further exploration through the complementary tools.

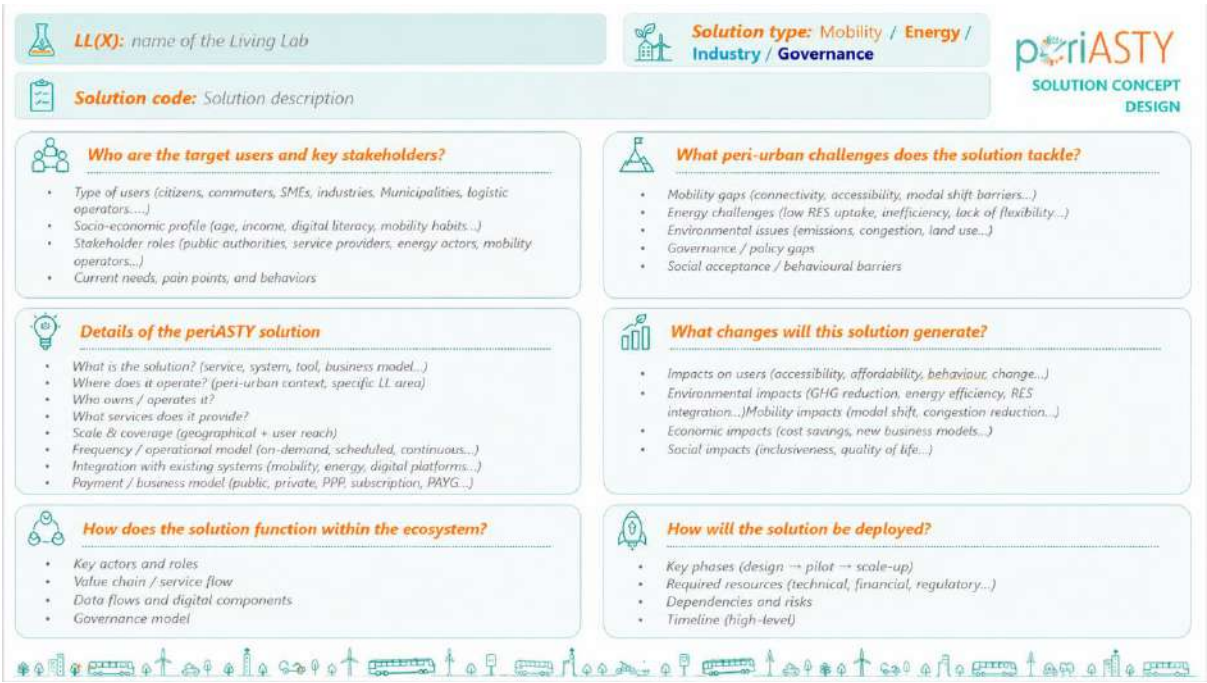


Figure 14. User-friendly Solution Concept Design template

By concentrating these six dimensions on a single canvas, the core template provided participants with a shared overview of the measure and made relationships between the problem, users, solution characteristics, expected changes, ecosystem and deployment approach visible during the discussion. The resulting inputs subsequently informed the extended SCD sections on the solution overview, target users, problem addressed, functional description, technical architecture, implementation scope, climate-neutrality contribution, expected benefits, dependencies and implementation pathway.

b. User Journey & Experience

The **User Journey & Experience template** drafted in Figure 15 examined one principal user profile and use case across five stages: before use, access/start, during use, after use and long-term use. For each stage, participants identified user actions, physical or digital touchpoints and the expected experience. They then considered barriers relating to accessibility, affordability, information, digital access, trust, safety and service performance, together with possible improvements and expected benefits. Separate canvases could be completed where a measure involved substantially different user profiles. These inputs informed the extended SCD's functional description and adoption factors, and relevant BIGM considerations such as incentives and operational responsibilities.



Figure 15. User-friendly User Journey & Experience template

c. Implementation Pathway

The **Implementation Pathway template** shown in Figure 16 translated the proposed concept into an indicative deployment sequence. Participants first defined what would be implemented and which prerequisites were needed, distinguishing available resources from those still to be secured. They then considered five phases: preparation, design, set-up, pilot/demonstration and monitoring/scale-up. For each phase, the canvas captured actors, responsibilities, resources and timing, supported by an assessment of dependencies, risks, milestones and follow-up actions. Its purpose was to establish an initial planning and feasibility basis, with further detail to be developed after the workshop.

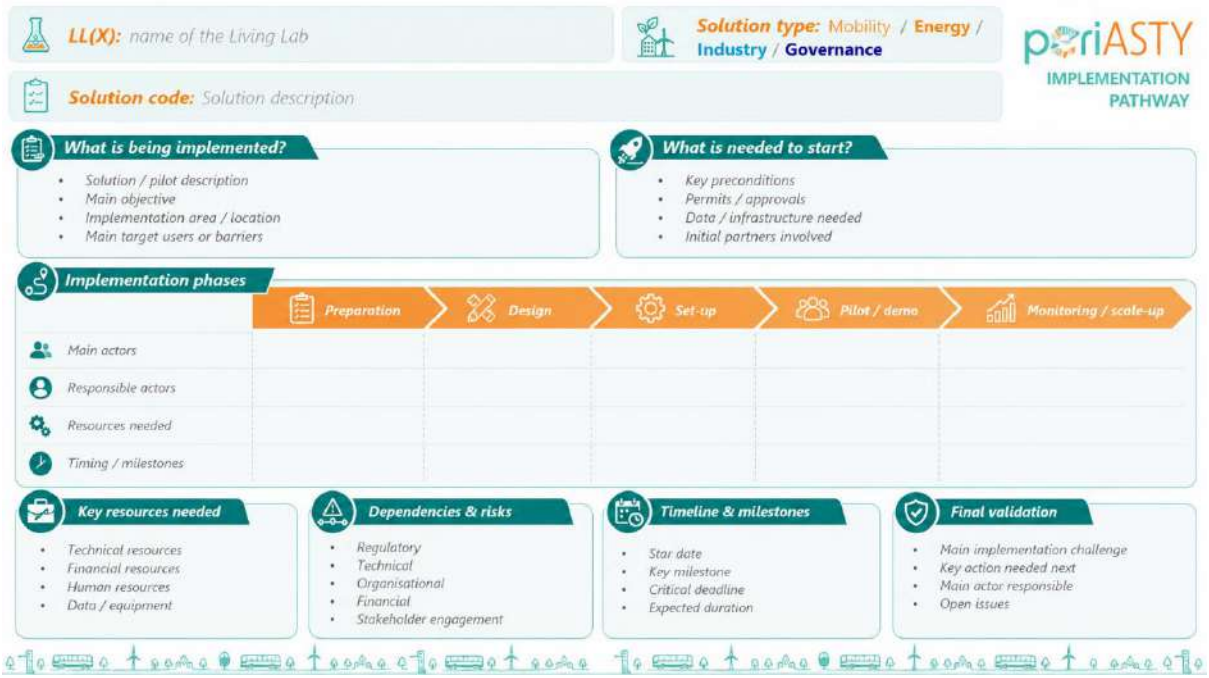


Figure 16. User-friendly Implementation Pathway template

The three canvases allowed stakeholders to contribute according to their expertise while keeping operational, user and implementation perspectives connected. Completed packages recorded design proposals, preliminary agreements, assumptions and unresolved issues for consolidation in the extended SCD. Their complementary focus allowed different dimensions to be explored without overloading a single canvas:

- the core SCD established what the measure was, why it was needed and how it fitted within the local ecosystem;
- the User Journey & Experience template examined for whom the measure was being designed and how it would be experienced; and
- the Implementation Pathway template explored how, by whom, with which resources and under which conditions it could be implemented.

4.3.2. Extended SCD Template

The extended SCD template provided a common structure for consolidating workshop inputs into a detailed description of each measure. Completed by LL leaders and responsible partners, it combined stakeholder contributions with the technical and contextual information required to explain how the solution would operate, how users would interact with it and which conditions would enable implementation. For the purposes of the template, each measure was therefore treated as a solution concept to be progressively developed from the initial description included in the Grant Agreement into a more operational and locally grounded design.

The extended template enabled the information generated during the workshops to be complemented with details that participants could not necessarily provide during a limited co-design session. These additional inputs included the geographical and temporal scope of the demonstration, operational processes, technical components, data requirements, integration with existing systems, regulatory and infrastructure dependencies, links with other periASTY innovations and factors influencing user adoption. Figure 17 presents its structure.



Figure 17. Structure of the extended Solution Concept Design template

A separate template was intended for each measure. Its eight sections cover the solution overview, implementation scope, problem addressed, target users, functional description, technical architecture, dependencies, and user experience and adoption factors. Table 21 summarises the information required and the purpose of each section.

Table 21. Structure and purpose of the extended Solution Concept Design template.

Template section	Information to be provided	Main purpose
1. Solution overview	Solution code, solution name, sector, LL location and a concise description of what the solution is, who it is for and which main function or service it provides	Establish a common and traceable identification of the measure
2. Implementation scope	Preparation, demonstration and monitoring timeframes; demonstration area; map or image of the area; relevant local characteristics	Define where, when and at what practical scale the solution will be implemented
3. Problem addressed	Specific peri-urban challenge and connection with decarbonisation, emissions reduction, energy efficiency, circularity or other climate-neutrality objectives	Explain why the solution is required and how it contributes to the LL's climate-neutrality transition
4. Target users	Citizens, businesses, authorities, service providers and other primary users or secondary stakeholders	Identify the groups that will use, benefit from, manage, implement or be affected by the solution
5. Functional description	Operational logic, principal processes and services, user journey and experience and implementation pathway	Explain how the solution will function in practice from operational and user perspectives
6. Technical architecture	Technologies, tools, platforms, devices, systems, data flows and integration with	Identify the technical components and interfaces enabling the solution

	existing services, infrastructure and periASTY innovations	
7. Dependencies	Infrastructure, data access, regulatory and administrative requirements and dependencies on other project innovations	Clarify the conditions that must be in place and distinguish confirmed elements from assumptions or constraints
8. User experience and adoption factors	Incentives, behavioural-change requirements and risks to user or stakeholder acceptance	Identify the conditions influencing uptake, continued use and acceptance of the solution

The sections form a connected description: the identified problem and users inform the proposed functions, while the operational model must be supported by appropriate technologies, data, infrastructure and implementation arrangements. The User Journey & Experience and Implementation Pathway outputs feed into the functional description, with related requirements elaborated under implementation scope, technical architecture, dependencies and adoption factors.

The level of detail reflects the maturity of each measure. Confirmed elements should be distinguished from assumptions, constraints and information requiring further validation, particularly regarding technical components, data access, regulatory requirements and dependencies on other periInnovations. The template provides an initial design reference, with further technical specification expected as development progresses. Sections 4.5 and 4.6 describe the consolidation and validation procedures.

The extended SCD is used alongside the corresponding BIGM, which develops the value proposition, stakeholder relationships, governance and financing arrangements. Together, they support technical development in WP2 and demonstration preparation in WP3 and WP4. The initial outputs summarised in Section 5 remain subject to refinement through stakeholder follow-up, implementation planning and demonstration experience.

4.4. Development of the prototypical BIGM template

The BIGM templates were developed to define the organisational, governance and economic arrangements supporting each periASTY measure. They complement the SCD by identifying how value is created, delivered and captured, which actors must collaborate, and how responsibilities, resources and financing are organised. A user-friendly canvas supports workshop discussion, while an extended template consolidates the resulting inputs into a prototypical model for each measure.

4.4.1. User-friendly BIGM template

The user-friendly BIGM canvas (Figure 18) enabled stakeholders to discuss how each measure could be organised and sustained. It was designed for collaborative completion after the initial SCD activities, once participants had established the measure's purpose, intended users and proposed operation. Short questions and visual spaces supported contributions through notes, post-its and actor relationships.

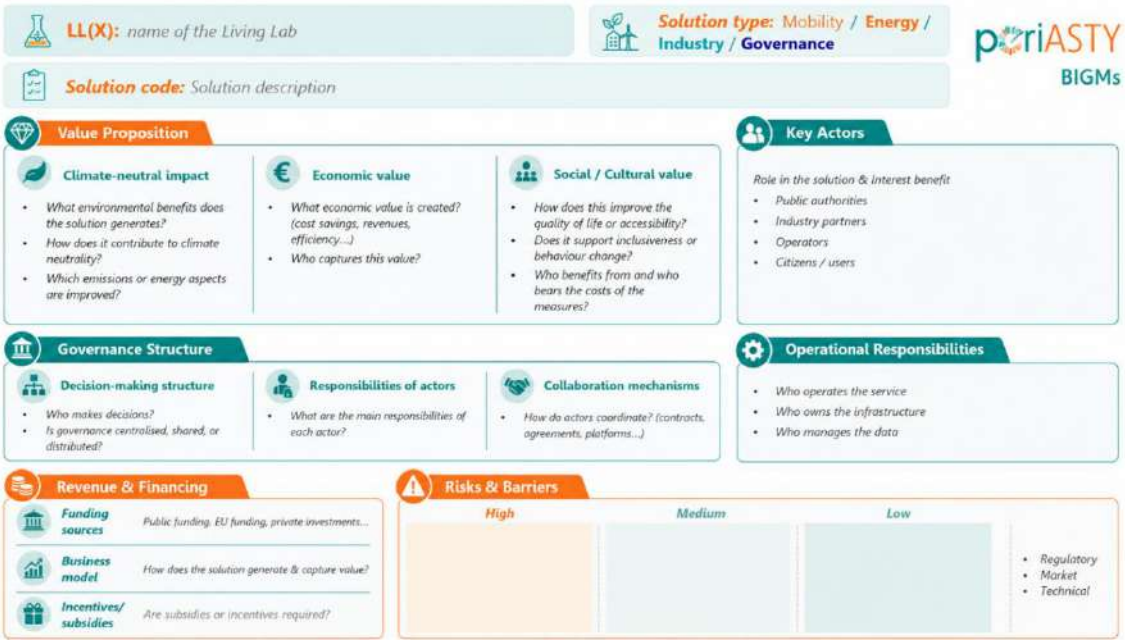


Figure 18. User-friendly Business, Innovation and Governance Model template

The canvas covered six dimensions: value proposition, key actors, governance structure, operational responsibilities, revenue and financing, and risks and barriers. Table 22 summarises their content and purpose.

Table 22. Structure and purpose of the user-friendly BIGM template.

Template section	Information to be provided	Main purpose
1. Value proposition	Climate-neutral value, economic value and social or cultural value generated by the measure; main beneficiaries; expected benefits and potential distribution of value	Establish why the measure is valuable and identify the different forms of environmental, economic and social value that it is expected to create
2. Key actors	Public authorities, industry partners, operators, service providers, infrastructure owners, technology providers, citizens/users and other relevant stakeholders; their roles, interests and level of involvement	Identify the ecosystem of organisations and stakeholder groups required to implement, operate, support or benefit from the measure
3. Governance structure	Decision-making arrangements, responsibilities of the different actors and collaboration mechanisms such as agreements, working groups, contracts, partnerships or data-sharing arrangements	Clarify how the participating actors will coordinate, how decisions will be taken and how responsibilities will be distributed
4. Operational responsibilities	Who operates the service or intervention; who owns or manages the infrastructure; who collects, stores, shares or manages the required data	Define the practical allocation of responsibilities necessary for the day-to-day operation of the measure
5. Revenue and financing	Potential funding sources, business-model logic, subsidies, incentives and other mechanisms that may support implementation, operation or uptake	Explore how the measure could be financed and sustained during demonstration and, where relevant, beyond the project period
6. Risks and barriers	Regulatory, market, technical, financial, organisational or governance barriers; preliminary prioritisation of risks and possible mitigation needs	Identify the main conditions that could constrain implementation, operation, financing or stakeholder uptake and highlight issues requiring further analysis

Value was considered in climate-neutral, economic and social or cultural terms, recognising that many periASTY measures generate public-service improvements, environmental benefits or avoided costs alongside potential revenues. The financing discussion therefore accommodated public funding, subsidies, operational savings and mixed arrangements according to the nature of each intervention.

Participants were encouraged to identify specific organisations and distinguish decision-making responsibilities from service operation, infrastructure ownership and data management. This helped reveal missing actors, unclear responsibilities and coordination needs. Preliminary financing assumptions and barriers were recorded for subsequent assessment.

Each completed canvas provided a stakeholder-informed basis for the extended BIGM, including proposed arrangements, assumptions and unresolved issues. Consolidation and validation followed the procedures described in Sections 624.5 and 4.6.

4.4.2. Extended BIGM template

The extended BIGM template (Figure 19) enabled LL leaders and responsible partners to develop workshop inputs into a detailed account of the actors, governance arrangements and economic conditions supporting each measure. A separate template was intended for each intervention, ensuring that responsibilities and financing assumptions remained linked to its specific operational requirements.

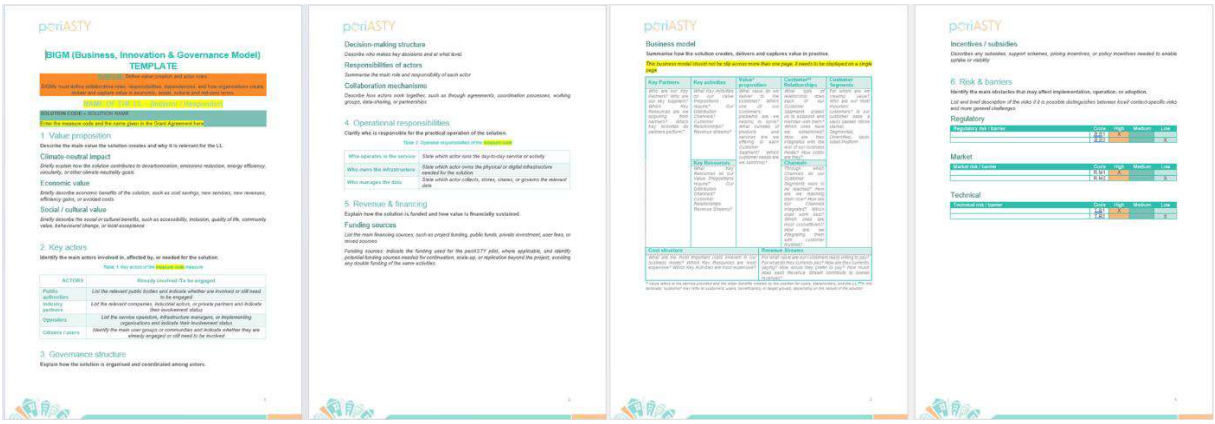


Figure 19. Structure of the extended Business, Innovation and Governance Model template

The extended version retained the six dimensions of the user-friendly canvas while requiring greater detail on actor involvement, collaboration mechanisms, business-model components and risks. Table 23 presents its structure and information requirements.

Table 23. Structure and purpose of the extended Business, Innovation and Governance Model template.

Template section	Information to be provided	Main purpose
1. Value proposition	Climate-neutral impact, economic value, and social or cultural value generated by the measure	Define why the measure is relevant and which forms of value it creates for users, stakeholders and the LL
2. Key actors	Public authorities, industry partners, operators, citizens/users and other relevant organisations, including whether they are already involved or still need to be engaged	Identify the actor ecosystem required for implementation and clarify the status of stakeholder involvement
3. Governance structure	Decision-making structure, responsibilities of actors and collaboration mechanisms	Explain how the measure will be organised, coordinated and governed among participating actors

4. Operational responsibilities	Responsibility for day-to-day service operation, infrastructure ownership and data management	Clarify who is responsible for the practical operation and management of the solution
5. Revenue and financing	Funding sources, business-model logic, key partners, key activities, key resources, customer/user relationships and segments, channels, cost structure, revenue streams and incentives/subsidies	Describe how the solution creates, delivers and captures value and how implementation and longer-term continuity may be financially supported
6. Risks and barriers	Regulatory, market and technical risks, including code and qualitative assessment as high, medium or low	Identify the main obstacles that may affect implementation, operation or adoption and support subsequent mitigation

The extended template distinguished actors already involved from those still requiring engagement and clarified who would take decisions, operate the service, own infrastructure and manage data. These distinctions supported the identification of governance gaps and dependencies on organisations whose participation had not yet been confirmed.

The financing section distinguished resources supporting the periASTY pilot from those potentially required for continuation, scale-up or replication. It also required attention to avoiding double funding of the same activities. Funding sources, incentives and subsidies were considered alongside the resources and activities needed to deliver the measure

The business-model component (Figure 20) organised this information into key partners, activities, resources, value proposition, customer relationships, customer segments, channels, cost structure and revenue streams. Within periASTY, customers may include users, beneficiaries or target groups, and financial sustainability may depend on public-service funding, operational savings or mixed sources as well as direct revenues.

<table>
<tr><td rowspan="2">Key Partners
Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?</td><td>Key activities
What Key Activities do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue streams?</td><td rowspan="2">Value* proposition
What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? What bundles of products and services are we offering to each Customer Segment? Which customer needs are we satisfying?</td><td>Customer** Relationships
What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How are they integrated with the rest of our business model? How costly are they?</td><td rowspan="2">Customer Segments
For whom are we creating value? Who are our most important customers? Is our customer base a Mass Market, Niche Market, Segmented, Diversified, Multi-sided Platform</td></tr>
<tr><td>Key Resources
What Key Resources do our Value Propositions require? Our Distribution Channels? Customer Relationships Revenue Streams?</td><td>Channels
Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?</td></tr>
<tr><td colspan="3">Cost structure
What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?</td><td colspan="2">Revenue Streams
For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?</td></tr>
</table>

** Value refers to the service provided and the wider benefits created by the solution for users, stakeholders, and the LL.** In this template, 'customer' may refer to customers, users, beneficiaries, or target groups, depending on the nature of the solution*

Figure 20. Business model included in the Business, Innovation and Governance Model extended version.

Risks were recorded under regulatory, market and technical categories, with a code and a qualitative high, medium or low assessment. Where relevant, supporting explanations addressed organisational, financial or stakeholder-engagement issues and distinguished local constraints from barriers potentially affecting replication elsewhere.

Consistency with the SCD was required throughout:

- actor roles and operational responsibilities had to correspond to the proposed implementation pathway;
- infrastructure and data arrangements had to match technical dependencies;
- and financing assumptions had to reflect resource needs.

The value proposition, incentives and acceptance risks also need to align with the expected benefits and user requirements. The resulting BIGMs represent the organisational and economic understanding available at the D1.1 stage. They provide a reference for implementation planning and further stakeholder coordination, with refinement expected as partnerships, funding arrangements and demonstration conditions become more clearly defined.

4.5. Translation from workshop inputs to the extended templates

The workshop outputs required a structured consolidation process to become coherent, measure-level SCD and BIGM descriptions. In this context, translation refers to the interpretation and development of stakeholder contributions, including notes, diagrams, preliminary agreements and open questions. Figure 21 presents the process from workshop evidence to reviewed extended templates.



Figure 21. Process to translate co-design workshop discussions and user-friendly templates into validated extended Solution Concept Design and BIGM outputs.

LL leaders or responsible partners first **collected the completed canvases**, rapporteur notes, photographs and supporting materials, linking them to the corresponding LL, measure code and working group. Figure 22 shows examples of these outputs.

Where several groups contributed to the same measure, their inputs were compared to identify shared findings, complementary perspectives and differences requiring clarification.

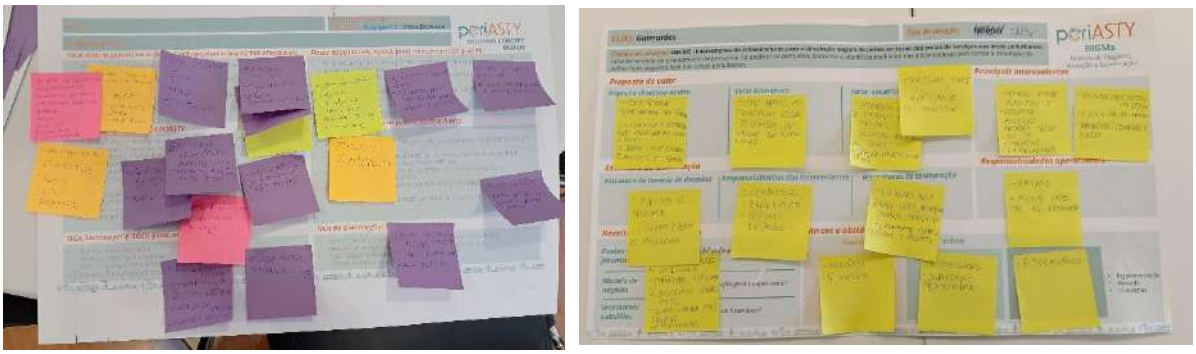


Figure 22. Examples of completed templates collected at the end of the co-creation activities.

The **initial review** distinguished agreed elements from proposals, assumptions, contradictory statements and missing information. Repeated contributions were merged, while unclear or conflicting inputs were referred to the relevant partners or retained as open issues. **Interpretation** was expected to preserve participants' meaning and avoid presenting preliminary suggestions as confirmed decisions.

The user-friendly and extended templates were deliberately designed as two levels of the same methodological framework. The user-friendly versions captured the principal discussion points in an accessible format, while the extended versions provided the structure required to describe each measure in greater technical, operational, user-related, organisational and governance detail.

The workshop guideline included explicit correspondence tables indicating how each section of user-friendly templates should be fed into the extended SCD and BIGM. The principal translation logic is summarised in Table 24.

Table 24. Translation of user-friendly workshop inputs into the extended templates.

User-friendly source	Principal information collected	Main destination in the extended templates
Solution Concept Design	LL and measure identification; target users and stakeholders; peri-urban challenge; solution details; expected changes; position within the local ecosystem; preliminary deployment approach	Solution overview; target users; problem addressed; functional description; technical architecture; implementation scope; climate-neutrality contribution; expected benefits; integration and dependencies; Implementation Pathway; timeline and risks
User Journey & Experience	Main user profile and use case; steps before, during and after use; touchpoints; pain points and barriers; improvement proposals; expected user benefits; open issues	Target users; problem addressed; functional description; User Journey & Experience; technical and service touchpoints; adoption factors; incentives and behavioural requirements; expected benefits; acceptance risks and follow-up needs
Implementation Pathway	Scope of implementation; prerequisites; implementation phases; actors and responsibilities; resources; dependencies and risks; timeline and milestones; next steps	Solution overview and implementation scope; technical architecture; Implementation Pathway and timeline; stakeholder and operational responsibilities; required technologies, infrastructure, data and resources; dependencies, regulations, risks and follow-up actions
BIGM	Value proposition; key actors; governance structure; operational responsibilities; revenue and financing; incentives; risks and barriers	Value proposition; key actors; governance and decision-making arrangements; operational model; ownership and data-management responsibilities; financing and business-model logic; incentives; risks and barriers

LL leaders and responsible partners **developed mapped inputs into explanatory text** that could be understood independently of the workshop discussion. This involved connecting related contributions, specifying organisations and responsibilities where supported, and distinguishing existing conditions from proposed arrangements. The User Journey & Experience and Implementation Pathway were integrated into the SCD, while relevant inputs also informed BIGM responsibilities, incentives, financing and risks.

A **completeness review** identified outstanding technical, operational, regulatory, financial and stakeholder information. **Targeted follow-up** with relevant partners and experts was used to clarify these gaps. Additional information was incorporated where it could be supported or confirmed; otherwise, assumptions, missing inputs and pending decisions remained explicit.

The **SCD and BIGM were cross-checked for consistency** in measure identification and scope, expected benefits and value proposition, actor roles, implementation and operational responsibilities, resource requirements, financing assumptions and adoption barriers. Where inconsistencies emerged, the corresponding descriptions were reviewed together so that changes in one template were reflected in the other.

The consolidated drafts were then shared with the relevant LL partners for **review and validation**, as described in Section 4.6. This step checked that the descriptions reflected the workshop contributions and available local knowledge, while retaining unresolved issues and follow-up needs. The resulting versions provided the initial reference for subsequent development and demonstration planning, with their level of detail reflecting the maturity of each measure.

4.6. Living Lab review and validation process

Following consolidation, the draft extended SCD and BIGM templates were **returned to the relevant LL leaders and partners responsible** for each measure. This review checked that the descriptions accurately reflected the workshop contributions, local context and intended scope of the intervention.

Validation was conducted at measure level, with technical partners, operators or public authorities consulted where clarification was required within their areas of responsibility. LL representatives reviewed the accuracy and completeness of the descriptions, the feasibility of the proposed arrangements at the current stage of development, and the distinction between confirmed information and assumptions. Table 25 summarises the review criteria for both templates:

Table 25. Elements of the SCD and the BIGM to be reviewed by the LL leaders before the co-creation process is finalised.

SCD	BIGM
Measure code, name, sector and implementation area were correctly identified	Climate-neutral, economic and social or cultural value proposition was aligned with the intended outcomes of the measure
Description of the peri-urban challenge accurately reflected the local context	Relevant actors had been identified
Target users and relevant stakeholders were correctly represented	Status of their involvement was correct
Functional description corresponded to the measure that the LL intended to implement	Governance and decision-making arrangements were appropriately described
User journey and experience reflected realistic interactions with the proposed solution	Actor responsibilities were clearly and realistically assigned
Implementation pathway, timing and scope were realistic at the current stage of development	Operational responsibilities for the service, infrastructure and data were correctly identified
Technical architecture and integration requirements were correctly described	Proposed partnerships and collaboration mechanisms were appropriate
Relevant infrastructure, data, regulatory and project dependencies had been captured	Funding sources and business-model assumptions reflected the current knowledge of the LL
Adoption factors, incentives and acceptance risks were appropriately represented	Incentives or subsidies had been correctly identified where relevant
Assumptions or unresolved issues were clearly distinguished from confirmed information	Regulatory, market and technical risks reflected the actual conditions affecting the measure

The review also checked **consistency between the SCD and BIGM**, particularly regarding actor roles, implementation and operational responsibilities, infrastructure and data requirements, expected benefits and financing assumptions. Where feedback affected both documents, the corresponding sections were revised together.

LL feedback was incorporated to correct descriptions and complete missing information where confirmation was available. Matters that could not yet be resolved remained explicitly recorded as assumptions, dependencies or follow-up needs. This preserved the distinction between the intended

design and arrangements still requiring technical assessment, stakeholder agreement or resource commitments.

The revised templates formed the **consolidated outputs for D1.1**. Validation confirmed that the descriptions reflected the current understanding of the relevant LL partners and retained the principal workshop contributions and outstanding uncertainties. It did not constitute final approval of fully specified or implementation-ready solutions.

The process reinforced local ownership by involving the partners responsible for further development and maintained traceability between the initial GA measures, workshop inputs and subsequent clarifications. The consolidated templates provide a reference for continued refinement during technical development, demonstration preparation and implementation.

4.7. Workshop feedback and methodological refinement

The first co-design round tested the common methodology under different local, sectoral and organisational conditions. The assessment draws on LL feedback, implementation observations, the completeness of workshop outputs and issues identified during consolidation. No harmonised participant-satisfaction survey was available across the LLs, so these findings should be interpreted as methodological lessons rather than a systematic assessment of participant experience.

The common toolkit provided a shared structure for examining solution operation, user experience, implementation and business and governance arrangements. Its application highlighted the importance of matching workshop scope and format to measure maturity, available time, stakeholder expertise and access to relevant information

Table 26 consolidates the principal lessons and refinements proposed for subsequent activities. It distinguishes adaptations already adopted from recommendations requiring incorporation into future workshop planning and guidance.

Table 26. Summary of key implementation issues, methodological lessons, and proposed refinements identified during the periASTY co-design workshops.

Implementation observation	Methodological lesson	Adaptation adopted or proposed refinement
In **Helmond**, all groups discussed ten measures, but completed templates for only two during the workshop.	Workshop scope must reflect the number and complexity of measures and the time available.	Allocate specific measures to groups and retain the three-hour agenda as an indicative format. Use parallel groups, prioritisation or additional sessions where necessary.
Sisslerfeld's solution definition depended on ongoing modelling. **Marseille** deferred industry measures because relevant information and implementation conditions were not sufficiently developed.	Readiness includes both a sufficiently defined concept and access to the actors, knowledge and resources needed for meaningful discussion.	Sisslerfeld adopted a phased approach. For future workshops, assess concept maturity, stakeholder availability, technical information and partner resources in advance; use exploratory engagement or defer detailed co-design with explicit follow-up actions where needed.
Stakeholder expertise and participation conditions **varied** across LLs, including voluntary involvement in Sisslerfeld.	Different questions require complementary perspectives, and recruitment must reflect local engagement conditions.	Map stakeholders early and distinguish workshop participants, technical contributors and actors required for later validation. Use targeted interviews or smaller meetings to address missing perspectives.

Broad discussions and extensive template requirements can **limit** the **detail** obtained for individual measures.	Facilitation should prioritise concrete, unresolved design questions.	Pre-fill known information, identify core questions for workshop discussion and distinguish fields that partners can complete afterwards. Request specific examples, locations, resources and barriers.
Generic actor **descriptions** can leave responsibilities and engagement **status unclear**.	A usable governance model requires identifiable organisations and realistic roles.	Record specific organisations where possible, distinguish proposed roles from confirmed responsibilities, and identify actors still requiring engagement.
Workshop notes include **incomplete statements, assumptions and information requiring** confirmation.	Output quality depends on structured consolidation and follow-up as well as workshop discussion.	Retain the user-friendly and extended formats. Clearly label confirmed information, proposals and open issues, and assign follow-up needs to relevant actors with an indicative resolution stage where possible.
Actor roles, incentives, resources and risks appear in several canvases and may be described inconsistently.	Overlapping content provides an opportunity to check agreement between operational and governance arrangements.	Compare related SCD and BIGM fields during consolidation and revise them together before LL validation.
Available **feedback was not collected through a common assessment** across all workshops.	More consistent feedback would strengthen the evidence for methodological refinement.	Introduce a short post-workshop debrief with LL leaders covering timing, question clarity, participation gaps and incomplete outputs, and use the findings to revise guidance.

Subsequent co-design activities should retain common information requirements while adapting the engagement format and timing to local readiness. The proposed refinements focus on obtaining sufficiently detailed inputs for each measure, documenting uncertainty and ensuring that incomplete outputs lead to defined follow-up actions. Their application and the feedback collected after future workshops will inform further updates to the methodology as the measures progress towards demonstration.

5. Initial co-designed solutions and prototypical BIGMs – workshop outputs

This section presents the consolidated outputs resulting from the co-design process described in section 4. It provides the initial portfolio of periASTY solutions and their associated prototypical SCD and BIGMs, based on the information collected during the workshops, the user-friendly templates, the extended templates and the subsequent validation performed by the LLs.

The information generated through the co-design process is extensive and measure-specific. To keep D1.1 readable while retaining the implementation logic captured by the templates, the complete SCD and BIGM files are not reproduced in the main body of the report. Instead, their contents are synthesised into a common measure-level reporting structure that combines the solution-design perspective with the business, governance and implementation perspective. This allows the reader to understand the essential characteristics of each proposed measure while maintaining traceability to the more detailed templates used by the Living Labs.

For each measure, the synthesis therefore focuses on a consistent set of dimensions. Applying the same analytical lens across the nine LLs supports comparison without implying that all measures have reached the same level of maturity. Differences in the level of detail are retained where they reflect genuine differences in local readiness, stakeholder involvement or technical definition.

5.1. Main results per LL and measure

The results presented in the following subsections provide a consolidated overview of the main outcomes obtained through the co-design process carried out with the periASTY LLs. This section extracts and synthesises the information considered most relevant for understanding the current definition of each measure, its expected contribution to the corresponding LL, and the main conditions that will influence its subsequent development and demonstration. The detailed templates therefore constitute the underlying working material, while the results reported here provide a harmonised and comparable representation of the measures across the different LLs.

Two complementary instruments were used to structure the definition of the measures: the SCD and the BIGM. Together, they provide a multidimensional description of each solution, moving beyond a purely technological characterisation. The SCD focuses primarily on what will be implemented, for whom, where and how, covering aspects such as the peri-urban challenge addressed, demonstration scope, target users, functional operation, user experience, technical components, data flows, integration requirements, dependencies and the pathway from concept to demonstration. The BIGM complements this perspective by addressing who is needed to enable and sustain the solution and how value is created, delivered and captured, including the value proposition, key actors, governance arrangements, operational responsibilities, financing and business-model considerations, incentives, and regulatory, market and technical barriers.

The combination of these two perspectives makes it possible to characterise each measure in terms of its technical, operational, institutional, social and economic feasibility. Consequently, the outputs should not be understood simply as descriptions of individual technologies or services. They provide an initial representation of the broader implementation ecosystem required around each measure, including the interaction between local authorities, service operators, technology providers, businesses, citizens and other relevant stakeholders. In particular, the identification of decision-making responsibilities, operational roles, infrastructure ownership, data management and collaboration mechanisms help clarify how the proposed solutions could be embedded within the existing structures of each LL.

A specific emphasis was also placed on the user perspective. The definition of the solutions therefore considered not only how they are expected to operate technically, but also how users will access and interact with them, the main touchpoints throughout the user journey, potential pain points and barriers, expected benefits, and possible changes or support mechanisms required to facilitate uptake. The Solution Concept Design explicitly captures user profiles, use cases, different stages of the user journey, accessibility and behavioural aspects, as well as ideas for improvement and outstanding

issues. This user-centred perspective is particularly relevant within the co-design approach adopted in T1.3, as the effectiveness of the solutions will depend not only on their technical performance but also on their usability, accessibility, acceptance and capacity to respond to locally identified needs.

The level of definition achieved is not necessarily identical across all measures. The nine LLs have different local contexts, starting conditions, stakeholder ecosystems and levels of technical and organisational maturity. Accordingly, some measures may already have relatively well-defined implementation areas, technologies, operators or responsible actors, while others may still require further decisions regarding data access, infrastructure, governance arrangements, financing mechanisms, regulatory requirements or user engagement. The templates were designed to make these differences visible by identifying both confirmed elements and assumptions, constraints, dependencies and open issues. Such differences should therefore be interpreted as part of the outcome of the co-design process rather than as inconsistencies between LLs: they indicate where further development and coordination will be required during subsequent project activities.

For reporting purposes, the information has consequently been organised around a common set of dimensions that capture the most relevant characteristics of each measure. These include the solution concept and peri-urban challenge addressed; demonstration scope and target users; expected operation and user interaction; anticipated climate-neutral, economic and social value; key actors and responsibilities; implementation pathway and enabling conditions; and the most relevant dependencies, barriers and open issues. Where appropriate, technical elements, data requirements, governance arrangements and financing considerations are also highlighted when they are particularly relevant for understanding the feasibility or future development of the measure. More detailed information contained in the extended templates, such as complete user journeys, detailed technical architectures, full Business Model Canvases or exhaustive lists of risks, is not systematically reproduced in the tables below to maintain the readability and comparability of the results.

Particular attention is given to the contribution of each measure to the climate-neutrality transition. Both templates explicitly require consideration of environmental and climate-related value, including aspects such as decarbonisation, GHG-emission reduction, improved energy efficiency, sustainable mobility, renewable energy integration, circularity and more efficient use of resources, depending on the nature of the measure. These contributions are reported alongside the expected economic and social benefits to reflect the wider value generated by the periASTY solutions and their relevance to the specific needs of peri-urban areas.

The results also identify the principal enabling conditions and implementation challenges associated with each measure. These may relate to the availability of infrastructure and data, interoperability with existing systems, permits and regulatory requirements, technical resources, financing, organisational arrangements, stakeholder engagement or user acceptance. The BIGM further structures the main barriers according to regulatory, market and technical dimensions, while the SCD identifies dependencies and risks throughout the implementation pathway. Reporting these aspects is important because the co-design process is intended not only to describe the desired solutions, but also to identify the conditions that need to be addressed to enable their successful deployment.

Finally, the outputs presented in this section should be considered as a design baseline for the subsequent development and demonstration of the periASTY measures, rather than as fixed final specifications. They will support the progressive refinement of technical and operational requirements, engagement of additional actors where needed, clarification of data and infrastructure requirements, resolution of regulatory or organisational dependencies, preparation of the demonstrations, and subsequent monitoring and impact-evaluation activities. The implementation pathway included in the SCD already frames this progression through the stages of preparation, design, set-up, pilot/demonstration and monitoring/scale-up, linking these stages with the actors, responsibilities, resources and milestones required for implementation. The consolidated results below therefore provide both a snapshot of the status reached through the initial co-design process and a structured basis for guiding the next steps towards the implementation, validation and potential future replication or scale-up of the solutions.

5.1.1. Dublin, Balbriggan – LL1

The Dublin LL is led by University College Dublin (UCD), working with Fingal County Council (FCC) on local implementation, stakeholder engagement and data collection. BLEEP supports the Community Bike Library and secure bicycle parking, while SEC contributes to the development of sustainable energy communities.

The Dublin Living Lab focuses on Balbriggan, a rapidly growing peri-urban area within Greater Dublin characterised by a young and culturally diverse population and significant urban–peri-urban mobility and accessibility challenges. The area experienced a population increase of approximately 215% between 1991 and 2022, a development that has been accompanied by socio-spatial inequalities, particularly in urban-fringe areas, and an increasing need to provide sustainable and inclusive mobility and energy solutions adapted to this evolving peri-urban context.

Mobility represents one of the main challenges addressed by the Living Lab. Private cars currently account for approximately 48% of commuting trips, while cycling represents only around 2% of the modal share. In this context, improving the attractiveness and accessibility of sustainable transport alternatives is particularly relevant. Specific challenges include strengthening first- and last-mile connections to the train station, increasing the uptake of cycling, addressing bicycle theft and security concerns around mobility hubs, and improving road safety for cyclists and other vulnerable road users (VRUs). Beyond mobility, the LL also considers the development of renewable and local energy communities, together with the need to reinforce governance capacity and promote more integrated, cross-sectoral planning.

Against this background, the Dublin LL co-design workshop was held on 24 June 2026, bringing together 21 participants to further explore and develop the solutions proposed for Balbriggan. All four measures initially proposed for the Living Lab were addressed during the session, covering complementary aspects of sustainable mobility, mobility safety and local energy transition.

The mobility dimension was represented by three measures. DU-M1 – Community Bike Library proposes a community-led e-bike sharing scheme through which participants can borrow an e-bike for a period of two to three months, allowing them to test its use in their daily activities and explore its potential as an alternative to private-car travel. DU-M2 – Multimodal mobility hub reflective of peri-urban safety needs focuses on improving bicycle security at the train-station mobility hub through secure bike bunkers, access managed through the BLEEP app and tracking systems for rented bicycles. DU-M3 – Generative AI tool for improved peri-urban safety addresses cycling and vulnerable-road-user safety by collecting information through cameras installed on shared bicycles and using a generative AI tool to identify potentially unsafe locations. The concept also envisages an online interface through which citizens can explore safer routes and provide feedback.

The energy dimension was addressed through DU-EN1 – Sustainable Energy Communities for Peri-Urban Transition. This measure focuses on supporting residents associated with selected local buildings in the creation of local energy communities. The proposed approach incorporates engagement activities, including focus groups, to explore local energy needs and support collective decision-making concerning investment in clean-energy solutions.

These four measures provided the basis for the structured discussions carried out during the Dublin workshop. The workshop setting and the tools used to support the co-design process are illustrated in the figures below, including photographs from the session (Figure 23) and examples of the user-friendly templates (Figure 24) used to organise and collect the information discussed by participants. From an organisational perspective, the workshop was completed as planned, with no problems reported by the LL leader.




Figure 23. Collaborative discussion during the Dublin's (Balbriggan) LL workshop on the mobility and energy measures.

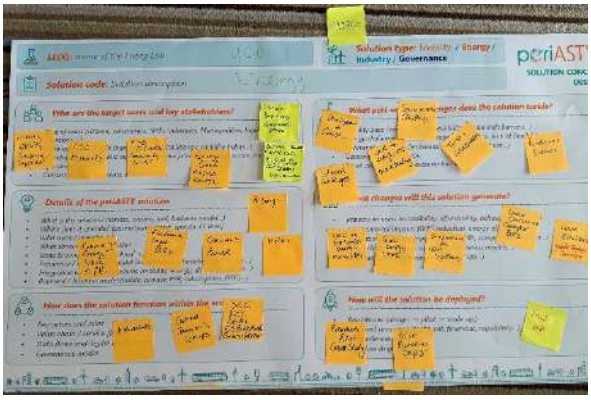
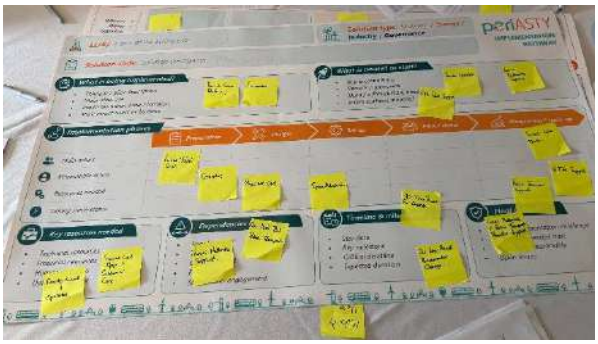



Figure 24. Templates used to structure discussion and information collection during the workshop.

The following Table 27 presents the workshop outputs separately for each of the four measures, reflecting the information gathered and subsequently structured through the co-design templates.

Table 27. Consolidated overview of the main co-design outcomes for Dublin's measures.

DU-M1 – Community Bike Library: A community-led e-bike sharing scheme in Balbriggan. Participants borrow an e-bike for 2-3 months to test it in daily life, experience its benefits, and consider replacing private cars.	
Solution & Concept challenge	High car dependence and very low cycling uptake, reinforced by limited e-bike familiarity, safety concerns and bicycle theft.
Target users	Balbriggan residents, workers and students, including migrants, two-car households and people considering cycling.
Demonstration & operation	BLEEP e-bikes are loaned for two to three months through rolling allocations, supported by an app, maintenance and community monitoring.
Expected value / climate contribution	Encourages modal shift, reduces emissions and congestion, lowers household transport costs and builds confidence in everyday cycling.
Key actors	Fingal County Council, BLEEP, UCD, schools, sports and voluntary groups, cycling organisations and a local repair partner.
Implementation / dependencies	Available fleet, secure storage and distribution, app configuration, maintenance capacity, recruitment, data sharing, funding and partner commitment.
Main risks & open issues	Theft, road safety, low uptake, liability and insurance, maintenance or battery failures, and incomplete monitoring integration.
DU-M2 – Multimodal mobility hub reflective of peri-urban safety needs: Secure bike bunkers will be installed at the train station mobility hub to reduce bike theft. Access will be managed through the BLEEP app, and rented bikes will include tracking for added security.	
Solution & Concept challenge	The rail hub lacks secure, integrated bicycle and micromobility storage, reducing confidence in bike–train travel and increasing theft concerns.
Target users	Rail commuters from Balbriggan and surrounding peri-urban areas, public-transport users and current or potential cyclists.

Demonstration & operation	Secure smart-lock bike bunkers at the station are accessed through the BLEEP app and combined with tracking and journey information.
Expected value / climate contribution	Supports bike–train trips, reduces car commuting and parking demand, and offers a lower-cost, healthier first- and last-mile option.
Key actors	Fingal County Council, BLEEP, the bunker or hub operator, UCD, the National Transport Authority, Irish Rail and transport providers.
Implementation / dependencies	Station space and permissions, bunker and smart-lock installation, reliable operation and customer care, bicycle availability and data agreements.
Main risks & open issues	Public-transport disruption, bicycle or storage shortages, lock and app failures, break-ins, and privacy or data-sharing constraints.
DU-M3 – Generative AI tool for improved peri-urban safety: Shared bikes with cameras will collect safety data while cycling. A generative AI tool will identify unsafe hotspots, and citizens will be able to check safer routes and provide feedback online.	
Solution & Concept challenge	Cyclists and other vulnerable road users face safety risks, while planners lack sufficiently detailed evidence on unsafe locations.
Target users	Cyclists, potential cyclists, pedestrians and other vulnerable road users, together with municipal transport and road-safety planners.
Demonstration & operation	Cameras and GPS on BLEEP bicycles collect route evidence; UCD AI identifies safety hotspots and supports a public safer-route and feedback tool.
Expected value / climate contribution	Enables targeted safety improvements, supports cycling uptake and modal shift, and can reduce emissions, congestion and perceived travel risk.
Key actors	UCD, BLEEP, Fingal County Council, transport and road authorities, cyclists, pedestrians, insurers and bicycle-service partners.
Implementation / dependencies	Cameras, GPS and connectivity, secure hosting, suitable training data, anonymisation and lawful public-road video processing.
Main risks & open issues	Privacy and surveillance concerns, weak user trust, AI or data-quality limitations, cybersecurity issues and approval delays.
DU-EN1 – Sustainable Energy Communities for Peri-Urban Transition: Selected local buildings will support residents in forming Local Energy communities. Focus groups will help identify energy needs and guide collective investment in clean energy solutions.	
Solution & Concept challenge	Rapid growth has outpaced energy infrastructure, while apartment residents face limited access to renewable generation and barriers related to sites, trust and finance.
Target users	Balbriggan households, apartment residents, community groups and businesses, with particular relevance for people experiencing energy poverty.
Demonstration & operation	A Sustainable Energy Community identifies sites and collectively develops renewable assets, supported by focus groups, metering, billing and democratic governance.
Expected value / climate contribution	Expands local renewable energy, can reduce bills and fossil-energy use, improves resilience and enables inclusive community ownership.
Key actors	Balbriggan SEC, Fingal County Council, UCD, SEAI, ESB Networks, Codema, utilities, building owners and community members.
Implementation / dependencies	Suitable sites, feasibility and zoning, grants, legal and ownership agreements, grid connection, metering, data management and durable governance.
Main risks & open issues	Site or zoning conflicts, misinformation and low trust, weak member participation, insufficient finance and unclear governance boundaries.

The workshop validated a complementary package combining access to e-bikes, secure bike–rail interchange, data-supported road safety and community energy. Delivery depends on close coordination among Fingal County Council, BLEEP, UCD (project partners) and community organisations, together with sustained communication and user support. The main issues requiring follow-up are bicycle security and maintenance, safe and lawful use of camera data, integration with transport services, suitable sites and grid arrangements for community energy, and viable long-term funding and governance. Taken together, the measures address both practical barriers to sustainable travel and the institutional capacity needed for local decarbonisation.

5.1.2. Limassol-Kourion – LL2

The Limassol–Kourion LL is led by Kourion Municipality (KOUR), which coordinates local engagement and demonstration activities. MaaSLab (MLAB), PAN, NTUA and TRANSI support mobility service provision, planning and optimisation, while IDEO and the University of Patras (UoP) contribute to industrial measures, circular-economy approaches, Local Green Deals and smart waste management.

The Limassol Living Lab focuses on Kourion, in West Limassol, a rapidly growing peri-urban area characterised by outward residential expansion, a diverse population and a significant industrial presence. The area reflects several of the challenges associated with the transition of peri-urban territories towards climate neutrality, particularly regarding mobility patterns, industrial activities and the coordination of different sectors through integrated governance. At the same time, existing initiatives related to waste management and circular economy provide an important foundation upon which the solutions developed within periASTY can build.

Mobility represents one of the main challenges in Kourion. Travel patterns are currently characterised by a very high dependence on private cars, accounting for approximately 93% of trips, while public transport represents only around 2%. This situation highlights the need to improve the performance, reliability and geographical coverage of public transport services, while providing more flexible alternatives capable of responding to the dispersed and heterogeneous mobility demand typical of peri-urban areas. Particular attention is also required to improve multimodal connectivity between Kourion and the main urban mobility hubs in Limassol, as well as to provide suitable shared and on-demand transport options for families, people with disabilities, commuters and tourists. These mobility challenges are further influenced by the continued residential expansion of peri-urban areas, partly associated with high rental costs in the urban areas of Limassol.

Alongside mobility, the LL has a strong industrial and circular-economy dimension. Kourion includes 1,544 industries located across two industrial zones, where industrial activities remain highly dependent on fossil fuels. Consequently, the transition towards more sustainable industrial practices requires not only improvements in energy use but also more efficient approaches to waste management, recycling logistics and the circulation and reuse of materials. Existing circular-economy initiatives, including the Green Dot and the “Pay as You Throw” scheme, provide a starting point for strengthening urban mining practices, material reuse and the development of marketplaces through which citizens and businesses can exchange resources that might otherwise become waste.

The LL therefore addresses mobility, industry and governance as interconnected components of the peri-urban transition. In addition to sector-specific interventions, there is a need to strengthen integrated cross-sectoral governance, planning capacity and data-supported decision-making, allowing information from different local systems and services to be considered jointly.

Against this background, the Limassol LL co-design workshop was held on 22 June 2026, with the participation of 30 attendees. All nine measures proposed for the LL were addressed during the workshop, covering four mobility measures, four industry and circular-economy measures, and one cross-sectoral governance measure. The workshop was completed as planned, with no problems reported by the Living Lab leader.

Within the mobility domain, four complementary measures were considered. KOUR-M1 – Shared on-demand mobility for families & disabled people proposes a shared door-to-door DRT service operated with minibuses, addressing, among other needs, children's trips to scheduled activities and improving accessible transport options for people with disabilities. KOUR-M2 – Optimization of PT operations &

reliability focuses on analysing and improving existing public transport routes, stops and timetables, supported by simulation and updated GTFS data to improve service coverage, reliability and planning. KOUR-M3 – Improve multimodal connectivity of mobility hubs in peri-urban areas addresses the connection between the urban mobility hub and peri-urban transport services, focusing on the synchronisation of timetables and demand information to facilitate transfers between buses and other transport modes. Finally, KOUR-M4 – Microtransit for commuters & tourists proposes on-demand minibus services connecting peri-urban areas with Limassol city centre and the industrial zones, providing a more flexible transport option for commuters and visitors.

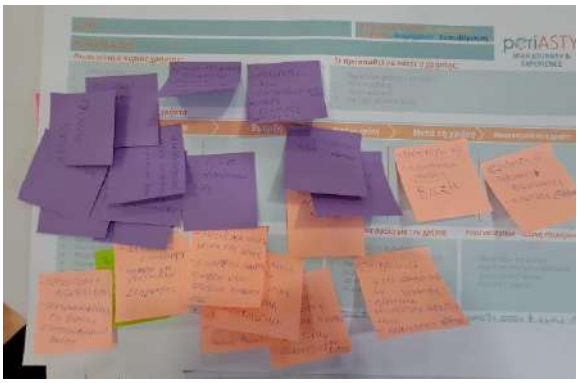
The industry and circular-economy domain comprises another four measures addressing different stages of material management and industrial transition. KOUR-IN1 – Urban mining market platform connected to the Green Dot proposes a digital platform linked to Green Dot collection points where reusable materials and products, including furniture, electronics and construction items, can be made visible and redirected towards reuse rather than disposal. KOUR-IN2 – Waste management & logistics operations improvements focus on tagging recycling bins, optimising collection routes and upgrading the existing application to increase the efficiency of recycling operations and encourage circular-economy participation. KOUR-IN3 – LGD Action Plan for industries envisages the development of a practical action plan to guide industries towards more sustainable practices across areas such as energy, mobility, construction and tourism. Complementing these measures, KOUR-IN4 – Circular economy marketplace proposes a marketplace through which citizens and businesses can exchange, sell, purchase or donate goods and where companies can trade industrial and commercial waste so that these materials can become useful inputs for other activities.

Finally, the cross-sectoral dimension is represented by KOUR-G1 – AI cross-sectoral data warehouse. This measure envisages a digital twin platform integrating information from mobility, energy and other local data sources, thereby supporting more coordinated planning and integrated governance across the FUA.





Figure 25. Participants during the Limassol's (Kourion) LL co-design workshop held on 22 June 2026.



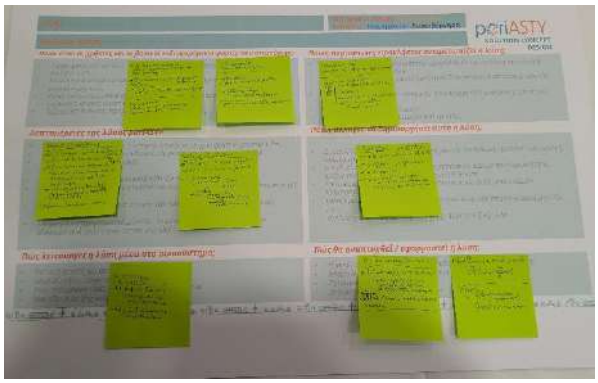


Figure 26. Templates used to structure the discussion and collection of information on the measures addressed during the workshop.

Together, these nine measures constituted the basis for the structured co-design activities carried out during the Limassol workshop. The workshop setting and collaborative process can be illustrated

through photographs from the session (Figure 25), while examples of the user-friendly templates (Figure 26) can be included to show how the proposed measures were presented to participants and how the discussions were structured. These visual elements provide context for the detailed measure-level outputs presented in the following Table 28, where the information collected during the workshop is organised and reported for each of the measures addressed.

Table 28. Consolidated overview of the main co-design outcomes for Limassol's measures.

KOUR-M1 – Shared on-demand mobility for families & disabled people: A shared door-to-door DRT service using minibuses. Families can register children's activity schedules, while people with disabilities gain more accessible transport options.	
Solution & Concept challenge	Dependent passengers in Kourion have few accessible transport options, forcing parents and caregivers to make repeated car trips at busy times.
Target users	Working parents, children and teenagers travelling to scheduled activities, with later extension to people with disabilities, older adults and other dependent users.
Demonstration & operation	Users pre-book trips through an app or assisted channel; MaaSLab groups requests and generates daily routes, while EMEL operates accessible minibuses using a hybrid door-to-door or cluster model with live trip information.
Expected value / climate contribution	Consolidating individual car journeys can reduce emissions and congestion, release caregivers' time and provide safer, more inclusive access for dependent users.
Key actors	Kourion Municipality and its municipal departments, MaaSLab, EMEL, the Ministry of Transport, schools and industry stakeholders, parents, dependent passengers and accessibility groups.
Implementation / dependencies	Demand and accessibility data, accessible vehicles, fleet and driver availability, booking, routing and tracking systems, suitable cluster stops, operating permissions, fare rules and pilot funding.
Main risks & open issues	Licensing or agreement delays, safety and trust concerns for minors, limited fleet capacity, pricing constraints, low uptake and temporary failures in booking, routing or tracking systems.
KOUR-M2 – Optimization of PT operations & reliability: Existing bus routes, stops, and timetables will be analysed and improved. Simulations and updated GTFS data will support better coverage, reliability, and service planning.	
Solution & Concept challenge	Existing routes, stops and timetables do not fully match dispersed peri-urban demand, limiting public-transport coverage, reliability and attractiveness.
Target users	Residents, commuters, students, older adults, people with disabilities and low-income households, together with visitors, operators and transport planners.
Demonstration & operation	MLAB and NTUA map the network and simulate route, stop and timetable scenarios; TRANSI updates the validated GTFS information, while EMEL and the authorities assess feasibility and approve or implement changes.
Expected value / climate contribution	More reliable and accessible services can support modal shift, reduce congestion and emissions, and improve the use of the existing fleet and infrastructure.
Key actors	Kourion Municipality, the Ministry of Transport, EMEL, MLAB, NTUA, TRANSI, citizens and users, employers, schools, businesses and tourism stakeholders.
Implementation / dependencies	Complete operational and GTFS data, formal data-sharing, realistic simulation, operator coordination, authority approval and an agreed process for maintaining updated service information.
Main risks & open issues	Approval delays, unclear responsibilities, missing or outdated data, model limitations, continued car dependency, low awareness and digital exclusion.

KOUR-M3 – Improve multimodal connectivity of mobility hubs in peri-urban areas: The urban mobility hub will be better connected with peri-urban transport services. Timetables and demand data will be synchronised to improve transfers between buses and other modes.	
Solution & Concept challenge	Poor timetable coordination, long waits and uncertain transfers between peri-urban buses and modes at the Limassol mobility hub make multimodal travel unattractive.
Target users	Peri-urban residents, commuters, students, workers, older adults, people with reduced mobility, low-income households, visitors and tourists transferring through the hub.
Demonstration & operation	Multimodal timetable, demand, fleet and transfer data are onboarded and used by NTUA and MLAB to simulate synchronisation scenarios; operators validate feasibility and TRANSI updates the agreed timetable information.
Expected value / climate contribution	More predictable transfers and better use of existing services can reduce waiting, increase patronage and make sustainable multimodal journeys a credible alternative to the private car.
Key actors	Kourion Municipality, the Ministry of Transport, EMEL, hub and shared-mobility operators, MLAB, NTUA, TRANSI, employers, schools, tourism stakeholders and users.
Implementation / dependencies	A confirmed hub and mode set, consistent multimodal and GTFS data, transfer-time and demand evidence, operator coordination, data-sharing agreements, accessible interchange facilities and timetable approvals.
Main risks & open issues	Fragmented responsibilities, missing or inconsistent data, operator resistance, missed connections, weak physical transfer conditions, continued car dependency and exclusion of users without digital access.
KOUR-M4 – Microtransit for commuters & tourists: On-demand minibuses will serve trips between peri-urban areas, Limassol centre, and industrial zones, supporting commuters and visitors with more flexible mobility.	
Solution & Concept challenge	Dispersed settlements, limited fixed-route coverage and poorly served shift and visitor trips reinforce car dependency between Kourion, Limassol centre and industrial or tourism destinations.
Target users	Residents and commuters, industrial workers, students, older adults and people without a car, as well as tourists, employers and local businesses.
Demonstration & operation	On-demand or semi-flexible minibuses group bookings made through an app, website, phone or assisted channel, with services adapted to commuter peaks, industrial shifts, tourism periods and off-peak demand.
Expected value / climate contribution	Shared trips improve access to jobs, services and destinations, support first- and last-mile connections, and can reduce private-car kilometres, congestion, parking demand and emissions.
Key actors	Kourion Municipality as the proposed pilot operator, the Ministry of Transport, MLAB, EMEL, booking and routing providers, employers, industrial and tourism stakeholders, mobility-hub actors and users.
Implementation / dependencies	Suitable vehicles and stopping points, demand and shift data, booking, routing, dispatch and payment tools, permits, accessible non-digital channels and integration with KOUR-M2, KOUR-M3 and existing public transport.
Main risks & open issues	Low or seasonal demand, excessive waiting or detours, unclear fares and operating model, digital exclusion, licensing and data-protection requirements, and uncertain long-term finance.
KOUR-IN1 – Urban mining market platform connected to the Green Dot: A digital platform linked to Green Dot collection points will show available reusable materials, furniture, electronics, and construction items, supporting reuse instead of disposal.	

Solution & Concept challenge	Reusable goods and materials reach landfill because Green Dot items are not visible or connected to potential users before becoming waste.
Target users	Citizens, businesses, Green Dots, schools, social organisations, repair services and users seeking affordable reusable items.
Demonstration & operation	Green Dots and other users list reusable items with location and condition; users arrange donation, exchange, sale or collection.
Expected value / climate contribution	Extends product life, reduces waste and illegal dumping, saves resources and costs, and supports circular-economy and social objectives.
Key actors	Municipalities, Green Dots, businesses, schools, NGOs, social enterprises, repair providers, logistics services and the future platform operator.
Implementation / dependencies	Clear governance and business model, secure user-friendly platform, ICT hosting, logistics and repair partnerships, data protection and product rules.
Main risks & open issues	Uncertain long-term finance, transport of bulky items, low awareness or trust, listing quality, legal liability and GDPR compliance.
KOUR-IN2 – Waste management & logistics operation improvements: Recycling bins will be tagged and collection routes improved. The existing app will be upgraded to make recycling collection more efficient and increase circular economy engagement.	
Solution & Concept challenge	Fixed collection schedules, limited real-time information and weak segregation cause overflowing bins, inefficient routes, contamination and avoidable costs.
Target users	Households, businesses and SMEs, municipal waste services, collection operators and technology or maintenance providers.
Demonstration & operation	Tagged bins, optional fill-level sensors and user reports feed a digital platform that supports collection scheduling and route optimisation.
Expected value / climate contribution	Reduces unnecessary collection trips, fuel use and emissions; improves recycling, service responsiveness and municipal resource allocation.
Key actors	Kourion Municipality, Green Dot Cyprus, local government bodies, businesses, ICT and sensor providers, collection operators and citizens.
Implementation / dependencies	Bins and sensors, mobile and dashboard access, GPS and operational data, system integration, procurement, training and GDPR compliance.
Main risks & open issues	Low participation, procurement delays, unclear data responsibilities, vandalism, sensor or connectivity failures and inaccurate reports.
KOUR-IN3 – LGD Action Plan for industries: A practical action plan will guide industries towards more sustainable practices in energy, mobility, construction, tourism, and other key sectors.	
Solution & Concept challenge	Industrial sustainability actions are fragmented and constrained by limited coordination, finance, expertise and a common local governance framework.
Target users	Industries and SMEs, municipal and national authorities, business and professional bodies, consultants, universities, NGOs and community representatives.
Demonstration & operation	Kourion Municipality coordinates engagement, voluntary commitments, joint actions, monitoring, communication, capacity building and access to support or finance.
Expected value / climate contribution	Accelerates industrial decarbonisation, efficiency and circularity while reducing costs, strengthening competitiveness and building shared responsibility.
Key actors	Kourion Municipality, government departments, EAC, chambers and professional bodies, industries, Green Dot Cyprus, universities, NGOs and consultants.

Implementation / dependencies	Sustained participation, clear governance and monitoring, reliable organisational data, training, finance and alignment with environmental and energy policy.
Main risks & open issues	Weak industry participation, changing priorities, limited funding, incomplete or non-standard data, insufficient expertise and poor coordination.
KOUR-IN4– Circular economy marketplace: A marketplace will allow citizens and businesses to exchange, sell, buy, or donate items. Companies can also trade industrial and commercial waste as useful inputs.	
Solution & Concept challenge	Functional household, commercial and industrial items are discarded because no organised channel connects potential providers and re-users.
Target users	Citizens, businesses, schools, social and charitable organisations, repair providers and users seeking reusable goods or secondary materials.
Demonstration & operation	Users list items with descriptions and condition, search offers and arrange donation, exchange, sale or collection before waste disposal.
Expected value / climate contribution	Prevents waste, retains materials in use, lowers purchase and disposal costs and supports industrial symbiosis and social redistribution.
Key actors	Municipalities, businesses, platform operator, technology provider, repair and logistics services, schools, NGOs, charities and citizens.
Implementation / dependencies	Governance and sustainable business model, secure accessible platform, verification, logistics, storage or repair partnerships, GDPR and transaction rules.
Main risks & open issues	Transport constraints, limited trust or awareness, poor listing management, restricted product categories, financing and legal responsibility.
KOUR-G1– AI cross-sectoral data warehouse: A digital twin platform will integrate data from mobility, energy and other local sources to support better planning and integrated governance across the FUA.	
Solution & Concept challenge	Fragmented mobility, energy, land-use, environmental and socio-demographic data limit coordinated planning across the Functional Urban Area.
Target users	Municipal planners, technical officers, authorities and operators; citizens and businesses benefit indirectly from better-informed decisions.
Demonstration & operation	A cross-sectoral data warehouse and digital twin harmonise, visualise and analyse datasets and scenarios across sectors and geographical scales.
Expected value / climate contribution	Supports evidence-based climate planning, reduces duplicated analysis, improves investment prioritisation and makes governance more transparent and inclusive.
Key actors	Kourion Municipality, wider Limassol authorities, MLAB, NTUA, ministries, transport and energy operators, utilities and other data providers.
Implementation / dependencies	Secure hosting, databases and APIs, formal data-sharing agreements, common standards and metadata, regular updates, access controls and cybersecurity.
Main risks & open issues	Unclear ownership and access rights, reluctant providers, incomplete or incompatible data, weak adoption and uncertain long-term maintenance.

The workshop indicates that the nine measures should be implemented as one portfolio rather than as isolated pilots. In mobility, KOUR-M2 establishes the fixed-network and GTFS backbone, KOUR-M3 improves transfers at the mobility hub, and KOUR-M1 and KOUR-M4 add flexible services where conventional public transport cannot adequately serve dependent passengers, shift workers and visitors. Before piloting, the two on-demand concepts should be clearly separated by target group, geography and operating period, while assessing whether they can share vehicles, booking tools and

back-office functions. Demand, shift-pattern and tourism data, together with authority and operator agreements, are therefore on the critical path. Across the wider portfolio, the data warehouse can provide a common evidence base for monitoring, while the circular-economy measures require clear ownership, sustained business participation and a sharper distinction between KOUR-IN1 and KOUR-IN4.

5.1.3. Marseille, 11-16 districts – LL3

The Marseille LL is led by the City of Marseille (MARS). WIMOOV supports inclusive mobility, LIME and VOI contribute shared micromobility services, and CITIZ and AGAM support shared-car provision and mobility planning. NTUA contributes transport analysis related to materials and waste management.

The Marseille Living Lab focuses on the city's peri-urban districts 11–16, where mobility, social inclusion, industrial activity and governance challenges intersect. Marseille is France's second-largest city and one of the EU Mission Cities. Although the city has a dynamic economy, particularly in sectors such as culture and tourism, its peri-urban areas are characterised by marked social inequalities, an ageing population and comparatively limited access to sustainable mobility options. These conditions make Marseille a relevant setting for exploring how mobility and circular-economy solutions can support the transition of peri-urban areas towards climate neutrality.

Mobility constitutes one of the principal challenges addressed by the LL. Peri-urban areas are characterised by high private-car dependency, limited public transport provision and weak first- and last-mile connections to the main transport nodes. Shared-mobility services are also more strongly concentrated in the urban core, highlighting the need to expand their geographical coverage and adapt them to the specific characteristics of peri-urban demand. At the same time, the Living Lab must consider the affordability and accessibility of these services, particularly for disadvantaged users, as well as appropriate pricing and communication strategies capable of encouraging their uptake.

The Marseille context nevertheless provides an existing base upon which new mobility services can build. In particular, CITIZ currently operates 180 car-sharing vehicles and 104 parking stops across Marseille and Avignon. The proposed measures therefore seek not only to introduce additional mobility alternatives, but also to examine how existing shared-mobility ecosystems can be expanded beyond the urban core and better connected with the wider transport network.

Beyond passenger mobility, the Living Lab also considers the potential role of smaller and more energy-efficient vehicles in supporting local logistics. This responds to the need to address mobility and logistics jointly in peri-urban areas, where passenger and goods movements can contribute to congestion and emissions. More broadly, the Marseille Living Lab faces challenges related to industrial and logistics emissions associated with material and waste flows, together with the need to strengthen circular-economy practices.

Governance represents an additional cross-cutting challenge. Mobility responsibilities are distributed among different public authorities, transport operators and service providers, requiring coordination between stakeholders and alignment with wider regional mobility policies. This fragmented governance environment reinforces the importance of collaborative processes when defining how the proposed solutions should operate, which actors need to be involved and how the different services can be integrated within the existing mobility system.

Against this background, the Marseille co-design workshop was held on 8 June 2026, with the participation of nine attendees. Four measures had originally been proposed for the Living Lab, comprising two mobility measures and two industry-related measures. During this first round of co-creation, the workshop focused specifically on the two mobility measures, MRS-M1 and MRS-M2. The industry-related measures were not addressed at this stage because the Marseille Living Lab partners were not yet in a position to develop them within the first co-creation round, notably because none of the Marseille LL partners receive project funding for these measures. The Living Lab also requires a demonstration period of at least seven months, which constitutes an important consideration for the subsequent development and implementation of the selected solutions.

The first mobility measure, MRS-M1 – Extend shared mobility & micromobility to peri-urban areas, concerns the extension of car-sharing, bike e-sharing, e-scooters and social-leasing schemes to Marseille's peri-urban districts. The measure is intended to strengthen first- and last-mile connectivity and provide alternatives to private-car use by expanding shared-mobility services beyond the urban core.

The second measure addressed during the workshop, MRS-M2 – Intermediary vehicles for passengers & logistics in peri-urban areas, explores the use of small, energy-efficient intermediary vehicles for both passenger transport and local logistics. This dual-purpose concept responds to the particular mobility characteristics of peri-urban areas by considering passenger and goods movements within the same broader mobility framework.

The workshop photographs included below provide a visual record of the co-design session and the interaction between participants (Figure 27). In parallel, examples of the user-friendly templates illustrate the instruments used to structure the discussion around the proposed measures and to support the collection of information in an accessible and consistent manner.



Figure 27. Collaborative discussion during Marseille's LL workshop (left) and example of user-friendly template completed during the activity (right).

The following Table 29 then presents the detailed workshop outputs for the two mobility measures addressed during the session.

Table 29. Consolidated overview of the main co-design outcomes for Marseille's measures.

MRS-M1 – Extended shared mobility & micromobility to peri-urban areas: Marseille will extend car-sharing, bike e-sharing, e-scooters, and social leasing to peri-urban areas. The aim is to improve first/last-mile connections and reduce private car use.	
Solution & Concept challenge	Northern peri-urban districts have weak transport connectivity, scarce cycling infrastructure and high car dependence, congestion and air pollution.
Target users	Adult residents and workers with smartphones; local employers and their employees also benefit from improved commuting options.
Demonstration & operation	Voi and Lime provide self-service e-bikes and e-scooters from designated stations, located and unlocked through their applications.
Expected value / climate contribution	Supports first- and last-mile modal shift, reduces car use, emissions, noise and congestion, and can shorten local journeys.
Key actors	City of Marseille, AGAM, Metropolitan Authority, Voi, Lime, residents, workers and local employers.
Implementation / dependencies	Political approval, operator permits, station locations, markings and possible racks or signs, app access, service data and communication.

Main risks & open issues	Low profitability, affordability and awareness barriers, unsafe cycling conditions, vandalism and excessive fleet concentration in coastal areas.
MRS-M2 – Intermediate vehicles for passengers & logistics in peri-urban areas: Energy-efficient small vehicles will support both passenger trips and local logistics. The service will target low-income households and businesses with more affordable, sustainable transport options.	
Solution & Concept challenge	High private-car ownership and limited alternatives constrain modal shift and consume public space in L'Estaque and neighbouring districts.
Target users	Adult residents and workers, cost-conscious households, vulnerable users referred by social organisations, businesses and institutions.
Demonstration & operation	Citiz provides subscription-based, round-trip electric car-sharing: vehicles are booked through an app and returned to fixed charging stations.
Expected value / climate contribution	Can reduce car ownership, parking demand and emissions while providing occasional, lower-cost vehicle access and freeing public space.
Key actors	City of Marseille, Metropolitan Authority, Citiz, employers, institutions, social organisations and residents.
Implementation / dependencies	Approved station locations, public-space permissions, installed charging points, coordination with the Metropolitan Authority and targeted communication.
Main risks & open issues	Underuse and operating deficit, station-delivery delays, vandalism, difficult relocation and reputational risk if stations close after the pilot.

The workshop points to a two-tier shared-mobility strategy for Marseille's northern peri-urban districts. Shared e-bikes and scooters can address short first- and last-mile connections to rail and bus services, while round-trip car sharing can cover longer or occasional journeys that are difficult to make by active or public transport. Their value is therefore complementary, but only if they are planned as a connected network around a limited number of high-demand interchange and neighbourhood nodes. A dispersed deployment with poor cycling access or weak links to public transport could add vehicles without materially reducing car ownership or use. The pilot should prioritise station locations using accessibility and demand evidence, coordinate user information and pricing incentives, and use early uptake data to rebalance fleets and relocate underperforming stations before scale-up. Affordability is particularly important in lower-income areas.

5.1.4. Ljubljana, Urban Region – LL4

The Ljubljana LL is led by the Regional Development Agency of the Ljubljana Urban Region (RRAL), which coordinates local implementation and stakeholder engagement. Nomago (NOM) contributes mobility operations and services, MaaSLab (MLAB) supports the on-demand platform and its integration, and NTUA provides algorithms for micromobility rebalancing and public transport optimisation.

The Ljubljana Living Lab is located within the Ljubljana Urban Region, a broad and spatially dispersed functional area comprising 25 municipalities, 921 settlements and 549,171 residents. The region is strongly influenced by the concentration of economic activities and services in the city of Ljubljana, inward migration and substantial daily commuting flows between the urban core and its surrounding municipalities. These territorial characteristics generate mobility patterns that are representative of many European peri-urban areas, where dispersed settlement structures and uneven access to transport services contribute to a high dependence on private vehicles.

Mobility constitutes the central focus of the Ljubljana Living Lab. Approximately 60% of journeys are made by private car, while around 140,000 commuters travel to Ljubljana every day, creating considerable pressure on the regional transport system. At the same time, some lower-density peri-urban areas remain poorly served by regular public transport, resulting in accessibility gaps and forms

of mobility poverty, particularly for people who depend on public or shared transport to reach essential destinations such as employment, healthcare and education.

These conditions highlight the need to provide more flexible and inclusive mobility alternatives that can respond to dispersed demand while complementing the existing public transport network. Improving first- and last-mile connectivity is particularly relevant, as current micromobility and shared-mobility services have limited coverage in the peri-urban fringe. The relatively small number of bike-sharing stations outside the urban core restricts their potential role as feeders to public transport. Consequently, better integration between shared bikes, buses and other transport services is required to support multimodal journeys across the wider region.

Transport equity represents another important consideration within the Living Lab. Improving mobility provision is not limited to increasing service coverage but also requires considering the accessibility, affordability and usability of the services provided. Particular attention is therefore given to communities with limited existing transport options, commuters, people with disabilities and users making essential trips. These challenges are accompanied by a broader governance dimension, as effective implementation requires stronger regional coordination and integrated mobility planning across the municipalities and organisations operating within the Ljubljana Urban Region.

Against this background, the Ljubljana Living Lab co-design workshop was held on 8 June 2026, bringing together 16 participants to discuss and further define the three mobility measures proposed for the region. **All three measures were addressed during the session**, which was completed as planned, with no problems reported by the Living Lab leader.

The first measure, LJ-M1 – On-demand mobility service for peri-urban areas, focuses on providing a flexible bus-based service for underserved and low-density areas. The concept is intended to connect these communities with essential destinations and services, including healthcare, education and employment. The proposed service also envisages integrating on-demand transport and shared bicycles within NOM's digital platform, providing users with a common interface for accessing information, booking mobility services and supporting their coordination.

The second measure, LJ-M2 – Micromobility network with regional shared bikes & synchronization with PT, addresses the expansion of the existing bike-sharing system towards peri-urban areas. Additional bicycles and docking stations are envisaged as a means of strengthening last-mile connections with public transport. The concept also considers the use of algorithms to support the distribution of shared bicycles according to demand and their coordination with existing bus schedules, thereby facilitating more seamless multimodal journeys between peri-urban locations and the urban core.

The third measure, LJ-M3 – Addressing mobility poverty, focuses specifically on areas and communities with insufficient transport provision. The measure envisages identifying currently underserved areas and considering how existing roads and mobility services could be reorganised to improve their accessibility. It also incorporates the exploration of alternative pricing and business models, recognising that the long-term viability of peri-urban mobility services depends on achieving an appropriate balance between accessibility and affordability for users and the operational sustainability of the service.

Together, the three measures provide a complementary response to the principal mobility challenges identified in the Ljubljana Urban Region. While LJ-M1 addresses flexible mobility provision in areas where conventional public transport may be insufficient, LJ-M2 focuses on extending micromobility and strengthening its integration with public transport, and LJ-M3 introduces a broader accessibility and transport-equity perspective. Their joint consideration during the workshop enabled the co-design process to address mobility provision, multimodal integration and mobility poverty within the same regional framework.

The photographs included below (Figure 28) provide a visual record of the Ljubljana co-design workshop and the interaction between participants during the session. In addition, examples of the user-friendly templates are included to illustrate the tools used to facilitate and structure the discussion around each proposed measure (Figure 29). These templates provided participants with a common framework through which the different dimensions of the solutions could be considered before the information was subsequently organised into the more detailed project templates.

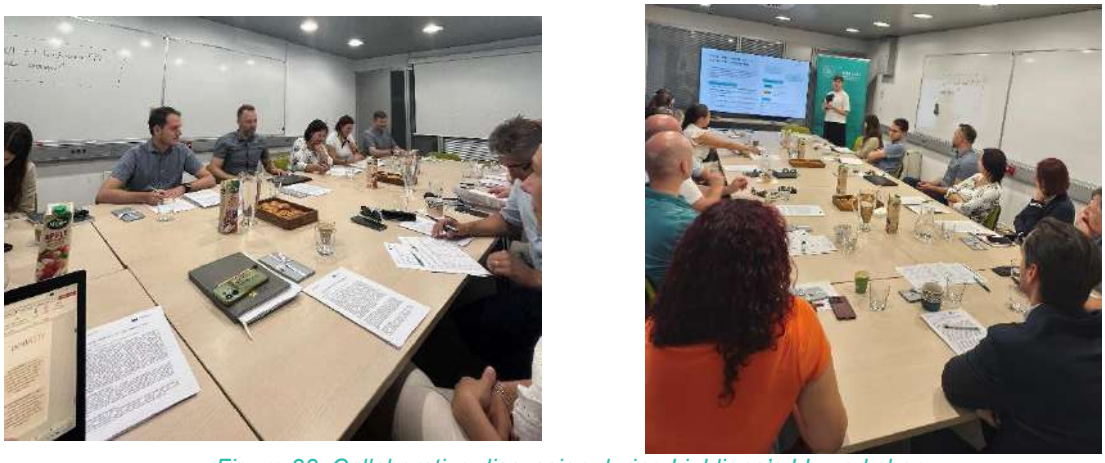


Figure 28. Collaborative discussion during Ljubljana's LL workshop.

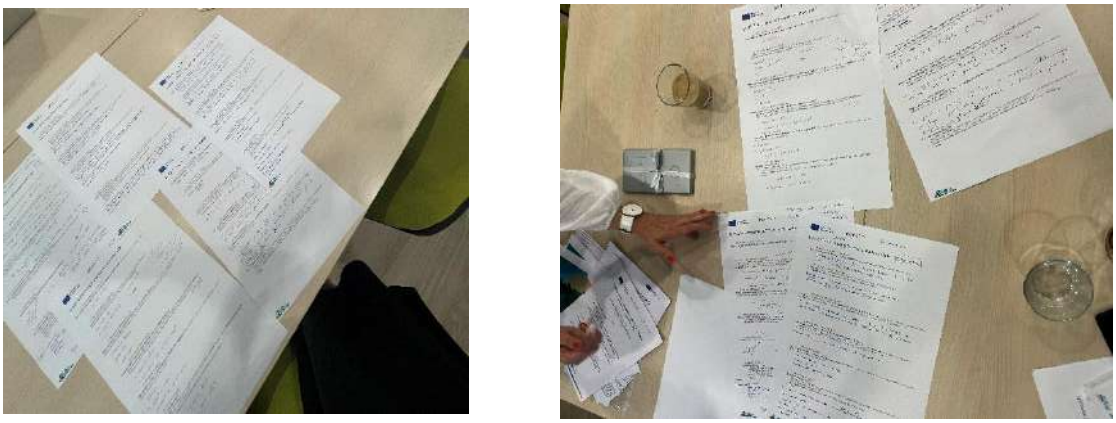


Figure 29. Templates used for discussion and information collection on the measures addressed during the workshop.

The following Table 30 presents the workshop outputs separately for LJ-M1, LJ-M2 and LJ-M3, reflecting the key information collected and structured through the co-design process.

Table 30. Consolidated overview of the main co-design outcomes for Ljubljana's measures.

LJ-M1 – On-demand mobility service for peri-urban areas: A flexible bus-based service will connect underserved, low-density areas with essential services such as healthcare, education, and employment. On-demand services and shared bikes will be integrated into NOM's digital platform to support easier access, booking, and service coordination.	
Solution & Concept challenge	Dispersed settlements lack flexible public transport, creating car dependence, access barriers and mobility poverty for vulnerable groups.
Target users	Peri-urban residents, commuters, students, workers, elderly people and other users with limited mobility options.
Demonstration & operation	Users book at least 24 hours ahead; MaaSLab groups similar requests and optimises routes, while Nomago operates pick-ups at predefined points.
Expected value / climate contribution	Improves access and inclusion, reduces private-car dependence and travel costs, and uses shared transport resources more efficiently.
Key actors	RRA LUR, participating municipalities, MOP, DUJPP, Nomago, MaaSLab, public-transport operators and pilot users.
Implementation / dependencies	Municipal approvals and stops, vehicles and drivers, reliable booking and optimisation, service data, operator coordination and pilot demand.
Main risks & open issues	Low uptake, unwillingness to pay after the pilot, app or optimisation failures and difficulty integrating booking and availability data.

LJ-M2 – Micromobility network with regional shared bikes & synchronization with PT: The bike-sharing network will expand towards peri-urban areas, adding bikes and docking stations to improve last-mile connectivity with public transport. Algorithms will help place shared bikes where they are most needed and coordinate them with existing bus schedules.	
Solution & Concept challenge	Peripheral municipalities have public-transport gaps and limited first- and last-mile options, reinforcing high car dependence.
Target users	Regional commuters, students, local residents, mobility-poor households and employees travelling to transport, education and employment hubs.
Demonstration & operation	Nomago operates an automated, interoperable e-bike network with docking stations near public-transport nodes across participating municipalities.
Expected value / climate contribution	Shifts short and feeder trips from cars, improves public-transport access and occupancy, lowers travel costs and strengthens spatial equity.
Key actors	RRA LUR, Komenda, Trzin and Mengeš municipalities, MOP, DUJPP, Nomago, local employers and end users.
Implementation / dependencies	Municipal land and consents, electricity and lighting, docking stations, mobile coverage, app and telemetry, maintenance and regional coordination.
Main risks & open issues	Approval delays, low uptake, unsafe cycling links, digital exclusion, uncertain post-pilot willingness to pay, vandalism and theft.
LJ-M3 – Addressing mobility poverty: Unserved areas will be identified, and existing roads and mobility services will be reorganized to improve access for communities with limited transport options. Different pricing and business models will be tested to improve accessibility, affordability, and long-term service sustainability.	
Solution & Concept challenge	Spatial, economic and service barriers restrict access to work, education and services and create high transport costs for vulnerable peri-urban groups.
Target users	Mobility-poor households, residents of low-density areas, commuters, students, elderly people and non-drivers.
Demonstration & operation	Nomago operates an automated, interoperable e-bike network with docking stations near public-transport nodes across participating municipalities.
Expected value / climate contribution	Improves affordable access and autonomy while reducing transport inequality and enabling lower-emission travel without excluding vulnerable users.
Key actors	RRA LUR, participating municipalities, MOP, DUJPP, Nomago, commuters and mobility-poor users.
Implementation / dependencies	Station sites and approvals, utility connections, mobile coverage, accessible digital or assisted access, service affordability and maintenance.
Main risks & open issues	Car-oriented habits, unsafe cycling infrastructure, smartphone exclusion, uncertain long-term affordability, vandalism and technical disruption.

The workshop confirmed that flexible transport, regional e-bike provision and mobility-poverty reduction should be treated as an integrated accessibility strategy. Nomago, MaaSLab, RRA LUR (project partners) and participating municipalities have complementary operational, technical and coordination roles, while municipal consents and suitable sites remain decisive. The principal challenges are car-oriented behaviour, safe cycling connections, digital exclusion, service reliability and affordability after the pilot.

5.1.5. Guimarães, Surrounding Communities – LL5

The Guimarães LL is led by the Municipality of Guimarães (GUI), which coordinates implementation and local stakeholder engagement. VIT supports demand-responsive transport operations and data provision, IDEO contributes industrial measures and Local Green Deal templates, and NTUA develops an AI-based pedestrian-safety tool.

The Guimarães LL is located in a city that combines strong climate ambition with relevant peri-urban mobility, demographic, governance and industrial-transition challenges. As a Mission City and 2026 European Green Capital, Guimarães provides a particularly relevant context for testing and further developing solutions aimed at supporting the transition of peri-urban areas towards climate neutrality. At the same time, the municipality faces structural challenges associated with population decline and ageing, limited migration in peri-urban areas, strong dependence on private cars and unequal access to public transport services.

Mobility represents one of the central challenges of the Living Lab. Car dependency remains high in peri-urban areas, while public transport provision outside the urban core is limited. In particular, 58 rural and peri-urban locations currently have no public transport services, which creates important accessibility constraints for residents and reinforces dependence on private vehicles. This situation highlights the need for more flexible mobility services capable of connecting dispersed areas with the wider public transport network and ensuring more equitable access to essential destinations and services.

The demographic characteristics of the area add another layer of complexity to these mobility challenges. Guimarães has experienced a declining population since 2020, with an average age of 44 years, while immigrants account for only around 5% of the peri-urban population. These characteristics underline the importance of considering accessibility, inclusion and ease of use when designing mobility services, particularly for population groups that may have more limited access to private transport or may experience greater difficulty using conventional mobility systems.

Pedestrian accessibility and safety are also relevant issues in the peri-urban context. The LL identifies the need to provide safer pedestrian routes around service zones, where current infrastructure conditions may hinder comfortable and secure walking. This challenge complements the need to improve public transport access, as pedestrian connectivity is an essential component of first- and last-mile travel and of the overall accessibility of peri-urban services.

Another important issue concerns the fragmentation of the mobility system. Existing transport services require stronger integration so that flexible and demand-responsive mobility can function as part of the wider public transport network rather than as an isolated service. This is accompanied by a broader governance challenge, with a need to reinforce cross-sectoral planning, coordination and capacity building in order to support the effective implementation of the proposed measures.

In parallel with mobility and governance, the Guimarães Living Lab also addresses the transition of local industries towards more sustainable practices. The industrial dimension includes the need to support changes across sectors such as energy, mobility, construction and tourism, linking local economic activity with the wider climate-neutrality objectives of the LL.

Against this background, the Guimarães co-design workshop was held on 30 June 2026, with the participation of 17 attendees. A total of three measures were proposed for the LL, and all three were addressed during the workshop. These measures cover complementary mobility and industrial-transition dimensions and were discussed as part of the co-design process. The session was completed as planned, with no problems reported by the Living Lab leader.

The first measure, GM-M1 – Integrated DRT system for peri-urban areas, focuses on the development of a flexible on-demand transport service aimed at connecting peri-urban areas with the wider public transport network. The measure responds directly to the current fragmentation of mobility provision and to the absence of regular public transport services in a number of rural and peri-urban locations.

The second mobility measure, GM-M2 – Infrastructure interventions for safe pedestrian movement around service zones in peri-urban areas, addresses pedestrian accessibility and safety. The proposed concept is based on the use of a routing tool to analyse walking routes and identify potential infrastructure improvements that could make pedestrian movements safer and easier in peri-urban areas.

The third measure, GM-IN1 – LGDs, introduces the industrial-transition dimension of the LL. It envisages the preparation of a practical Action Plan to support industries in adopting more sustainable practices across areas including energy, mobility, construction, tourism and other relevant sectors.

Together, these three measures establish the framework for the Guimarães workshop discussions, addressing complementary challenges related to transport accessibility, integration of peri-urban mobility services, pedestrian safety and sustainable industrial practices. Their consideration within the same co-design process also reflects the broader need for coordinated and cross-sectoral planning in the Living Lab.

The photographs included below provide a visual record of the Guimarães co-design workshop and the interaction among participants during the session (Figure 30). In addition, selected examples of the user-friendly templates are included to illustrate the tools used to organise and facilitate the discussion of each proposed measure (Figure 31). These templates supported a common and accessible structure for the co-design activities before the collected information was subsequently organised into the more detailed project templates.



Figure 30. Collaborative discussion during the Guimarães LL workshop.

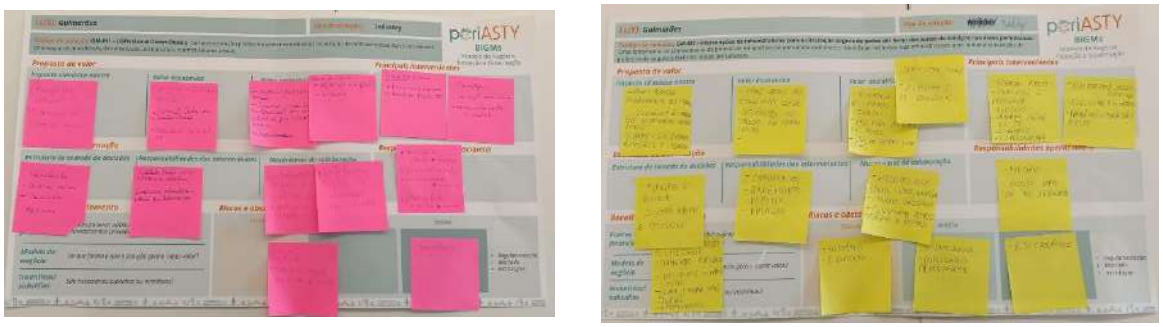


Figure 31. Templates used for discussion and information collection on the measures addressed during the workshop.

The following Table 31 presents the workshop outputs separately for GM-M1, GM-M2 and GM-IN1, reflecting the information collected and structured during the co-design process.

Table 31. Consolidated overview of the main co-design outcomes for Guimarães's measures.

GM-M1 – Integrated DRT system for peri-urban areas: A flexible on-demand transport service will connect peri-urban areas with the wider public transport network, reducing fragmentation and improving accessibility.	
Solution & Concept challenge	Low-density settlement and irregular roads make conventional public transport inefficient, leaving underserved areas and strong car dependence.
Target users	All residents, especially elderly people, students, people with mobility impairments, night-shift workers and residents without public transport.

Demonstration & operation	The existing pre-booked electric DRT expands from feeder routes to trips across ten service areas and two circuits during weak-service periods.
Expected value / climate contribution	Reduces car use and emissions, improves autonomy and social inclusion, lowers travel costs and supports access to local commerce.
Key actors	Municipality of Guimarães, parishes, Vitrus Ambiente, technology providers, employers, schools, associations and public-transport operators.
Implementation / dependencies	Accessible electric buses and stops, ticketing, booking and route-planning tools, timetable and pass data, technology procurement and regulation.
Main risks & open issues	Behavioural resistance to advance booking, difficulty understanding the service, technology cost, restrictive policy and limited resources.
GM-M2 – Infrastructure operations for safe pedestrian movement around services zones in peri-urban areas: A routing tool will analyse walking routes and identify infrastructure improvements to make pedestrian movement safer and easier in peri-urban areas.	
Solution & Concept challenge	Discontinuous, poor-quality walking and cycling routes and limited route information encourage individual motorised travel.
Target users	Residents, people with mobility impairments, children, teenagers and cyclists; schools, health units and employers are key destinations.
Demonstration & operation	NTUA's routing platform identifies suitable walking or cycling routes and lets users report public-space barriers for municipal and parish action.
Expected value / climate contribution	Promotes active mobility and public-transport access, reduces emissions and supports inclusion, autonomy, health and local commerce.
Key actors	Municipality, parishes, NTUA, Green Brigades, transport operators, schools, health units, employers and citizens.
Implementation / dependencies	Mapped and improved public space, routing data, citizen reports, parish access permissions, maintenance workflows and GDPR-compliant follow-up.
Main risks & open issues	Failure to implement physical improvements, low awareness or participation, resistance to change, platform malfunction and duplicated reporting channels.
GM-IN1 – LGDs: A practical Action Plan will support industries in adopting sustainable practices across energy, mobility, construction, tourism, and other key sectors.	
Solution & Concept challenge	Businesses pursue sustainability in isolation and lack coordinated technical, financial and governance support for industrial decarbonisation.
Target users	Industrial companies, manufacturers, hotels, logistics operators, SMEs, the municipality, academia and other transition partners.
Demonstration & operation	The Climate Pact and Local Green Deal create a voluntary framework for joint action planning, commitments, implementation, monitoring and improvement.
Expected value / climate contribution	Coordinates emission, energy, mobility, waste and circularity actions; reduces costs, improves competitiveness and strengthens local climate governance.
Key actors	Municipality and parishes, IDEO, Landscape Laboratory, industries, transport operators, academia, employees and other local stakeholders.
Implementation / dependencies	Sustained engagement and political support, the WP4 Action Plan, trustworthy sustainability data, coordination, technical capacity and finance.
Main risks & open issues	Weak commitment or trust, reluctance to share information, limited finance or staff, regulatory constraints and loss of long-term participation.

The Guimarães workshop produced three mutually reinforcing measures: an expanded electric DRT service, a routing and reporting tool linked to pedestrian improvements, and a Local Green Deal for coordinated industrial action. Existing municipal and operator structures provide a strong starting point, but implementation will require continued engagement by parishes, employers, schools, industries and users. Priority follow-up concerns include procuring and integrating the required digital tools, ensuring that reported public-space problems lead to physical interventions, supporting users who may struggle with advance booking, and sustaining industry participation, data sharing, technical assistance and finance within the Local Green Deal.

5.1.6. Helmond, BZOB – LL6

The Helmond LL is led by the Municipality of Helmond (HELM), supported by Eindhoven University of Technology (TUE) in organising activities and assessing mobility services. REMO contributes automated public transport operations, NEMI provides the on-demand platform, and KVR supports renewable-energy integration, charging infrastructure, energy sharing and industrial decarbonisation.

Urban city that forms part of the wider Eindhoven Mission City area. Helmond has experienced substantial demographic and economic growth over recent decades, with a current population of approximately **96,000 residents** and a population that has nearly doubled since the 1980s. Employment has followed a similar trajectory, with the number of jobs almost doubling as business activity has expanded. The city is also characterised by a mature and diverse population, with an average age of 41 years and immigrants representing approximately 33% of the population.

Despite benefiting from strong regional and national rail connections, Helmond still faces important peri-urban mobility challenges, particularly in relation to first- and last-mile connectivity. Connections between major public transport nodes and lower-density areas remain limited, which reinforces dependence on private cars for many journeys. These challenges are especially relevant for the BZOB industrial area, where employees and other users require efficient links with the city centre, railway stations and wider transport network.

At the same time, the Helmond Living Lab has a strong energy and industrial decarbonisation dimension. Grid congestion currently represents a major barrier to further electrification, including the electrification of industrial activities and the deployment of electric freight vehicles. Existing industrial energy systems also constrain the integration of renewable energy, creating the need for solutions that combine local renewable generation, storage, energy sharing and more intelligent management of electricity demand. In this context, the Living Lab considers the planned deployment of approximately 15,000 m² of solar panels combined with battery storage as an important component of the local renewable-energy transition.

These energy constraints are closely linked to the broader industrial transition of the BZOB area. The Living Lab therefore considers not only the generation and distribution of renewable electricity, but also its use in industrial mobility, freight transport and internal industrial operations. In parallel, data-driven monitoring and decision-support tools are envisaged to strengthen the coordination and evaluation of mobility and energy-related services.

Against this background, the Helmond co-design workshop was held on 30 June 2026, with the participation of 20 attendees. A total of **ten measures** had been proposed for the Living Lab, covering mobility, energy, industry and governance. However, during the workshop, only two measures were addressed through the co-design templates: HM-M1 and HM-EN2.

The workshop implementation differed from the methodology initially established for the co-design sessions. Rather than dividing participants into groups and assigning one measure to each group, the Helmond session addressed the measures collectively with all participants. In addition, the available workshop time was insufficient to complete the templates for the full set of proposed measures. Consequently, the scope of the workshop outputs presented in the following subsections is limited to the two measures for which the structured co-design exercise was completed. This contextual information is important for interpreting the extent of the results reported for the Helmond Living Lab, without affecting the broader set of measures planned for subsequent development.

The first measure addressed, HM-M1 – On-demand automated transportation for industrial areas, focuses on the introduction of automated shuttle services connecting industrial areas with public transport services and mobility hubs. The measure responds to existing last-mile accessibility constraints and the high dependence on private cars for travel to and from lower-density employment areas.

The second measure addressed, HM-EN2 – Local energy sharing & BMs, focuses on testing local energy-community models and new approaches to shared access to electricity infrastructure. The concept includes shared grid access, energy storage and dynamic pricing involving industrial and public actors, with KvR playing a central role in exploring the feasibility of these arrangements.

Although they were not addressed through the workshop templates during this session, the wider Helmond Living Lab also includes a broader portfolio of measures that frame the context in which HM-M1 and HM-EN2 are situated. Within the mobility domain, HM-M2 – Shared & electric mobility hubs propose hubs combining shared e-bikes, electric shared vehicles, cycling and public transport, while HM-M3 – Integration of Mass Transit & CCAM solutions considers connected and automated mobility services linking the industrial areas with the city centre, train stations and major transit hubs.

Within the energy domain, HM-EN1 – Renewable energy expansion focuses on the deployment of 15,000 m² of solar panels and battery storage at BZOB, while HM-EN3 – AI-driven energy optimization considers the use of AI tools to optimise energy consumption, power distribution and EV charging tariffs in order to reduce grid congestion and peak demand.

The industrial measures complement this energy transition. HM-IN1 – Industrial decarbonization via EV infrastructure focuses on high-power DC charging infrastructure to support the transition from diesel trucks to battery-electric freight vehicles. HM-IN2 – Industrial process electrification addresses the replacement of gas-powered internal industrial vehicles, such as forklifts and reach trucks, with electric alternatives. HM-IN3 – Shared grid for industry considers the sharing of KvR's heavy grid connection with industrial actors, including the Process Water Factory, to support more sustainable operations.

Finally, the governance dimension is represented by HM-G1 – Data-driven decision-making & monitoring framework, which envisages a real-time data platform supporting monitoring, scenario analysis and decision-making for automated public transport services.

Together, these measures illustrate the broader multisectoral character of the Helmond Living Lab, where mobility accessibility, grid capacity, renewable-energy deployment, industrial electrification and data-driven governance are closely interconnected. The workshop outputs reported in the following subsections therefore focus specifically on HM-M1 and HM-EN2, while the remaining measures provide the broader context for the LL's planned transition pathway.

The photographs included below provide a visual record of the Helmond co-design workshop and the interaction between participants during the session (Figure 32). Selected examples of the user-friendly templates are also included to illustrate the tools used to structure the discussion and collect information on the measures addressed (Figure 33). These visual elements help contextualise the structured outputs presented in the following subsections.



Figure 32. Participants during Helmond's LL co-design workshop held on 30 June 2026.



Figure 33. Templates used for discussion and information collection on the measures addressed during workshop

The following Table 32 presents the workshop outputs separately for HM-M1 and HM-EN2, reflecting the information collected and structured during the co-design process.

Table 32. Consolidated overview of the main co-design outcomes for Helmond's measures.

HM-M1 – On-demand automated transportation for industrial areas: Automated shuttles will connect industrial areas with public transport and mobility hubs, helping reduce car dependency.	
Solution & Concept challenge	BZOB lacks direct public transport within the industrial park, causing car dependence, poor last-mile access and conflicts among road users.
Target users	Employees, visitors, clients, trainees and suppliers, particularly those able to reach the connecting regional public-transport stop.
Demonstration & operation	An electric automated shuttle links the mobility hub with BZOB companies, using either request-based operation or a high-frequency loop.
Expected value / climate contribution	Improves industrial-area accessibility, supports recruitment and inclusion, and can replace individual car trips with shared electric transport.
Key actors	City of Helmond, RDW, Province and public-transport authorities, Brainport Bereikbaar, BZOB management and companies, Hermes, Ne-Mi and REMOTED.
Implementation / dependencies	Vehicle approval, stops and signage, safe route and charging, demand and timetable data, operator subsidy, remote supervision and company engagement.
Main risks & open issues	Approval and automated-driving compliance, high costs, uncertain demand, unreliable or uncompetitive service, company engagement and vehicle incidents.
HM-EN2 – Local energy sharing & BMs: KvR will test local energy communities' models, shared grid access, energy storage, and dynamic pricing with industrial and public actors.	
Solution & Concept challenge	Grid congestion restricts business electrification and electric freight charging while competing local demands intensify pressure on available capacity.
Target users	Logistics companies, electric-truck fleets, grid-constrained businesses, neighbouring energy-sharing participants and charging users.
Demonstration & operation	KvR's shared charging hub combines grid capacity, fast chargers, photovoltaics, battery storage and an EMS to optimise and potentially share energy.
Expected value / climate contribution	Enables zero-emission logistics, improves use of grid and renewable capacity and reduces individual infrastructure investment barriers.
Key actors	KvR Energy, City of Helmond, Province, Enexis, business-park management, participating companies, EMS and charging-infrastructure providers.

Implementation / dependencies	Grid capacity, EMS delivery, chargers, batteries and PV, quarter-hour energy data, company agreements, permits and an enabling energy-sharing framework.
Main risks & open issues	Changing energy rules, restrictions on sharing and battery services, permitting delays, low participation, insufficient charging demand and continuing grid constraints.

The workshop shows that BZOB's transition is constrained by two infrastructures at the same time: access to public transport and access to electricity. The automated shuttle can reduce employee car dependency only if it connects reliably with the bus line and reflects company shift patterns, while the shared charging hub can enable fleet electrification only if scarce grid capacity is managed collectively. The measures therefore form a coherent mobility-energy package, although direct operational integration should not yet be assumed: charging compatibility, spatial links and operating schedules still need to be tested. The main bottleneck is institutional rather than purely technical.

5.1.7. Kalamata, Surrounding Communities – LL7

The Kalamata LL is led by the Municipality of Kalamata (KAL). The University of Patras (UoP) supports smart waste management and training, NTUA contributes public transport scheduling and fleet optimisation, and MaaSLab provides on-demand service software. AKAL supports the implementation and validation of public transport schedules and the introduction of the on-demand service.

The Kalamata Living Lab focuses on the city of Kalamata and its surrounding peri-urban communities, addressing challenges related to mobility accessibility, industrial transition, resource management and cross-sectoral governance. Kalamata is an important regional hub in the Peloponnese and an increasingly prominent tourist destination, with a population of approximately 72,906 residents. Its peri-urban communities are located roughly 6–30 km from the city centre, creating mobility and accessibility conditions that differ significantly from those of the urban core.

Although the city and its surrounding communities are connected by public transport, service provision becomes considerably more limited in more distant peri-urban areas. Current public transport coverage consists of eight bus routes serving 14 communities, while some locations receive only two to three bus services per week. Poor road conditions in parts of the surrounding area further constrain accessibility and the quality of connections between peri-urban settlements and Kalamata.

These limitations affect access to a broad range of essential and everyday destinations, including employment, education, healthcare, shopping, sports and leisure activities. They also create an important equity dimension, particularly for people with disabilities, vulnerable users and visitors who may not have access to a private vehicle. The demographic context reinforces this challenge, as Kalamata has an average population age of approximately 41 years, making accessible and inclusive mobility provision an important consideration when developing new services.

The Living Lab therefore addresses the need to provide more flexible public transport alternatives, improve the efficiency of existing services and strengthen accessibility for vulnerable road users (VRUs). In particular, the proposed mobility measures consider how on-demand services, improved public transport scheduling and safer pedestrian routing can complement one another in addressing the mobility needs of dispersed peri-urban communities.

Alongside mobility, the Kalamata Living Lab also considers challenges related to sustainable resource management and industrial transition. Local industrial areas currently face limited incentives and opportunities to shift towards more sustainable practices. At the same time, there is a need to improve waste-management systems serving industries, hotels and peri-urban households, particularly through more efficient collection and recycling processes. These issues are closely connected to the wider tourism economy of Kalamata and to the need to support more sustainable management of resources across urban, peri-urban and industrial areas.

A further cross-cutting challenge concerns governance and institutional capacity. The implementation of mobility, waste-management and industrial-transition measures requires stronger cross-sectoral planning and coordination between the actors responsible for transport, industry, tourism,

environmental management and local services. The co-design process therefore provides an opportunity to consider the proposed measures not as isolated interventions but within the broader context of the peri-urban transition of Kalamata.

Against this background, the Kalamata Living Lab co-design workshop was held on **18 June 2026**, with the participation of 24 attendees. A total of five measures were proposed for the Living Lab, and all five were addressed during the workshop, covering three mobility measures and two industry and resource-management measures. The session was completed as planned, with no problems reported by the Living Lab leader.

The first mobility measure, KM-M1 – On-demand peri-urban PT for health & educational purposes, focuses on the provision of an on-demand public transport service connecting residents of peri-urban communities with healthcare and educational services located in the urban area. The measure responds directly to the limited frequency of conventional public transport in some communities and the resulting accessibility constraints for essential trips.

The second mobility measure, KM-M2 – Optimize PT schedule & fleet management for peri-urban coverage, addresses the organisation and efficiency of the existing public transport system. The measure envisages the use of simulations to improve bus routes, service frequencies and fleet allocation, with particular attention to locations where current services operate only a few times per week.

The third mobility measure, KM-M3 – Equitable peri-urban mobility for VRUs, introduces a pedestrian-accessibility and safety dimension. It proposes the use of a pedestrian routing tool to assess existing footways and identify safer walking routes in peri-urban areas, supporting more equitable mobility for vulnerable road users.

The industrial and resource-management dimension is represented by two complementary measures. KM-IN1 – Smart waste management for industry & peri-urban households focuses on the use of smart systems to optimise waste collection and recycling processes serving industries, hotels and households located in peri-urban areas. In parallel, KM-IN2 – LGD Action Plan for industries envisages the preparation of a practical Action Plan to support industries in adopting more sustainable practices across areas such as energy, mobility, construction, tourism and related sectors.

Together, these five measures establish the framework for the Kalamata workshop discussions, covering peri-urban public transport provision, service optimisation, pedestrian accessibility, smart waste management and sustainable industrial practices. Their joint consideration reflects the multisectoral nature of the challenges affecting the Living Lab and the need for coordinated approaches capable of responding to the characteristics of both the urban centre and its surrounding communities.

The photographs included below provide a visual record of the Kalamata co-design workshop and the interaction among participants during the session (Figure 34). Selected examples of the **user-friendly templates** are also included to illustrate the tools used to structure the discussions and facilitate the collection of information for each measure (Figure 35). These visual elements provide context for the detailed measure-level outputs presented in the following subsections.



Figure 34. Collaborative discussion during Kalamata's LL workshop.



Figure 35. Templates used for discussion and information collection on the measures addressed during the workshop.

The following Table 33 therefore presents the workshop outputs separately for KM-M1, KM-M2, KM-M3, KM-IN1 and KM-IN2, reflecting the information gathered and subsequently organised through the co-design process.

Table 33. Consolidated overview of the main co-design outcomes for Kalamata's measures.

KM-M1 – On-demand peri-urban PT for health & educational purposes: A public service will connect peri-urban residents with health and education services in the urban area.	
Solution & Concept challenge	Infrequent and inflexible services limit access from peri-urban communities to the University and other education or health destinations.
Target users	University students, peri-urban residents, young people without cars, people with disabilities, elderly people and other vulnerable groups.
Demonstration & operation	Users submit trip needs digitally or by phone; the platform groups demand and optimises routes, schedules and vehicle allocation for AKAL.
Expected value / climate contribution	Improves equitable access, reduces household travel costs and private-car dependence, and lowers vehicle kilometres and emissions per passenger.
Key actors	Municipality of Kalamata, Region of Peloponnese, University, AKAL, MaaSLab, NTUA, telematics providers and users.
Implementation / dependencies	Suitable buses and stops, booking and optimisation tools, academic schedules and demand data, approvals, operator integration and accessible support.

Main risks & open issues	Approval and regulatory delays, low or seasonal demand, uncertain finance, insufficient data, platform failure, digital exclusion and system integration.
KM-M2 – Optimize PT schedule & fleet management for peri-urban coverages: Simulations will improve bus routes, frequency, and fleet use, especially where current services run only three times per week.	
Solution & Concept challenge	Some peri-urban communities receive only occasional public transport, limiting access and increasing transport exclusion and car dependence.
Target users	Passengers, students, workers, elderly and vulnerable residents, tourists, AKAL and municipal or regional transport planners.
Demonstration & operation	Demand, GPS and route-performance data feed simulations comparing routes, frequencies and fleet-allocation scenarios for planning and operations.
Expected value / climate contribution	Improves coverage and accessibility, increases fleet utilisation, reduces inefficient kilometres and operating costs, and supports modal shift.
Key actors	Municipality of Kalamata, Region of Peloponnese, AKAL, NTUA, transport authorities, telematics providers and local communities.
Implementation / dependencies	Operational fleet and telematics, reliable demand and occupancy data, data-sharing agreements, modelling expertise and approval of service changes.
Main risks & open issues	Poor data and forecasts, approval delays, resistance to changes, limited participation, seasonal demand and interoperability constraints.
KM-M3 – Equitable peri-urban mobility for VRUs: A pedestrian routing tool will assess footways and identify safer walking routes in peri-urban areas.	
Solution & Concept challenge	Discontinuous and inaccessible pedestrian infrastructure makes essential journeys unsafe for elderly people, students and people with disabilities.
Target users	Elderly residents, people with disabilities, students, parents with strollers, public-transport users and other pedestrians.
Demonstration & operation	A GIS platform maps footways, crossings, lighting and barriers, recommends safer routes and supports municipal prioritisation of improvements.
Expected value / climate contribution	Encourages walking, improves safety and independence, reduces short car trips and helps target public investment in accessible infrastructure.
Key actors	Municipality and Technical Services, Region of Peloponnese, NTUA, GIS and accessibility specialists, mapping teams and local users.
Implementation / dependencies	Reliable geospatial and field data, municipal GIS, citizen reporting, interoperability, maintenance resources and approvals for physical interventions.
Main risks & open issues	Incomplete or outdated data, insufficient infrastructure funding, low citizen participation, limited specialist capacity and GIS interoperability problems.
KM-IN1 – Smart waste management for industry & peri-urban households: Smart systems will optimize waste collection and recycling for industries, hotels and peri-urban households.	
Solution & Concept challenge	Fixed collection, overflowing containers and limited recycling data cause unnecessary routes, fuel use, costs and weak material recovery.
Target users	Peri-urban households, farmers, hotels, industries, commercial waste producers, municipal services and waste-management operators.
Demonstration & operation	IoT bin sensors send fill levels to a platform that analyses patterns and updates collection routes and operational recommendations.

Expected value / climate contribution	Reduces collection mileage, fuel and emissions, improves service efficiency and recycling, and supports cleaner communities and circularity.
Key actors	Municipality of Kalamata, FODSA Peloponnese, BIOPA businesses, municipal collection services, University of Patras and technology providers.
Implementation / dependencies	Smart bins and sensors, communications, vehicles and GIS platform, operational and GPS data, procurement, integration and stakeholder cooperation.
Main risks & open issues	Procurement delays, uncertain long-term finance, limited business participation, sensor or communication failure and system-integration problems.
KM-IN2 – LGD Action Plan for industries: A practical Action Plan will help industries adopt sustainable practices in energy, mobility, construction, tourism, and related sectors.	
Solution & Concept challenge	Industrial sustainability initiatives are fragmented and constrained by limited expertise, finance, coordination and shared monitoring.
Target users	Industries, manufacturers, hotels, logistics and construction firms, SMEs, authorities, chambers, employees and local communities.
Demonstration & operation	A voluntary Local Green Deal framework supports joint action design, commitments, implementation and monitoring across sustainability themes.
Expected value / climate contribution	Accelerates efficiency, renewable energy, sustainable mobility and circularity, reducing costs and emissions while strengthening collaboration and competitiveness.
Key actors	Municipality of Kalamata, Region of Peloponnese, Messinian Chamber of Commerce, IDEO businesses, professional networks and communities.
Implementation / dependencies	Sustained stakeholder and political commitment, reliable sustainability data, monitoring tools, technical support, finance and policy alignment.
Main risks & open issues	Limited business participation or investment, changing regulations, insufficient technical expertise and poor-quality sustainability data.

The workshop defined a balanced package addressing access to essential services, public-transport efficiency, pedestrian inclusion, smart waste management and industrial transition. The mobility measures depend on reliable demand, operational and geospatial data and close cooperation between the Municipality, AKAL, NTUA and users. The industrial measures require procurement and integration of monitoring technology as well as sustained business participation in the Local Green Deal. Common priorities are accessible non-digital support, formal data-sharing arrangements, realistic long-term finance and administrative approvals. The package offers useful synergies: route and demand evidence can improve transport provision, while shared governance and monitoring can connect waste, industry and climate objectives.

5.1.8. Sofia, Surrounding Communities – LL8

The Sofia LL is led by Sofia Municipality (SM), working with Sofia Urban Mobility Centre (SUMC). Their responsibilities cover stakeholder engagement, shared electric bicycle services, integration with public transport, fleet optimisation and coordination of local mobility and governance activities.

The Sofia Living Lab focuses on the peri-urban and surrounding communities of Sofia, where important mobility and accessibility challenges persist despite the city's extensive public transport network and the existence of a long-term Sustainable Urban Mobility Plan (SUMP) framework to 2035. With approximately 1.3 million residents in the city and more than 1.6 million in the wider metropolitan area, Sofia combines the characteristics of a large metropolitan centre with lower-density peripheral neighbourhoods and recreational areas where sustainable transport alternatives remain comparatively limited.

Mobility represents the central focus of the Living Lab. Although public transport provision is well developed in the urban core, accessibility gaps remain in lower-density peri-urban areas, where

residents are more dependent on private cars and first- and last-mile connections to the main public transport nodes are weaker. Shared micromobility services are also less widely available in these areas, limiting their potential to complement conventional public transport and support multimodal journeys.

A particularly relevant example is Vitosha Mountain and its surrounding area, which combines recreational and everyday mobility demand and experiences considerable pressure from private vehicles. More than 5,000 car trips per day are made towards the mountain area, illustrating the need for viable alternatives capable of connecting users with Vitosha while reducing dependence on private cars. Improving access to this area requires not only additional mobility services, but also better integration between public transport and active or shared mobility.

The Living Lab therefore places particular emphasis on first- and last-mile connectivity and multimodality, especially through the integration of public transport with shared electric bicycles. The proposed approach seeks to make transfers between these modes easier and to extend sustainable mobility options into areas where conventional public transport alone may not fully respond to users' mobility needs.

Accessibility and transport equity constitute another relevant consideration. Existing mobility gaps particularly affect people living in underserved peri-urban neighbourhoods and can also create barriers for people with disabilities. The development of new mobility services must therefore consider not only geographical coverage but also accessibility and ease of connection between transport modes.

These mobility challenges are accompanied by a broader governance and planning dimension. Sofia has an established SUMP framework extending to 2035, but the Living Lab identifies the need to further integrate climate-neutrality objectives, active mobility and shared mobility services into future planning. Stronger cross-sectoral coordination is consequently required to ensure that mobility infrastructure, public transport, shared services and wider climate objectives are addressed within a coherent planning framework.

Against this background, the Sofia Living Lab co-design workshop was held on 18 June 2026, with the participation of 23 attendees. A total of two measures were proposed for the Living Lab, and both measures were addressed during the workshop. The session was completed as planned, with no problems reported by the Living Lab leader.

The first measure, SOF-M1 – Extend shared mobility (electric bikes only) to peri-urban areas, focuses on expanding electric bike-sharing services towards peri-urban areas currently characterised by limited public transport provision. The measure is intended to strengthen first- and last-mile connectivity and provide users with an additional sustainable alternative to private-car travel.

The second measure, SOF-M2 – Mobility hub for access to Vitosha Mountain, focuses on the development of a new mobility hub near the ring road and Vitosha Mountain. The proposed hub would connect public transport services with shared electric bicycles, providing an interchange point designed to facilitate both work-related and recreational journeys towards the mountain area.

The two measures are closely interconnected through their emphasis on multimodal travel. Both concepts seek to facilitate transfers between public transport and shared electric bicycles, thereby extending the effective reach of the public transport network into peri-urban and recreational areas and providing users with more convenient alternatives to private-car use.

Together, SOF-M1 and SOF-M2 establish the framework for the Sofia workshop discussions, addressing complementary dimensions of the same mobility challenge: the geographical expansion of shared electric mobility, improved first- and last-mile connections and the creation of physical interchange infrastructure supporting multimodal travel. Their joint consideration also reflects the broader objective of incorporating active and shared mobility more systematically within Sofia's future mobility-planning framework.

The photographs included below provide a visual record of the Sofia co-design workshop and the interaction among participants during the session (Figure 36). Selected examples of the **user-friendly templates** are also included to illustrate the tools used to organise the discussion and collect

information on the two measures in a consistent and accessible manner (Figure 37). These visual elements provide context for the detailed measure-level outputs presented in the following subsections.




Figure 36. Participants during the Sofia LL co-design workshop held on 18 June 2026.

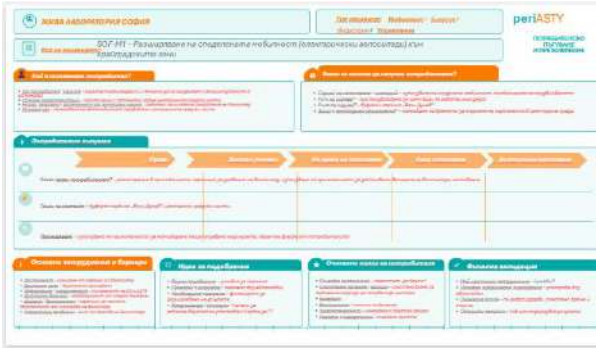
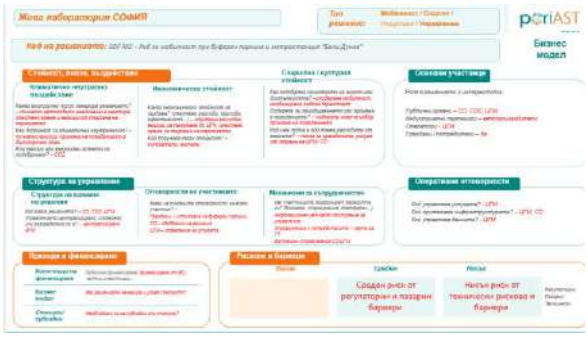



Figure 37. Templates used for discussion and information collection on the measures addressed during the workshop.

The following Table 34 therefore presents the workshop outputs separately for SOF-M1 and SOF-M2, reflecting the information gathered and subsequently structured through the co-design process.

Table 34. Consolidated overview of the main co-design outcomes for Sofia's measures.

SOF-M1 – Extended shared mobility (electric bikes only) to peri-urban areas: Electric bike-sharing will be expanded to peri-urban zones with limited public transport, improving first/last-mile connectivity and reducing car dependency.	
Solution & Concept challenge	Peri-urban commuters remain car-dependent because shared micromobility is concentrated in the centre and first- and last-mile options are limited.
Target users	Daily peri-urban commuters and other adults seeking active transport; nearby businesses and neighbouring municipalities are relevant stakeholders.
Demonstration & operation	A shared e-bike service is integrated into Sofia Urban Mobility Centre systems, allowing users to check, book, unlock and return bicycles through an app.
Expected value / climate contribution	Combines Park & Ride and Park & Bike, reduces car kilometres and emissions, and supports healthier, more inclusive multimodal travel.
Key actors	Sofia Municipality and Council, Sofia Urban Mobility Centre, neighbouring municipalities, e-bike suppliers, software developers and pilot users.
Implementation / dependencies	Approval, parking and charging infrastructure, monitoring and maintenance, app and mobile coverage, user registration data and operational integration.
Main risks & open issues	Vandalism, low or seasonal uptake, weak awareness, limited behavioural change and occasional network or software instability.

SOF-M2 – Mobility hub for access to Vitosha Mountain: A new mobility hub near the ring road and Vitosha Mountain will connect public transport with shared electric bikes, supporting easier work and recreational trips.	
Solution & Concept challenge	High car inflows from north-west peri-urban areas create congestion and emissions despite an existing Park & Ride connected to public transport.
Target users	Daily peri-urban car commuters using Beli Dunav and people transferring to metro, tram, bus or shared e-bikes.
Demonstration & operation	The existing facility is upgraded with e-bike sharing and integrated into Sofia Urban Mobility Centre's Park & Ride services.
Expected value / climate contribution	Creates a practical multimodal interchange, reduces car travel into Sofia and improves inclusive access to jobs, education and services.
Key actors	Sofia Municipality and Council, Sofia Urban Mobility Centre and Parking Department, neighbouring municipalities, suppliers and users.
Implementation / dependencies	Council approval, e-bike stands and charging, safe access and signage, digital and physical customer service and integration with parking data.
Main risks & open issues	Unsafe bicycle access through the car ramp, restricted opening hours, low or seasonal use and insufficient public awareness.

The Sofia outputs support a combined Park & Ride and Park & Bike model in which Sofia Urban Mobility Centre operates both the shared e-bike service and the existing interchange facility. The measures can reduce car travel into the city if approval, charging and parking infrastructure, safe bicycle access, app integration, maintenance and user communication are secured. Vandalism, seasonal demand and limited behavioural change are the main adoption and operational concerns.

5.1.9. Sisseln, Sisslerfeld – LL9

Under the Grant Agreement, EMPA leads the Sisslerfeld demonstration task, with EPFL contributing AI-driven charging-pricing models and MBL supporting on-demand mobility and fleet optimisation. Local engagement follows the adapted Reallabor process described below, reflecting the research-led development of the measures and the voluntary participation of local stakeholders.

The Sisslerfeld Living Lab focuses on a rapidly developing industrial and peri-urban area located along the Rhine between Zurich and Basel. The area extends across the four municipalities of Eiken, Münchwilen, Sisseln and Stein and hosts several major multinational companies. Approximately 10,000 people currently work in Sisslerfeld, while employment is expected to double over the next 20 years. This anticipated growth creates significant implications for mobility, energy demand and the coordination of development across the wider area.

Sisslerfeld presents a particularly relevant peri-urban context because of the strong interaction between industrial activity, commuting patterns, energy consumption and governance. Mobility is currently characterised by a high dependence on private cars for commuting, accompanied by comparatively limited public transport and active-mobility alternatives. Expected employment growth could place additional pressure on the transport system, increasing the importance of understanding future traffic patterns and anticipating the implications of the transition towards electric mobility. In particular, the Living Lab identifies the need for improved traffic monitoring, forecasting of future electric-vehicle charging demand and more efficient management of charging infrastructure.

The energy dimension is equally significant. Sisslerfeld contains an energy-intensive industrial sector with substantial reliance on fossil fuels, while the integration of local renewable-energy communities remains limited. Reducing energy demand for heating and cooling in both industrial and residential activities, improving the integration of renewable resources and exploring energy-sufficiency approaches therefore constitute important components of the Living Lab's transition towards climate neutrality.

These mobility and energy challenges are accompanied by a complex governance context. Sisslerfeld is distributed across four municipalities and involves additional cross-border stakeholders, including actors from Germany. There is currently no single unified governance model covering the whole area. Consequently, the development of mobility and energy solutions requires coordination among municipalities, industrial actors, research organisations and other public and private stakeholders operating at different territorial levels.

Within this context, five preliminary measures have been identified for further exploration within the Living Lab, comprising three mobility measures and two energy measures. However, the co-creation process in Sisslerfeld has required a different approach from that applied in most of the other periASTY Living Labs. At the current stage of the project, the common Task 1.3 workshop format could not be applied directly, mainly because the Sisslerfeld municipality is not itself a periASTY project partner and because the Living Lab activities remain strongly research-driven. The Swiss research team primarily supports the communication and transfer of project findings towards the Sisslerfeld Reallabor, which acts as the local governance association.

In addition, the definition of concrete mobility and energy solutions depends on the results of ongoing modelling and analytical activities. The measures currently identified therefore represent areas for further investigation rather than fully specified solutions ready for detailed measure-specific co-design. This has implications for the timing and format of stakeholder engagement, as meaningful application of the Task 1.3 templates requires a sufficient level of maturity regarding the potential interventions under consideration.

Stakeholder participation also differs from that of Living Labs directly represented within the periASTY consortium. Participation by Sisslerfeld stakeholders is voluntary, and local actors have not formally committed to implementing periASTY solutions. Engagement activities must consequently be adapted to stakeholder interest, availability and the opportunities provided through the existing Reallabor process.

To respond to these specific conditions, the Swiss research team and the LL agreed on a phased and adapted co-creation approach. As a first step, an exploratory workshop focusing on **energy** and mobility sufficiency was developed and piloted with participants from academia, the public sector and the private sector. Rather than discussing predefined solutions in detail, this workshop was designed to explore the local solution space, identify stakeholder needs and priorities and better understand perceived barriers to the implementation of sufficiency measures. The approach is intended to ensure that stakeholder perspectives can inform the ongoing modelling and analytical activities and help orient subsequent research towards locally relevant challenges and opportunities.

The next step foreseen in the document is to organise this exploratory workshop with Sisslerfeld stakeholders in early autumn, subject to their availability. On the same occasion, the research team intends to organise a separate discussion with core representatives of the Sisslerfeld Reallabor to explore more specific mobility and energy issues and, where appropriate, apply relevant questions from the Task 1.3 templates. At a later stage, once the modelling and analytical work has generated more concrete solutions, a follow-up co-creation workshop is envisaged in which the Task 1.3 templates can be applied in a more measure-specific manner.

The preliminary mobility portfolio includes SF-M1 – High-resolution traffic monitoring for EV demand forecasting, which envisages the use of drones to collect detailed traffic information regarding congestion, vehicle types and future EV charging demand; SF-M2 – Smart EV charging optimization, which focuses on data-driven charging schedules to balance grid loads, reduce infrastructure costs and assess CO_2 and noise implications; and SF-M3 – Optimizing prices of EV charging stations, which considers smart-pricing approaches to influence when and where vehicles charge while accounting for queues, grid constraints and charger accessibility.

The energy dimension comprises SF-EN1 – Strategic energy planning for peri-urban communities, which considers simulation tools for identifying suitable combinations of local renewable generation, efficient heating and cooling technologies and building-retrofit measures, and SF-EN2 – Energy

sufficiency strategy integration, which focuses on scenarios exploring how households, industries and businesses could reduce energy demand while contributing to the transition towards climate neutrality.

Together, these five preliminary measures define the main thematic areas around which the Sisslerfeld co-creation process will progressively develop. Unlike the workshop results presented for LLs where the common co-design methodology could already be fully implemented, the Sisslerfeld section therefore reflects an adaptive and phased engagement process, moving from exploratory discussion towards more detailed measure-specific co-design as the underlying modelling and analytical work progresses. This approach ensures that stakeholder engagement remains meaningful within the specific institutional and research context of Sisslerfeld while remaining aligned with the overall objectives of Task 1.3.

The photographs included below illustrate the adapted exploratory co-creation approach developed for the Sisslerfeld Living Lab and provide visual context for the stakeholder engagement activities supporting the definition of future mobility and energy solutions (Figure 38).



Figure 38. Participants during the exploratory workshop developed to support the Sisslerfeld co-creation process.

Table 35 presents the results for the measures submitted for the town of Sisslerfeld on a stand-alone basis; these templates were completed using information gathered during the previous workshop, which was held outside the scope of the project but was related to periASTY.

Table 35. Consolidated overview of the main co-design outcomes for Sisslerfeld's measures.

SF-M1 – High-resolution traffic monitoring for EV demand forecasting: Drones will collect high-resolution traffic data to understand congestion, vehicle types, and future EV charging demand.	
Solution & Concept challenge	Rapid industrial growth creates uncertainty about traffic composition and future EV charging demand, while conventional monitoring has limited coverage.
Target users	Municipal and cantonal planners, residents, commuters, employees, logistics operators, fleet managers and industrial stakeholders.
Demonstration & operation	Professional drone flights provide video for AI vehicle detection and anonymised trajectories, combined with GIS, traffic and EV statistics.
Expected value / climate contribution	Improves EV-infrastructure and transport planning and can reduce survey costs while supporting transparent, evidence-based decisions.
Key actors	EPFL, MobiLysis, professional drone operators, Canton of Aargau, the four municipalities, local industries and future participants.
Implementation / dependencies	Drones and safe sites, permissions, suitable weather, AI computing, road GIS and complementary traffic and EV datasets.
Main risks & open issues	Weather and flight restrictions, privacy requirements, incomplete complementary data, AI performance limitations and slow institutional adoption.
SF-M2 – Smart EV charging optimization: Data-driven tools will schedule EV charging to balance grid loads, reduce infrastructure costs, and assess CO_2 and noise impacts.	

Solution & Concept challenge	Growing workplace EV demand could create charging queues, local grid peaks and costly infrastructure expansion in a car-dependent industrial area.
Target users	EV-driving commuters, residents and visitors; industrial companies, fleet managers, facility owners and charging-service providers.
Demonstration & operation	A data-driven system coordinates charging schedules using vehicle needs, arrival and departure times, charger status, grid capacity and energy conditions.
Expected value / climate contribution	Reduces peaks and charging costs, improves charger and grid utilisation, supports reliable access and facilitates transport electrification.
Key actors	The four municipalities, Canton of Aargau, future industrial partners, grid and energy providers, charging operators and users.
Implementation / dependencies	Representative smart chargers and meters, charging and traffic data, grid-capacity information.
Main risks & open issues	Data access, partner engagement and technical integration
SF-M3 – Optimizing prices of EV charging stations: Smart pricing will guide when and where vehicles charge, helping avoid queues, respect grid limits, and improve charger accessibility.	
Solution & Concept challenge	Concentrated EV charging demand may create queues, uneven station use and grid peaks as employment and electrification increase.
Target users	EV commuters, transient workers, residents, fleet and ride-hailing operators, charging hosts and price-sensitive users.
Demonstration & operation	An algorithm recommends dynamic prices by station and time using occupancy, queues, demand, grid capacity and potentially renewable availability.
Expected value / climate contribution	Distributes charging demand, reduces waiting and peak costs, improves infrastructure utilisation and supports lower-carbon charging periods.
Key actors	Municipalities and Canton, future charging and e-mobility operators, grid and energy providers, platform developers, businesses and users.
Implementation / dependencies	Communicating smart chargers, meters and management platform, charging and grid data and digital-twin algorithms,
Main risks & open issues	Operational ownership, pricing acceptability, equity safeguards, regulatory requirements and detailed technical risks remain to be defined with stakeholders.
SF-EN1 – Strategic energy planning for peri-urban communities: Simulation tools will identify the best mix of local renewables, efficient heating/cooling technologies, and building retrofits.	
Solution & Concept challenge	Fossil heating, low EV uptake and expected growth create uncertainty about cost-effective decarbonisation pathways and future electricity infrastructure.
Target users	Municipal, cantonal and federal planners, residents, future residents and the local pharmaceutical and crop-protection industrial cluster.
Demonstration & operation	The eHubX framework models the existing system and identifies cost-optimal investments and operation for renewables, heating, cooling, retrofits and transport electrification.
Expected value / climate contribution	Quantifies least-cost climate pathways, energy and emission reductions, investment needs and distributional implications for evidence-based planning.
Key actors	EPFL and research partners, the four municipalities, Canton and federal bodies, utilities, industries and future operators.
Implementation / dependencies	eHubX, timely building, mobility, industry and utility data, the industrial NDA and demand scenarios.
Main risks & open issues	Incomplete or delayed data, uncertain industrial access, model assumptions, weak policy uptake and undefined long-term operational responsibility.

SF-EN2 – Energy sufficiency strategy integration: Scenarios will test how households, industries, and businesses can reduce energy demand and support climate-neutral transition.	
Solution & Concept challenge	High living space and fossil heating create avoidable energy demand, while sufficiency options are not yet integrated into local planning.
Target users	Residents and future residents, industries, municipal, cantonal and federal authorities, and organisations supporting technical planning.
Demonstration & operation	Sectoral sufficiency scenarios are co-developed and simulated, then integrated into SF-EN1 to quantify energy, emissions, cost and equity effects.
Expected value / climate contribution	Reduces energy and material demand, avoids infrastructure costs and supports equitable, lower-carbon lifestyles while maintaining quality of life.
Key actors	EPFL and research partners, the four municipalities, Canton and federal bodies, local industries, residents and TBF+ Partner AG (local consultancy firm).
Implementation / dependencies	Stakeholder workshop access, building, mobility and industry data, the industrial NDA, enabling policies and integration with SF-EN1 and SF-M1–M3.
Main risks & open issues	Stakeholder availability, delayed or restricted data, political and behavioural resistance, regulatory change and undefined operational ownership.

Sisslerfeld should be presented as an evolving research and engagement process rather than a completed measure-specific co-design workshop. The five concepts form a coherent analytical chain: high-resolution traffic evidence informs EV charging forecasts, optimisation and pricing, while energy-system and sufficiency modelling explores wider decarbonisation pathways. Their value depends on timely access to industrial, utility, mobility and charging data and on engagement with the four municipalities, Canton, industries, operators and the Reallabor.

5.2. Link between the co-designed solutions and periInnovations

The co-design activities carried out under T1.3 provide a direct input to the development and adaptation of the periInnovations in WP2. While the LL workshops further defined the local needs, operational conditions, stakeholders and expected functioning of the proposed measures, WP2 develops the technological and non-technological solutions required to support their subsequent implementation and demonstration. The relationship between both activities is therefore iterative: the co-designed measures provide local requirements for the periInnovations, while the progressive development of the periInnovations will support the further refinement and implementation of the LL solutions.

Overall, the mobility measures proposed across the Living Labs are mainly linked to the **periMOBILITY** developments. These include demand-responsive transport and on-demand services, public transport optimisation, multimodal integration, shared and micromobility services, mobility hubs, automated and connected mobility, active-mobility and safety tools, and the associated business and pricing models. Although the specific configurations differ between LLs, the workshops consistently highlighted the need for solutions that can respond to the dispersed and lower-density demand typical of peri-urban areas and that complement, rather than replace, existing public transport and mobility services.

The energy-related measures are primarily supported by **periENERGY**, particularly through renewable and local energy planning, energy-community development, grid and charging optimisation, energy storage, demand management and associated business and pricing approaches. These developments are especially relevant in Living Labs where electrification is constrained by grid capacity or where mobility, industrial activity and energy demand are closely interconnected. As a result, some mobility and industrial measures also require direct integration with periENERGY developments, particularly those related to electric vehicles, charging infrastructure and industrial electrification.

The industry and circular-economy measures are mainly linked to **periINDUSTRY**, including smart waste-management solutions, waste-collection optimisation, urban-mining and circular-economy

marketplaces, and Local Green Deal frameworks. These measures show that technological developments need to be complemented by appropriate organisational arrangements, stakeholder involvement, incentives and business models to facilitate the participation of citizens, industries and local authorities. **periGOVERNANCE** provides a transversal layer supporting several of the measures through data integration, federated data governance, AI-based data management, digital-twin approaches and decision-support tools. This is particularly important where information from mobility, energy, industry and other sectors needs to be combined to support integrated planning at Functional Urban Area level.

Across the nine LLs, the co-design process identified several common requirements that should guide the subsequent development and adaptation of the periInnovations. The solutions should remain modular and interoperable, allowing integration with existing local platforms, applications, transport systems, infrastructure and data sources. They should also be configurable to different spatial, demographic and operational conditions, particularly low-density areas where demand and service availability differ substantially from those of urban cores. Accessibility and inclusiveness should be incorporated directly into the design of services and tools, considering the needs of vulnerable users, people with disabilities, older people, low-income households and communities currently experiencing limited transport or service provision.

The workshops also reinforced the importance of economic and operational viability. Sustainable business models, pricing strategies, incentives and clearly defined stakeholder roles will be necessary for many of the proposed mobility, energy and circular-economy services to remain viable beyond the demonstration period. Similarly, reliable and representative data will be essential for optimisation and AI-based tools, together with appropriate provisions for interoperability, data governance, privacy, transparency and explainability.

Finally, the co-design activities confirmed the importance of considering technological development and physical or organisational implementation together. Digital optimisation alone cannot address limitations such as insufficient transport infrastructure, unsafe pedestrian routes, lack of secure bicycle facilities, grid congestion, limited charging capacity or inadequate waste-management infrastructure. WP2 developments should therefore support not only service optimisation but also the identification of infrastructure, governance and operational changes required for successful implementation.

The level of maturity of the co-designed measures also differs between LLs. While most LLs were able to address their complete set of proposed measures, some solutions in Marseille, Helmond and particularly Sisslerfeld require further definition through subsequent engagement, modelling or analytical activities. The corresponding links with WP2 should therefore continue to be refined as these solutions mature.

Overall, the mapping confirms that the proposed Living Lab measures are strongly aligned with the four groups of periInnovations and that, in many cases, their implementation will require a combination of periMOBILITY, periENERGY, periINDUSTRY and periGOVERNANCE developments rather than a single isolated innovation. The co-design outputs therefore provide an important set of functional, user, organisational and contextual requirements for WP2, helping ensure that the periInnovations developed and adapted within periASTY are locally relevant, interoperable, inclusive and suitable for their subsequent demonstration in peri-urban environments.

5.3. Further use and development of the co-design outputs

The SCDs and prototypical BIGMs reported in this deliverable represents the **first consolidated version of the co-designed measures** for the nine periASTY LLs. They should therefore be understood as an initial approach of how each measure is expected to operate, which actors need to be involved, and which implementation conditions should be considered. Their main purpose is to provide a common and structured basis for the next stages of technical development, preparation, implementation and evaluation of the LLs demonstrations.

The validated SCDs will serve as a reference for the further technical development and adaptation of the corresponding periInnovations in WP2, and subsequently, for the preparation of the implementation

and activities in WP3 and WP4 and the subsequent deliverables, D3.1 and D4.1. In practical terms, they provide the LLs and technical partners with an initial description of the intended operation of each measure, its main users, expected interactions, dependencies and implementation requirements. These outputs will therefore support the transition from the conceptual definition of the measures towards their actual deployment in the LLs. In parallel, the prototypical BIGMs will support the organisational and governance preparation of the demonstrations. They provide an initial understanding of the actors that may need to participate, their expected roles and responsibilities, the relationships between them, and the mechanisms through which the proposed solutions could be organised and sustained. As implementation progresses, these models will help LL partners identify potential gaps in responsibilities, coordination needs, partnerships and governance arrangements that may need to be resolved before or during deployment.

Neither the SCDs nor the BIGMs should, however, be considered fixed outputs. Their current version reflects the level of knowledge and maturity available during the first co-design round and will need to evolve as the measures become more technically and operationally defined. Changes may result from the development of the periInnovations, pre-deployment activities, technical feasibility assessments, further stakeholder engagement, changes in local conditions, implementation experience and the monitoring and evaluation of the demonstrations.

To support this iterative process, a **second round of LL co-design workshops is provisionally foreseen for the beginning of 2027**, although the specific dates and organisation of these activities have not yet been defined. This second round will provide an opportunity to revisit the initial concepts once further technical and implementation information is available, assess whether the assumptions established during the first workshops remain valid, and refine aspects that could not yet be fully specified.

The outputs from the two workshop rounds should therefore be considered complementary rather than independent results. The first round establishes the initial operational, user and governance framework for each measure, while the second round is expected to refine this framework based on the progress achieved during the intervening project activities. Taken together, both sets of outputs will provide a progressively more detailed basis to support the implementation, demonstration and evaluation of the measures within the LLs.

This iterative development will continue throughout the project. Experience gained during pre-deployment and demonstration, together with stakeholder feedback and monitoring results, will be incorporated into the evolving Solution Concept Designs and BIGMs. The accumulated knowledge from the successive co-design and implementation stages will ultimately feed into the final co-created solutions and BIGMs to be reported later in WP1, D1.3, providing more mature representations of the measures actually implemented and tested in the periASTY Living Labs.

6. Preliminary Impact Evaluation Framework

The periASTY Impact Evaluation Framework (IEF) provides a common methodological structure for monitoring and assessing the effects of the solutions implemented in the nine LLs. Its purpose is to translate the expected benefits and targets associated with each Solution Concept into measurable indicators, allowing changes observed during the project to be compared with a clearly defined reference or baseline. The framework might be refined throughout the project as the Solution Concepts, monitoring systems and data-sharing arrangements are further developed.

6.1. Evaluation framework design

The IEF follows a logic that connects inputs, activities, outputs, outcomes and impacts. Inputs include the financial, technical and data resources mobilised by the project. These inputs support implementation activities in the LLs, which produce direct outputs such as new services, infrastructure, digital tools, energy systems or agreements. The use of these outputs is expected to generate outcomes, which are aimed at producing changes in travel behaviour, accessibility, energy consumption, industrial efficiency or emission decrease. KPIs provide the evidence needed to determine whether these expected changes occur and to what extent they contribute to the longer-term objectives of periASTY.

Each indicator is linked to one or more Solution Concepts, an expected result and a measurable target included in the Grant Agreement (GA). This connection ensures that monitoring focuses on changes that are relevant to the project and that may result from the measures being tested. It also creates a traceable route between solution implementation, the data generated by the solution and the evidence used to assess its impact.

The KPI development process started from the indicative targets defined in the GA and was subsequently refined in collaboration with the LL leaders. The initial targets were translated into operational indicators with a clear identifier, definition, unit, calculation method, required input variables and potential data sources. Indicators addressing similar impacts in different LLs were reviewed together to improve methodological consistency, while retaining the adaptations required by differences in scope, target population, geographical boundaries and data availability.

The selection and refinement of the KPIs considered five main criteria: (i) **relevance** to the demonstrated solution and its expected **impacts**; (ii) **measurability** within the project implementation period; (iii) **feasibility** of collecting the required **input data**; (iv) **sensitivity** to changes produced by the intervention; and (v) **transparency** and reproducibility of the calculation.

The calculation of the KPIs requires both **quantitative and qualitative** inputs: the former may be obtained from transport and energy operators, smart meters, mobility platforms, traffic counts, municipal registers, GIS analyses, etc.; the latter indicators require structured surveys, interviews or stakeholder workshops.

6.1.1. Evaluation stages and interpretation of the change

The framework considers three measurement stages: baseline, mid-term and final measurement. Comparisons should retain the same indicator definition, geographical boundary, population group, unit and calculation procedure. Any necessary methodological changes will be documented. Table 36 summarises the purpose of each stage and the reporting outputs to which the resulting evidence will contribute. Measurement timing will follow the implementation schedule and data availability of each measure:

Table 36. Purpose and use of the three evaluation stages

Stage	Purpose	Main use	Reporting outputs
Baseline	Characterise the situation before the solution is implemented.	Establish the reference against which subsequent changes are assessed.	**D1.1**: Subsequent baseline completion documented in internal LL monitoring records and carried into the evaluation reports.
Mid-term	Assess implementation progress and early results once sufficient operational data are available.	Identify deviations, data gaps and monitoring problems, and support corrective action.	Internal LL and WP3/WP4 monitoring reports. Relevant evidence may inform **D3.2** and **D4.2** on testing and engagement, depending on measure readiness.
Final measurement	Measure performance at the end of the demonstration period using methods comparable with the baseline.	Assess observed changes and progress towards targets, and support learning across LLs.	**D3.3** and **D4.3**: demonstration and impact evaluation for initiators and responders. Relevant findings also inform **D1.3** on final solutions, BIGMs, indicators and replicability.

It is also worth noting how the changes are interpreted throughout the various stages of evaluation. For indicators where an increase represents improvement, the relative change will generally be calculated as:

$$KPI\ change\ (\%) = \frac{final\ value - baseline\ value}{baseline\ value} \cdot 100$$

For indicators where a reduction represents improvement, it will be calculated as:

$$KPI\ change\ (\%) = \frac{baseline\ value - final\ value}{baseline\ value} \cdot 100$$

When the baseline is zero, results will be reported as an absolute change, a newly achieved value or a binary transition (e.g., 0 if “not achieved”, 1 if “achieved”), depending on the indicator. Composite indices will use the same components and weights at each measurement point. Qualitative indicators will use a consistently defined scoring rule so that the initial survey and subsequent observations can be compared accurately.

Comparisons between baseline, mid-term and final values indicate the direction and magnitude of observed change. Interpretation should also consider implementation progress and external influences, including wider policy changes, economic conditions, weather and prices. Where the evaluation design does not isolate these influences, observed changes should not be attributed exclusively to the periASTY measures.

6.2. KPIs classification, definition and baseline calculation

The periASTY KPI set is organised into four thematic categories corresponding to the main realms of action: mobility, energy, industry and governance. The categories provide a common structure across the LLs, while the individual indicators remain linked to the scope, users and expected results of each local Solution Concept.

6.2.1. Thematic categories

The thematic classification facilitates the organisation and interpretation of the KPI set by grouping indicators according to their primary field of impact. The categorisation is as follows:

- **Mobility (M)**: Travel behaviour, transport supply, accessibility, safety, service use and transport externalities → Modal shift, shared mobility, travel time decrease.
- **Energy (EN)**: Energy generation, demand, costs, local energy sharing and energy-system performance → Renewable generation, fossil and grid share, household or business costs.
- **Industry (IN)**: Resource and energy efficiency, circularity, waste logistics, industrial decarbonisation and net-zero readiness → Material reuse or Local Green Deals.
- **Governance (G):** Institutional coordination, cross-sectoral data integration and evidence-informed decision-making supporting peri-urban action, including the adoption or update of policies and agreements.

This categorisation does not imply isolation, as several mobility measures affect energy demand and greenhouse gas emissions, while energy and industrial interventions may depend on governance arrangements or stakeholder participation.

6.2.2. Definitions

The following tableTable 37 presents the current definition and calculation method for each KPI by LL. The specifications below constitute the common reference for calculating the baseline, mid-term and final values.

Table 37. KPIs' nomenclatures, definitions, units and calculation methods

Nomenclature & Category	Definition	Unit	Calculation Method
LL1-DUBLIN-BALBRIGGAN			
KPI-DU-M1 Sustainable mode share	Percentage of total trips within the intervention area made using sustainable modes (cycling, walking, shared bikes, public transport, multimodal combinations).	%	(Trips by sustainable modes / Total trips) × 100
KPI-DU-M2 GHG emissions from urban mobility	Total greenhouse gas emissions generated by transport activities within the intervention area, normalized per capita.	kg CO_2-eq/cap	Total transport related GHG emissions / Population
KPI-DU-M3 Average travel time index (TTI)	Ratio between actual travel time and free-flow travel time (theoretical time with no traffic) on selected routes connecting peri-urban areas to the nearest train station, reflecting congestion levels.	dmnl	Observed travel time / Free-flow travel time
KPI-DU-M4 Population accessibility to key destinations	Share of peri-urban residents and commuters who can reach at least 3 categories of key destinations (e.g., city centre, train stations or mobility hubs, employment hubs, education, health, shopping and essential services) within 30/45 minutes door-to-door using sustainable and multimodal transport options that are physically accessible and economically affordable for the users.	%	(∑ Population living in areas with access to ≥3 key destination categories within 30/45 min / Total peri-urban population) × 100
KPI-DU-M5 VRUs accident rate	Total number of reported traffic accidents involving vulnerable road users (VRUs: pedestrians, cyclists, micromobility users) normalized by population. Number of accidents involving vulnerable road users per 1,000 inhabitants per year	dmnl	(Number of VRU related accidents / Population) × 1000
KPI-DU-M6 Population exposure to transport-related air pollution	Average concentration of transport-related air pollutants ($PM_{2.5}$ and/or NO_2) to which the peri-urban population is exposed	µg/m³	∑ (Pollutant concentration × population exposed) / Total population
KPI-DU-EN1 Number LECs established and operational	Total number of Local Energy Communities formally created and actively operating within the intervention area, in line with EU definitions (e.g., Renewable Energy Communities or Citizen Energy Communities)	dmnl	∑ (Count of established and operational LECs)
KPI-DU-EN2 Fossil & grid energy share	Percentage of total energy consumption in the intervention area that is supplied by fossil fuels and non-renewable grid electricity	%	((Energy from fossil fuels + Non-renewable grid electricity) / Total energy consumption) × 100
KPI-DU-EN3 Average annual household energy cost	Mean annual expenditure on energy (electricity, heating, and other relevant energy uses) for participating households	€/hh/year	Total annual energy expenditure of participant households / Households

LL2-LIMASSOL-KOURION			
KPI- KOUR-M1 Transport mode diversity index	Average number of distinct, accessible transport modes available to families and persons with disabilities within the intervention area (e.g., public transport, bike-sharing, adapted vehicles, demand-responsive transport, walking infrastructure)	dmnl	∑ available accessible transport modes / number of assessed user groups or areas
KPI- KOUR-M2 GHG emissions from private car use per capita	Total greenhouse gas emissions generated by private car trips in the intervention area, normalized per capita, reflecting the shift toward shared mobility solutions	kg CO_2-eq/cap	Total emissions from private car use / Population
KPI- KOUR-M3 Average travel time index (TTI)	Ratio between actual travel time and free-flow travel time (theoretical time with no traffic) on selected urban-peri-urban routes, capturing congestion levels and improvements due to public transport (PT) optimisation and on-demand services	dmnl	Observed travel time / Free-flow travel time
KPI- KOUR-M4 PT service performance index	A composite index reflecting public transport performance in peri-urban areas, combining key service quality indicators such as punctuality, frequency, coverage, and travel time	composite index	w1·Punctuality + w2·Service frequency + w3·Coverage + w4·Average travel time (inverse)
KPI- KOUR-M5 Average door-to-door travel time to key destinations	Mean travel time from representative origin points (residential areas, entry points for visitors/tourists) to a defined set of key destinations (city centre, cultural sites, transport hubs, major services)	min	∑Travel time to key destinations / (Number of origin - Destination pairs)
KPI- KOUR-M6 Mobility hub performance index	A composite index measuring the operational efficiency and user effectiveness of mobility hubs, combining indicators such as usage, connectivity, waiting time, and service integration	composite index	w1·Usage rate + w2·Intermodality score + w3·Service availability
KPI- KOUR-IN1 Energy intensity	Amount of energy used in industrial processes normalized by production output, capturing efficiency improvements resulting from optimized waste management operations (e.g., waste heat recovery, material reuse)	kWh/unit	Total energy consumption in industrial processes / Total production output
KPI- KOUR-IN2 Net-zero readiness	Percentage of industrial facilities in the intervention area that meet predefined technical, financial, organizational, and regulatory readiness criteria for the deployment of strategic net-zero technologies (e.g., electrification, renewable hydrogen, CCUS, energy efficiency, and circular production solutions)	%	(Industries meeting readiness criteria / Total number of industries in the area) × 100
KPI- KOUR-IN3 Number of LGDs signed	Total number of Local Green Deals formally signed between relevant stakeholders (e.g., municipalities, industries, communities) within the project framework	dmnl	∑ (Count of signed agreements)

KPI- KOUR-IN4 Material reuse rate	Percentage of total material consumption in the intervention area that originates from reused refurbished, remanufactured, recycled, or recovered materials instead of virgin raw materials, reflecting the adoption of circular economy practices and resource circularity	%	(Amount of reused-recycled materials / Total material consumption) × 100
KPI- KOUR-IN5 GHG emissions from waste collection operations	GHG emissions generated by waste collection activities (fuel consumption, vehicle operations) normalized per tonne of waste collected, reflecting efficiency improvements	kg CO_2-eq/tonne	Total GHG emissions from waste collection / Total waste collected
KPI-KOUR-G1** Cross-sectoral data integration	Number of distinct thematic sectors whose datasets are integrated into the KOUR-G1 platform and jointly used in at least one documented analysis supporting governance across the FUA.	Sectors	Count distinct sectors meeting both conditions
LL3-MARSEILLE			
KPI-MRS-M1 Shared mobility trips per capita	Total number of trips made using shared mobility services (e.g., bike-sharing, car-sharing, ride-pooling, on-demand services) normalized per capita in the intervention area	trips/cap	Total shared mobility trips / Population
KPI-MRS-M2 Private car commuting trips per capita	Total number of commuting trips made using privately-owned vehicles (cars, motorcycles) normalized per capita in the intervention area	trips/cap	Total commuting trips by private vehicles / Population
KPI-MRS-M3 Trips per low-income household	Total number of trips made using intermediary/shared mobility services by households classified as low-income normalized per low-income household in the intervention area	trips/hh	Total intermediary-shared mobility trips by low-income households / low-income households
KPI-MRS-M4 PT trips per capita	Total number of trips made using public transport by residents of peri-urban areas, normalized per capita, reflecting increased usage due to improved connectivity	trips/cap	Total PT in peri-urban areas / Peri-urban population
KPI-MRS-M5 Supported citizens	Percentage of citizens in the intervention area who have received direct support to shift toward sustainable mobility (e.g., incentives, training, access to services, awareness programs)	%	(Citizens receiving mobility transition support / Total target population) × 100
KPI-MRS-IN1 GHG emissions intensity from raw material transportation	GHG emissions generated by transporting raw materials, normalized by transport activity (tonne-kilometres), reflecting efficiency improvements and modal shifts in logistics	tonnes CO_2-eq/(t·km)	Total GHG emissions from raw material transport / Total tonnes-km of transported raw materials
KPI-MRS-IN2 GHG emissions	Percentage reduction in total greenhouse gas (GHG) emissions within the intervention area, considering all relevant sectors influenced by the project (e.g., transport, energy, industry, waste)	(%)	((Baseline emissions - Final emissions) / Baseline emissions) × 100
LL4-LJUBLJANA			

KPI-LJ-M1 DRT trips per capita	Total number of trips made using demand-responsive transport (DRT) services (e.g., on-demand shuttles, flexible bus services) within peri-urban areas; one trip means one passenger's origin-to-destination ride	trips/cap	(Total DRT passenger trips/bookings recorded through the operator or booking platform) / Peri-urban population
KPI-LJ-M2 E-bikes trips	Total number of trips made using e-bikes (shared and private, if data available) normalized per capita in the intervention area	trips/cap	Total e-bike rentals/trips from the new stations
KPI-LJ-M3 PT coverage	Total number of kilometres operated by public transport services within peri-urban areas over a year, reflecting the spatial and service expansion of PT	km	Total km operated by PT services in peri-urban areas
KPI-LJ-M4 SUMP adoption	Formal approval and adoption of the updated Sustainable Urban Mobility Plan (SUMP) 2027 (currently under preparation) by the competent authority, including the integration of enhanced cycling infrastructure and mobility hubs	dmnl	1 if adopted or 0 if not adopted
LL5-GUIMARAES			
KPI-GM-M1 DRT ridership per capita	Total number of trips made using Demand-Responsive Transport (DRT) services normalized by the population in the intervention area, reflecting overall uptake of on-demand mobility	trips/cap	Total number of DRT trips / Population
KPI-GM-M2 Private vehicle trips per capita	Total number of trips made using privately-owned vehicles (cars, motorcycles) normalized per capita in the intervention area	trips/cap	Total number of trips by privately-owned vehicles / Population
KPI-GM-M3 GHG reduction	Percentage decrease in total greenhouse gas (GHG) emissions within the defined intervention area and system boundaries over the project period	%	((Baseline emissions - Final emissions) / Baseline emissions) × 100
KPI-GM-M4 Passenger satisfaction score with mobility	Average satisfaction level of users with mobility services (e.g., PT, shared mobility, DRT, mobility hubs), expressed as a percentage	%	(Sum of satisfaction ratings / Maximum possible score) × 100
LL6-HELMOND-BZOB			
KPI-HM-M1 Vehicles circulating per year	Total number of vehicles circulating within the defined intervention area over a given period (e.g. private vehicles-commuters, complemented by the nº of people currently using PT network and active mobility modes)	vehicles/year	Total vehicle counts in the area per year
KPI-HM-M2 Total stops	Total number of mobility access points available in the intervention area, including physical stops (e.g., PT stops, mobility hubs) and digital stops (e.g., virtual/on-demand pick-up points in DRT systems)	number of stops	Number of physical stops + Number of digital-virtual stops
KPI-HM-M3 Awareness	Percentage of the target population that is aware of the existence and basic functioning of the mobility service	%	(Number of users aware of the service / Total target population surveyed) × 100

KPI-HM-M4 Multimodal trips	Percentage of trips involving at least two different transport modes (e.g., PT + bike, car + PT, DRT + rail) that are initiated, transferred, or completed at mobility hubs	%	(Number of multimodal trips at hubs / Total number of trips at hubs) × 100
KPI-HM-M5 Sustainable mode share	Percentage of total trips within the intervention area made using sustainable modes (e.g., walking, cycling, public transport, shared mobility)	%	(Number of trips by sustainable modes / Total number of trips) × 100
KPI-HM-M6 Transport GHG emissions	Percentage decrease in greenhouse gas (GHG) emissions generated by transport activities within the intervention area	%	((Baseline tr emissions - Final tr emissions) / Baseline tr emissions) × 100
KPI-HM-M7 Private car commuting share	Percentage of total commuting trips (home-work) made using privately-owned vehicles (cars, motorcycles) within the intervention area	%	(Number of commuting trips by private car / Total number of commuting trips) × 100
KPI-HM-EN1 Renewable energy generation	Annual amount of electricity generated from the installed solar PV systems (15,000 m²), including effective use/storage via battery systems	MWh/year	∑Electricity produced by PV systems over one year
KPI-HM-EN2 Electricity cost	Mean annual expenditure on electricity for participating organization/s within the intervention area	€/org	Total annual electricity expenditure / Number of households and business
KPI-HM-IN1 Energy intensity	Amount of energy consumed in industrial processes per unit of production, reflecting overall process efficiency	kWh/unit	Total energy consumption in industrial processes / Total production output
KPI-HM-IN2 GHG emissions from industrial activities	Total annual GHG emissions from industrial activities in the peri-urban area, including CO_2, methane (CH_4), fluorinated gases (F-gases), and refrigerants, expressed in CO_2-equivalent	t CO_2-eq/year	∑ (Emissions of each gas × Global Warming Potential)
KPI-HM-G1** Use of the monitoring framework in decision-making	Number of documented planning or operational decisions concerning APTS that are informed by data analysis or scenarios produced through the HM-G1 framework during the reporting period.	Decisions/ reporting period	Count decisions supported by an identifiable framework output and documentary evidence
LL7-KALAMATA			
KPI-KM-M1 Transport mode diversity index	Average number of distinct transport modes available and accessible to users within the intervention area (e.g., private car, public transport, bike-sharing, e-bikes, DRT, walking, car-sharing)	dmnl	Distinct transport modes available and accessible to users in the area
KPI-KM-M2 Car-related GHG emissions	Total GHG emissions generated by private car trips within the intervention area, normalized per capita, capturing reductions due to modal shift toward shared mobility	kg CO_2-eq/cap	Total emissions from private car / Population
KPI-KM-M3 Average travel time index (TTI)	Average additional travel time experienced per vehicle compared to free-flow conditions (theoretical time with no traffic) on key urban-peri-	%	Observed travel time / Free-flow travel time

	urban routes, capturing congestion levels and improvements from PT optimisation and on-demand services		
KPI-KM-M4 PT performance index	A composite index measuring the overall performance of public transport services in peri-urban areas, based on key service indicators such as punctuality, service frequency, commercial speed, and coverage	composite index	∑ (wi × Ii)
KPI-KM-M5 Accessibility to key destinations for commuters, visitors and tourists	Share of commuters, visitors and tourists who can reach at least 3 categories of key destinations (e.g., city centre, train stations or mobility hubs, employment areas, education, healthcare, shopping, essential services, leisure or tourist attractions) within 30/45 minutes door-to-door using sustainable and multimodal transport options that are available, safe, affordable and physically usable for the relevant user groups.	%	(∑ Target users with access to ≥3 key destination categories within 30/45 min / Total target users) × 100
KPI-KM-IN1 Energy intensity of industrial processes	Amount of energy consumed in industrial processes per unit of production, capturing efficiency gains specifically linked to improved waste management (e.g., waste heat recovery, material reuse, reduced processing needs)	kWh/unit	Total energy consumption in industrial processes / Total production output
KPI-KM-IN2 Share of industries with net-zero readiness	Percentage of industrial facilities within the intervention area that meet predefined criteria indicating readiness to deploy strategic net-zero technologies (e.g., electrification, hydrogen, CCS, circular processes)	%	(Number of industries meeting readiness criteria / Total number of industries in the area) × 100
KPI-KM-IN3 Energy intensity of processes affected by waste management	Amount of energy consumed in processes influenced by waste management operations (e.g., treatment, recycling, industrial reuse), normalized per unit of output, capturing efficiency gains from improved waste handling and circular practices	kWh/unit	Total energy consumption in relevant processes / Total output
KPI-KM-IN5* GHG emissions from waste collection operations	GHG emissions generated by waste collection activities (fuel consumption, vehicle operations) normalized per tonne of waste collected, reflecting efficiency improvements	kg CO_2-eq/tonne	Total GHG emissions from waste collection / Total waste collected
LL8-SOFIA			
KPI-SOF-M1 Shared e-bikes trips per capita	Total number of trips made using shared electric bikes in peri-urban areas, normalised per capita	trips/cap	Total shared e-bike trips / Peri-urban population
KPI-SOF-M2 Private monitored trips per capita	Total number of trips made using privately-owned motorized vehicles (cars, motorcycles) in peri-urban areas, normalized per capita	trips/cap	Total trips by private monitored vehicles / Peri-urban population
LL9-SISSLERFELD			

KPI-SF-M1 Peak-hour emissions	Total GHG emissions generated by traffic during the defined peak hours in the intervention area reflecting the impact of smart EV charging on congestion smoothing and emission reduction	kg CO_2-eq/hour	∑ (Vehicle activity during peak hour × Emission factors)
KPI-SF-M2* Local renewable energy share	Percentage of total energy consumed within the Local Energy Community (LEC) that is generated locally from renewable sources (e.g., solar PV, wind)	%	(Local renewable energy / Total energy consumption within LEC) × 100
KPI-SF-M3* Heating & cooling energy intensity	Total energy consumed for heating and cooling in residential and industrial buildings, normalized per capita, reflecting efficiency improvements	kWh/cap	Total heating and cooling energy consumption / Population
KPI-SF-EN1 Renewable energy generation Renewable energy per capita	Total amount of energy generated from renewable sources (e.g., solar, wind, biomass) within the intervention area over one year	MWh/year	∑Energy produced from renewable source
KPI-SF-EN1 GHG reduction	Percentage decrease in total greenhouse gas (GHG) emissions within the defined intervention area and system boundaries over the project period	%	((Baseline emissions - Final emissions) / Baseline emissions) × 100
KPI-SF-EN1 Energy efficiency	Ratio between useful output (e.g., services delivered, production, mobility trips) and the resources consumed (e.g., energy, fuel, time), depending on the sector	dmnl	Useful energy output / Energy input
KPI-SF-EN2 Energy demand per capita	Total energy demand within the intervention area (across relevant sectors such as building, transport, and industry), normalized per capita, reflecting reductions in overall energy use	kWh/cap	Total energy consumption / Population
KPI-SF-G1 Number of updated policies	Total number of existing policies, plans, or regulatory frameworks that have been formally revised to incorporate both sustainable urban mobility and energy-related measures	dmnl	Count officially approved updated policies

** KPI-KM-IN5, KPI-SF-M2 and KPI-SF-M3 present typos in their nomenclatures that come from the GA. Instead, they should be named as KPI-KM-IN4, KPI-SF- EN1 and KPI-SF-EN2. For consistency, their original names are maintained throughout the entire document.*

*** Two supplementary governance indicators are proposed to address the monitoring of KOUR-G1 in Limassol–Kourion and HM-G1 in Helmond. They assess cross-sectoral data integration and the documented use of analytical outputs in decision-making, complementing the sectoral impact indicators. Their operational definitions, reporting periods, baseline values and targets remain subject to validation with the responsible LL and technical partners. These indicators assess enabling capabilities and their use; they do not independently demonstrate wider governance or environmental impacts.*

6.2.3. Baseline calculations

The baseline represents the situation before the implementation or effective operation of the relevant periASTY solution. It provides the reference against which the mid-term and final values will be assessed. Preliminary baseline figures have been compiled where sufficiently reliable data is available, with priority given to official statistics, municipal datasets and operators' records (shown in Table 38).

Where direct local measurements were unavailable, selected baseline values were estimated by adapting datasets covering broader geographical areas to the relevant peri-urban scope. Spatial analyses were also undertaken using QGIS 3.40.11 (QGIS.org, 2026) to support calculations of accessibility, travel times and transport-related emissions. Values derived from indirect data or modelling assumptions are identified as estimates or proxies, as appropriate. Their interpretation should consider the geographical coverage, reference year and limitations of the underlying data. The datasets used are listed in Annex 1, Table 44.

Finally, some KPIs are listed as Not Available (N/A), principally because they must be assessed through stakeholder surveys, which were not available for the baseline years and will be conducted after the submission of this deliverable.

It should also be noted that it is not possible to calculate Sofia KPIs currenlty due to the lack of reliable data, from a clear definition of peri-urban areas to valid official datasets. These will be calculated in following deliverables (D1.2 & D1.3).

Table 38. Baseline years, values and status per KPI

KPI	Baseline Year	Baseline Value	Unit	Status
LL1-DUBLIN-BALBRIGGAN				
KPI-DU-M1	2022	45%	%	Exact
KPI-DU-M2	2022	32.1	kg CO_2-eq/cap	Proxy
KPI-DU-M3	2022	1.15	dmnl	Exact
KPI-DU-M4	2022	82.08%	%	Proxy
KPI-DU-M5	2022	0.128	dmnl	Exact
KPI-DU-M6	2022	12.6	µg/m³	Proxy
KPI-DU-EN1	2022	2	dmnl	Exact
KPI-DU-EN2	2022	87.34%	%	Exact
KPI-DU-EN3	2022	2,475.05	€/hh/year	Exact
LL2-LIMASSOL-KOURION				
KPI- KOUR-M1	2019	2	dmnl	Exact
KPI-KOUR-M2	2019	1,399.27	kg CO_2-eq/cap	Proxy
KPI-KOUR-M3	2019	1.84	dmnl	Exact
KPI-KOUR-M4	2019	N/A	composite index	NA surveys in 2019
KPI-KOUR-M5	2019	N/A	min	NA in 2019, it is going to be implemented during the project
KPI-KOUR-M6	2019	N/A	composite index	NA in 2019, SUMP suggests being implemented in the future
KPI-KOUR-IN1	2019	N/A	kWh/plant	NA surveys in 2019
KPI-KOUR-IN2	2019	0	%	Exact
KPI-KOUR-IN3	2019	N/A	dmnl	NA surveys in 2019
KPI-KOUR-IN4	2019	N/A	%	NA surveys in 2019
KPI-KOUR-IN5	2019	N/A	kg CO_2-eq/km	NA surveys in 2019
KPI-KOUR-G1	TBC	N/A	Sectors	Proposed sup indicator
LL3-MARSEILLE				
KPI-MRS-M1	2025*	8.42	trips/cap	Exact
KPI-MRS-M2	2022	48.3%	trips/cap	Exact
KPI-MRS-M3	2025*	0	trips/hh	Exact
KPI-MRS-M4	2022	0.85	trips/cap	Exact

KPI-MRS-M5	2022	N/A	%	NA surveys in 2013
KPI-MRS-IN1	2022	470,211.07	tonnes CO_2-eq	Exact
KPI-MRS-IN2	2022	885,611.09 (reduction %)	(%)	Exact
LL4-LJUBLJANA				
KPI-LJ-M1	2018	0	trips/cap	Exact
KPI-LJ-M2	2018	0	trips/cap	Exact
KPI-LJ-M3	2018	9,684.10	km	Exact
KPI-LJ-M4	2018	0	dmnl	Exact
LL5-GUIMARAES				
KPI-GM-M1	2025	0.166	trips/cap	Exact
KPI-GM-M2	2025	0.556	trips/cap	Proxy
KPI-GM-M3	2025	339.02	kt CO_2-eq	Proxy
KPI-GM-M4	2025	94.9%	%	Exact
LL6-HELMOND-BZOB				
KPI-HM-M1	2025*	3,805,904	vehicles/year	Proxy
KPI-HM-M2	2023	0	number of stops	Exact
KPI-HM-M3	2023	N/A	%	NA surveys for 2023. To be assessed during the project
KPI-HM-M4	2023	N/A	%	NA surveys for 2023. To be assessed during the project
KPI-HM-M5	2023	N/A	%	NA surveys for 2023. To be implemented during the project
KPI-HM-M6	2023	536,479.75	%	Proxy
KPI-HM-M7	2023	78%	%	Exact
KPI-HM-EN1	2023	0	MWh/year	Exact
KPI-HM-EN2	2023	41,237	€/org	Proxy
KPI-HM-IN1	2023	N/A	kWh/unit	Not measurable in 2023
KPI-HM-IN2	2023	30,142.42	t CO_2-eq/year	Proxy
KPI-HM-G1	TBC	N/A	Decisions/ period	Proposed sup indicator
LL7-KALAMATA				
KPI-KM-M1	2022	3	dmnl	Exact
KPI-KM-M2	2022	417.74	kg CO_2-eq/cap	Proxy
KPI-KM-M3	2022	31.33	%	Exact
KPI-KM-M4	2022	50.15	composite index	Exact
KPI-KM-M5	2022	71.51% / 77%	%	Proxy
KPI-KM-IN1	2022	1,865.69	kWh/unit	Proxy
KPI-KM-IN2	2022	N/A	%	NA surveys in 2022
KPI-KM-IN3	2022	3,369.62	kWh/unit	Proxy
KPI-KM-IN5	2022	54.63	kg CO_2-eq/tonne	Exact
LL8-SOFIA				
KPI-SOF-M1	2019	-	trips/cap	NA
KPI-SOF-M2	2019	-	trips/cap	NA
LL9-SISSLERFELD				
KPI-SF-M1	2024	1,453.08	kg CO_2-eq/hour	Proxy
KPI-SF-M2	2024	4.11%	%	Exact
KPI-SF-M3	2024	7.34	kWh/cap	Exact
KPI-SF-EN1	2024	5.40	MWh/year	Exact
KPI-SF-EN1	2024	30,450.4 (reduction %)	%	Proxy
KPI-SF-EN1	2024	1.14	dmnl	Proxy
KPI-SF-EN2	2024	20.44	kWh/cap	Exact
KPI-SF-G1	2024	1	dmnl	Exact

6.3. Data collection framework

The IEF is supported by a common data collection framework that translates each KPI into a defined set of input variables. This procedure makes each KPI value traceable to the underlying evidence and clarifies which information must be provided by the Living Labs, operators, public authorities or external data providers.

In accordance with D6.2 - Data Management Plan and Ethics, the data used for impact monitoring may be primary or secondary and quantitative or qualitative. The baseline calculations combine different kinds of sources and techniques to obtain the necessary inputs. During the demonstration period, these sources will be complemented, where relevant, by new sensors, monitoring systems, booking and ticketing platforms, smart meters, as well as questionnaires, interviews and stakeholder workshops that will be carried out under the project.

6.3.1. Data requirements and sources

Although each KPI has a specific input structure, the required data can be grouped into five main families. Table 39 summarises the principal variables and collection channels identified. All the datasets employed are compiled in Annex 1, Table 44.

Table 39. Data categorisation by type and source

Data group	Input variables	Main sources and collection methods
Mobility operations and travel behaviour	Trips and users by mode; vehicle counts and speeds; service frequency, punctuality and coverage; travel and waiting times; bookings and validations; accidents; accessibility to destinations; fleet and fuel data.	Public transport, shared-mobility and DRT operators; MaaS apps and booking and ticketing platforms; GTFS and AVL data; traffic sensors and counts; mobile or GPS data; surveys; journey planners; transport models and GIS analysis.
Energy and buildings	Energy demand and consumption; local renewable generation; fossil and grid energy share; heating and cooling demand; smart-charging activity; household or business energy costs.	Utilities and energy system operators; LEC platforms; smart meters; energy bills; building management systems; PV, charging and other generation systems; national and regional energy statistics.
Industry and circularity	Industrial energy inputs and production outputs; material consumption and reuse; waste volumes and collection activity; fleet fuel use; process and logistics emissions; net-zero readiness.	Industrial monitoring systems and production logs; company records; waste collection and fleet data; material-flow analyses; audits and readiness assessments; emissions inventories and recognised emission factors.
Governance and social data	Policies and plans adopted or updated; signed agreements and Local Green Deals; participation and support records; user satisfaction, acceptance and perceived accessibility.	Official municipal or regional documents; programme and service records; structured surveys; interviews; workshops.
Contextual and spatial data	Population and households; socio-economic and target-group characteristics; administrative and functional boundaries; land use; transport networks; locations of services, stops, hubs and key destinations.	Census and national statistical offices; municipal and regional open-data portals; national geospatial datasets; OpenStreetMap and other documented GIS sources; Earth observation data where relevant.

Whenever possible, direct operational data generated by operators or by the technologies deployed in the project will be used for the mid-term and final measurements. These data are expected to provide greater temporal and spatial specificity than several of the sources currently available for the baseline. Nevertheless, official statistics and contextual datasets will remain necessary for denominators, normalisation, comparison and the interpretation of observed changes.

6.3.2. Data collection process and responsibilities

The initial data collection was carried out after the KPI definitions and calculation formulas had been consolidated. A standard baseline workbook was prepared for each Living Lab, with dedicated fields for the required input variables, units, geographical scope, reference period, etc. LL leaders and the partners responsible for the corresponding measures were asked to provide the local information already available, including administrative records, operator data, monitoring results and project documentation. Each input was linked to its provider and reference year and, where publicly available, to the original document, dataset or URL (Annex 1, Table 44).

Where the requested local data were not available, the initial baseline was completed through spatial analysis. Priority was given to official statistics, municipal and regional open-data portals, transport and energy operators and other authoritative sources. GIS-based calculations, spatial downscaling and documented assumptions were used only when no direct local measurement existed. The resulting inputs were checked against the KPI definition and geographical boundaries. The workbooks therefore distinguish the original source data from the calculation performed and record the assumptions and limitations associated with each preliminary value.

During the implementation and monitoring phases, each Living Lab will provide the actual operational data generated by the deployed solutions and by the organisations involved in their operation. LL leaders will coordinate their provision with the relevant local authorities, operators, companies and technology providers, using the common KPI workbooks, agreed reporting periods and consistent units. Indicators based on user or stakeholder perceptions will be populated through the surveys prepared for the corresponding evaluation stage.

During each stage, in accordance with D6.2, the LL Leader oversees data cleaning, anonymisation and compliance with ethics, data-protection and FAIR requirements, while the partner responsible for the related activity will validate that the dataset is fit for the calculation. Reliable historical records will replace or refine the corresponding preliminary baseline estimate where they become available; otherwise, the direct data will be used for the mid-term and final measurements while the proxy baseline remains explicitly identified. Raw data will be retained separately from processed KPI values, and personal or commercially sensitive data will only be reported in aggregated or anonymised form.

6.3.3. Data availability and uncertainty

Data availability is not uniform across the nine Living Labs or KPI categories, since there is a combination of directly observed values, values derived from official or operator records, spatially downscaled estimates, GIS-based calculations and indicators that cannot yet be calculated. Future operator data will be particularly important for shared e-bike, DRT and public transport use, ticketing and bookings, traffic conditions, charging behaviour, energy generation and industrial or waste-management performance.

The main sources of uncertainty include differences between the year of the available data and the selected baseline year, incomplete geographical coverage, downscaling from city or regional values, emission factors and differences in definitions used by data providers. These limitations will be taken into account when comparing measurement stages.

7. Continued Co-creation and social exploration plan

The co-creation and social-exploration plan connect s the participatory design work initiated under T1.3 with the questionnaire-based social-embracement exploration developed under T1.6 and the implementation activities in WP3 and WP4. Its purpose is to ensure that the measures continue to be refined with the actors who will use, operate, regulate, finance or be affected by them, and that evidence on acceptance, readiness, behaviour and user experience is systematically fed back into solution development. The plan should therefore be understood as an iterative engagement framework rather than as a single workshop activity.

7.1. Stakeholder categories

Stakeholders are identified at measure level, building on the SCD and BIGM actor mapping. Four broad groups are considered across the Living Labs: **citizens and end users**; **public authorities and public agencies**; **operators and service providers**; and **businesses, industry actors, community organisations and other local intermediaries**. Within these groups, Living Labs should explicitly consider users who may face higher accessibility or participation barriers, including people with disabilities or reduced mobility, older people, families with children, low-income households and groups with limited digital access. Engagement formats can include co-design workshops, focus groups, interviews, surveys, bilateral meetings, technical working groups and pilot feedback channels, selected according to the maturity of the measure and the type of input required.

7.2. Co-creation phases

The co-creation process comprises two complementary phases, covering initial solution definition and subsequent demonstration and evaluation. Building on the methodology described in Section 4 and the initial outputs presented in Section 5, stakeholder engagement continues throughout the project to support solution validation, refinement and adaptation.:

- **Co-design phase**: Before implementation, engagement is used to validate the local problem, target users, service concept, user journey, implementation pathway, actor roles, and main barriers identified in the SCD and BIGM. The first workshop round, described in Section 4, provides the basis for the initial solution designs presented in Section 5. Where measures remain insufficiently mature or key actors were not represented, Living Labs will organise targeted follow-up sessions rather than treating the first workshop as the end of co-creation. Outputs are incorporated into revised SCD/BIGM versions and into the technical requirements passed to WP2 and the demonstration teams.
- **Demonstration and monitoring phase**: During implementation, co-creation shifts from concept definition towards validation and adaptation. Users, operators, authorities and businesses provide feedback on accessibility, reliability, usability, perceived value, organisational feasibility and unintended barriers. This feedback is combined with technical monitoring and the questionnaire-based assessment described in Section 8. Where material issues are identified, the Living Lab documents the change requested, the actor responsible for addressing it and the resulting adjustment to the solution, service, governance arrangement, or communication approach.

7.3. Social acceptance and behavioural aspects

Social acceptance is treated as a condition for successful demonstration and longer-term uptake rather than as an outcome assessed only at the end of the project. The relevant dimensions include perceived usefulness, ease of use, affordability, accessibility, willingness to adopt the solution, and perceived environmental and social benefits. Depending on the measure, the analysis may also consider willingness to change travel or energy-consumption behaviour, willingness to share data, acceptance of new pricing or governance arrangements and organisational readiness among operators, businesses and public authorities.

The engagement approach should account for cultural and socio-demographic differences between and within Living Labs. Recruitment and facilitation should aim for balanced representation and avoid relying

only on already engaged or highly technical stakeholders. Gender and inclusion considerations are incorporated into stakeholder identification, survey design and interpretation of results, while alternative participation channels should be provided where digital-only engagement would exclude relevant groups. The purpose is not to impose identical participation profiles across all Living Labs, but to make the composition of participants transparent and to identify where missing voices could bias the design or evaluation of a measure.

8. Monitoring, evaluation and adaptive framework

The monitoring, evaluation and adaptive framework provides the basis for tracking the development, implementation and effects of the periASTY solutions across the nine Living Labs (LLs). It brings together monitoring of the solutions and their impacts with the systematic assessment of stakeholder and citizen engagement, social embracement, behavioural change and user experience. The framework is designed to generate evidence that can be used to assess progress, identify emerging challenges and inform the further refinement and adaptation of the solutions throughout the demonstration period.

8.1. Monitoring strategy

The monitoring strategy (T1.6) covers three dimensions across all nine periASTY Living Labs (Dublin, Limassol, Ljubljana, Marseille, Guimarães, Helmond, Kalamata, Sofia, Sisslerfeld). First, the periASTY solutions — the mobility, energy, industry and governance concepts co-designed in each LL are monitored. The specific combination of solutions varies across the LLs. For example, Dublin/Balbriggan combines mobility and energy solutions, Limassol/Kourion combines mobility and industry solutions, while Sisslerfeld focuses on mobility and energy solutions within an industrial setting. Mobility and governance are considered across all nine LLs, while the energy and industry topics are included where relevant to the specific LL context. Second, their impacts are assessed against the indicators and baselines set out in the Impact Evaluation Framework (IEF) developed under T1.4. Third, the level of engagement of citizens, stakeholders, and businesses in the co-creation process is monitored. This is the aspect specific to T1.6 and is tracked through questionnaire-based data collection tools developed by NTUA, with MLAB, TUE, and WIM supporting survey distribution and data collection in the field.

Monitoring takes place in two phases, corresponding to the two survey rounds defined in T1.6. The first round, conducted during the co-creation phase, captures engagement and initial perceptions of the solutions as the demonstrations are developed across the nine LLs. The second round, conducted after the solutions have been demonstrated for the required minimum period, assesses social embracement, behavioural change, user experience, and the overall efficiency and impacts of the solutions. The second survey is conducted after at least 7 months of demonstration in the four initiator LLs (Dublin, Limassol, Ljubljana, Marseille) and at least 6 months in the five responder LLs (Guimarães, Helmond, Kalamata, Sofia, and Sisslerfeld).

8.2. Evaluation

The collected questionnaire data will be evaluated using two complementary approaches. First, responses will be analysed against the relevant KPIs and baseline values defined in the IEF developed under T1.4 (Section 6). The tailored questions included in each Living Lab questionnaire are designed to provide the information required to establish baseline conditions and assess changes following the implementation of the respective solutions.

Second, the results will be analysed across the nine Living Labs, considering their different local, socio-economic, and solution-specific contexts. This cross-Living-Lab analysis will support the identification of common patterns, context-specific effects, and transferable practices, providing evidence for the cross-fertilisation and replication activities under T1.7. Evaluation results will be reported in accordance with the project's reporting periods (RP1 and RP2).

8.3. Questionnaires Development – Objectives

The objective of the questionnaires is to examine the social embracement of present and future transport, energy, industry and governance policies in each Living Lab, as well as the impact that the solutions will have on users' travel and energy consumption patterns or industrial operations, as part of T1.6 "periASTY's solutions social embracement exploration". Based on this task, participants will evaluate the transport system of their city, their energy consumption patterns and/or industrial operations. Their evaluation is based on their perceptions which determine social acceptance. These

questionnaires will be used to collect responses and compare results before and after the implementation of the respective solutions and innovations. In this deliverable the methodology and the structure of these questionnaires are described. For readability and to keep this deliverable concise, the methodology will be explained using the questionnaire developed for the Living Lab of Helmond, as it is the most complete example.

The questionnaires consist of three main sections:

- Socio-demographic characteristics
- Mobility section
- Governance section

Furthermore, depending on the solution and innovations that will be implemented in each Living Lab, two more sections are included:

- Energy section
- Industry section

The survey was created by the NTUA team, with the valuable feedback from all the involved partners. The questionnaires were developed in English at the first stage, and they will be translated to 7 different languages: Greek, French, Slovenian, Portuguese, Dutch, Bulgarian and German. The LLs are responsible for translating the questionnaires. Where appropriate, necessary adjustments will be applied and overall, the goal is at least 100 answers per LL.

In general, the length of the questionnaires depends on the solutions and innovations and the topics covered by each individual Living Lab. For instance, in the city of Helmond, all the four pillars of the project will be covered, therefore is the most extensive questionnaire among the Living Labs, with a total of 93 questions.

In contrast, the city of Guimaraes will focus on only two of the four pillars (Mobility and Governance) and is the more concise questionnaire with 54 questions in total.

In the following, we present the text from the introduction of the questionnaire focused on the city of Helmond.

"*This survey is being conducted as part of the periASTY project, funded by the European Union's Horizon Europe research and innovation program (Project 101239401).*

periASTY aims to support the transition of peri-urban areas towards climate neutrality by developing innovative solutions in mobility, energy, industry and governance, while taking into account the needs and experiences of local communities.

Great news! ***Helmond*** *is one of the study areas of the periASTY project. As part of periASTY, several initiatives will be developed and tested in Helmond and its peri-urban areas.*

Your participation is an important part of the Living Lab approach. By completing this questionnaire, you can share your current travel habits and preferences, your views on mobility and energy, your experiences and perceptions of local industry, and your views on governance. Your responses will help identify local needs and assess how the project can contribute to a more connected, sustainable, energy-efficient and climate-neutral Helmond.

The questionnaire consists of five sections:

- *Sociodemographic Characteristics*
- *Mobility*
- *Energy*
- *Industry*

- *Governance*

Thank you for taking the time to participate and for contributing to the future development of Helmond and its peri-urban areas."

Each Living Lab is free to deploy the questionnaire using a platform of their choice, provided it was covered by an existing agreement with the respective partner organization. The questionnaire content should remain consistent across all the Living Labs to ensure uniformity and the selected platforms should be compliant with EU General Data Protection Regulation (GDPR) standards, the Federal Act on Data Protection (FADP) for Switzerland, as well as with the D6.2 on Data Management and Ethics document.

8.4. Questionnaires design methods and techniques

The questionnaires were specifically designed as revealed-preference surveys, aimed at capturing changes in the travel behaviour, energy consumption patterns and industrial and waste management operations.

More specifically, nine (9) different questionnaires were developed, each specifically tailored to the characteristics and solutions of the respective Living Lab. The design of each questionnaire was informed by the relevant solutions, user-cases and KPIs identified for each Living Lab, ensuring that the questions adequately reflect the local context. However, a common structure, terminology, and overall methodological approach were maintained across all questionnaires to ensure that the questionnaires remain relevant to the specific innovations of each Living Lab while facilitating the systematic analysis and comparability of the collected responses across the different Living Labs.

It is worth mentioning that, not every target user will answer all the questions. Therefore, the questionnaires have been designed to include questions specifically targeting citizens, as well as questions addressed exclusively to respondents representing organisations and stakeholders.

To ensure that each question is addressed to the appropriate intended respondent, a specific note is provided alongside each question, clearly indicating which questions are addressed to citizens and which are intended for other stakeholders, such as public transport operators, mobility service providers, local authorities, technology providers etc. This approach ensures a clearer questionnaire structure that will support the survey distribution and thus possibly increasing the completion rate.

Since the methodological framework is based on the specific use cases, innovations and KPIs identified for each Living Lab, tailored questions were developed to support the assessment and calculation of the relevant KPIs. These questions were designed to capture the information required to establish baseline conditions and subsequently assess the changes resulting from the implementation of the proposed solutions.

For instance, in the case of Helmond, one of the key KPIs is the percentage increase in sustainable transport mode usage. To enable the calculation of this KPI, specific questions were included in the questionnaire to capture respondents' transport mode choices before and after the implementation of the proposed solutions. By comparing the responses across the two assessment periods, the percentage change in sustainable transport mode usage can be calculated and used to evaluate the effectiveness of the implemented measures.

The following section presents selected KPIs and the tailored questions incorporated into the questionnaires, to support their calculation:

- *Mobility Section:*

  KPI - HM – M7: % reduction in private car use for commuting
  " What is your primary mode of transport for daily trips?"

  - *Private car (alone)*
  - *Carpooling*

- *Bus*
- *Tram/train*
- *Bicycle*
- *Bike-sharing service*
- *Walking*
- *E-scooter/micromobility*
- *Combination of modes*
- *Other _____*

This question enables the estimation of the modal split in Helmond by quantifying the percentages of trips undertaken by each mode. By collecting comparable data before and after the implementation of periASTY solutions, changes in the relative modal split can be quantified and assessed against the baseline conditions, thereby providing a direct measure of progress towards the corresponding KPI.

- *Energy Section:*

KPI - DU – EN1: Establishment of at least 3 LECs

"Are you familiar with the concept of Renewable Energy Communities (RLECs)?

- *Yes*
- *Somewhat*
- *No*

"How interested would you be in joining a local renewable energy community?"

- *Very interested*
- *Interested*
- *Neutral*
- *Not interested*

These two questions assess participants' perceptions of Local Energy Communities (LECs) and their willingness to participate in such initiatives. The responses provide an indication of the level of interest among participants and their potential willingness to support or contribute to the establishment of an LEC.

- *Industry Section:*

KPI - LI – IN3: at least 50 LGDs to be signed

"How willing would your organisation be to participate in a voluntary Local Green Deal coordinated by the municipality?"

- *Very willing*
- *Somewhat willing*
- *Neither willing nor unwilling*
- *Somewhat unwilling*
- *Very unwilling*

This question assesses an organization's willingness to participate in Local Green Deals (LGDs) and provides an indication of its potential for engagement in such initiatives. The responses can therefore be used to assess the likelihood and level of readiness of an organization to participate in LGDs.

It is worth mentioning that, due to their considerable length, only the questionnaire developed for Helmond is included in the Appendix, as Helmond is the only Living Lab addressing all four pillars of the periASTY project (Mobility, Energy, Industry and Governance). The complete set of nine

questionnaires, developed specifically for each of the nine Living Labs, is available in the designated project SharePoint.

8.5. GDPR

These questionnaires are designed to ensure a safe, secure and reliable environment for all participants. Therefore, the following measures have been implemented to protect participants and their responses:

- **Optional Personal Data:** While the questionnaires may include questions regarding socio-demographic characteristics (i.e. gender, age group, income), participation in these questions is entirely voluntary. Participants may choose to skip any such question or select the “prefer not to say” option.
- **Location Privacy:** In the section that participants have to describe their more recent trips, additional measures have been implemented to safeguard respondents’ privacy. Respondents are not asked to provide the exact location of their destinations.
- **Informed Consent:** Transparency is essential. Therefore, responders receive an informed consent notice at the beginning of the questionnaire, explaining how their data will be used and allowing them to make an informed decision about participation.
- The questionnaires are in line with D6.2 - Data Management and Ethics

In addition, to ensure GDPR compliance, the following text has been added in every questionnaire form:

" Protecting your personal data is our top priority. To ensure that, we have put in place robust measures to safeguard the data you provide. Our data processing always complies with the obligations set by the legal framework, especially the General Data Protection Regulation (GDPR). By submitting the questionnaire, you consent to this data processing. Please note, that the questionnaire is anonymous and completed on a voluntary basis. You are free to withdraw from the questionnaire at any time. "

8.6. Integration with other WPs

This framework does not work in isolation. Findings on social embracement feed back into **WP2**, helping refine the mobility, energy, industry and governance innovations — especially where T1.3 flagged user acceptance risks during the initial co-design phase. The framework is applied directly in the Living Lab demonstrations under **WP3** (initiator LLs) and **WP4** (responder LLs), alongside the technical and environmental monitoring done in T3.6 and T4.7. The final, combined evaluation results then feed into **WP5**, supporting the mid-term impact assessment (T5.1), the governance and regulatory recommendations (T5.3), and the implementation roadmaps (T5.2) for wider replication.

This chain of work also lines up with periASTY's formal deliverables and milestones: the T1.6 findings feed into Deliverable D1.1 and, together with the rest of WP1's work, into the final Deliverable D1.3, the periASTY LLs' final solutions and BIGMs, including the cross-fertilisation and replicability assessment, meaning the monitoring and adaptive cycle described here directly shapes the project's final, replicable outputs.

9. Knowledge exchange and transferability framework

The knowledge exchange and transferability framework provides a structured basis for cross-fertilisation, mutual learning and knowledge exchange across the periASTY Living Labs (LLs). It supports collaboration between LLs to exchange experiences, practices, implementation approaches and lessons learned, with the aim of strengthening capacity building and identifying opportunities for replication across peri-urban contexts. This framework is established under Task 1.7.

The periASTY LLs operate in different territorial, governance and socio-economic conditions, while addressing climate neutrality challenges related to mobility, energy, industry and governance. Although each LL focuses on its own local priorities and demonstrative solutions, many implementation challenges are shared. This Framework (T1.7) therefore supports mutual learning between LLs and facilitates the structured exchange of experiences and solutions.

The framework also supports exchange around the periInnovations and demonstrative solutions developed across WP2, WP3 and WP4, ensuring that implementation experiences, governance approaches, operational lessons and stakeholder engagement practices can be shared, reflected upon and potentially adapted across different territorial and sectoral contexts.

Within this context, the Framework focuses on:

- supporting co-creation activities across LLs;
- facilitating structured knowledge exchange and cross-fertilisation;
- supporting peer learning and implementation reflection;
- and developing an initial transferability and replication framework between initiator and responder LLs.

The objective of T1.7 is not to duplicate the co-design methodologies developed under T1.3 or the social exploration tools under T1.6, but rather to complement these tasks by creating structured opportunities for exchange, reflection and adaptation.

9.1. Cross-fertilisation approach

The periASTY cross-fertilisation approach is designed as an iterative process of knowledge exchange between Living Labs throughout the project lifecycle. Cross-fertilisation activities are designed to facilitate structured peer learning between LLs by creating opportunities to exchange implementation experiences, governance approaches, stakeholder engagement practices and operational lessons. Rather than promoting the direct transfer of solutions, the approach encourages LLs to reflect on implementation journeys, identify common challenges and explore how practices can be adapted to different peri-urban contexts. The activities will also support the exchange around the periInnovations developed in WP2 and the demonstrative solutions implemented through WP3 and WP4, ensuring that knowledge generated across the project is shared systematically. As the project progresses, this exchange will extend beyond the 9 LLs to the 10 Observer periASTIES to be recruited under WP5, which will be involved in knowledge-transfer and replication activities, including visits to demonstration sites and exchanges with the LLs on lessons learned from implementation. This will enable the experiences generated within the LLs to inform replication and upscaling in additional peri-urban contexts. The approach follows several guiding principles:

Table 40. Guiding principles for T1.7 cross-fertilisation and knowledge exchange activities

Principle	Description
Collaboration	LLs are encouraged to actively exchange experiences and support one another
Mutual learning	Both successful experiences and implementation challenges should be shared
Flexibility	Solutions and practices should be adapted to local contexts
Replication through adaptation	Concepts should inspire other LLs rather than be directly copied

Context sensitivity	The objective is not to directly copy solutions between LLs, but to understand under which conditions approaches or practices may work effectively in different contexts
Cross-sector exchange	Learning across mobility, governance, energy and industry is encouraged
Practicality	Activities should remain operational and useful for LLs
Transparency	Lessons learned, barriers and recommendations should be documented and shared

Cross-fertilisation activities will focus on exchange of:

- implementation experiences;
- methodologies;
- operational practices;
- governance approaches;
- stakeholder engagement methods;
- barriers encountered;
- enabling factors;
- and adaptation strategies.

Cross-fertilisation activities will be implemented through a combination of complementary formats that support continuous learning, collaboration and knowledge exchange throughout the project. Rather than relying on a single type of interaction, periASTY will combine workshops, peer-learning sessions, webinars and bilateral exchanges to provide LLs with multiple opportunities to share implementation experiences, reflect on common challenges and identify practices that may be adapted in other peri-urban contexts. Together, these activities contribute to achieving project objective MO1.5, which foresees six cross-fertilisation events over the course of the project (Table 41).

Table 41. Proposed T1.7 cross-fertilisation and knowledge exchange activities

Activity	Purpose	Expected outputs	Indicative timing
Cross-fertilisation workshops	Exchange experiences, barriers and good practices between LLs	Lessons learned, replication opportunities, implementation reflections	Every 6 months
Thematic webinars	Discuss specific implementation topics or challenges	Shared thematic insights and peer exchange	As needed
Peer-learning sessions	Smaller exchange discussions between LLs	Operational reflections and targeted discussions	As needed
Bilateral LL exchanges or targeted LL exchanges	Exchange between initiator and responder LLs on specific challenges, exchanges or potential transferability opportunities	Initial transferability discussions and adaptation considerations	Continuous
Reflection sessions	Discuss lessons learned and recommendations	Recommendations and implementation insights	After co-creation phases
Knowledge-sharing repository	Share templates, workshop summaries and lessons learned	Shared project knowledge base	Continuous

While the proposed activities provide an initial structure for knowledge exchange, their implementation will remain flexible and will evolve according to the progress of the LLs and project needs. Where possible, cross-fertilisation activities will build on information and reflections emerging from WP3 and

WP4 bilateral LL exchanges and will be aligned with wider project events to maximise participation, minimise duplication and avoid placing additional burdens on LL partners.

Initial cross-fertilisation workshop

As an initial step towards establishing regular knowledge exchange between the LLs, the first cross-fertilisation workshop is currently envisaged during the October 2026 General Assembly in Ljubljana. Given that this workshop will take place shortly after the first co-design phase, its primary objective will not be to discuss replication of mature solutions, but rather to establish a common understanding of how each LL has approached the co-design process and to initiate peer learning across the consortium.

The workshop will provide an opportunity for LLs to present their local context, share their co-design approaches, reflect on stakeholder engagement experiences and identify common challenges, enabling factors and lessons emerging from the initial co-creation activities. Particular attention will be given to understanding similarities and differences across the LLs, identifying areas where peer support may be beneficial, and laying the foundations for future cross-fertilisation and replication activities as implementation progresses.

The workshop format is expected to combine short LL presentations with interactive discussions and peer-learning exercises. Where appropriate, interactive tools (e.g. Mentimeter, QR-code surveys or collaborative whiteboards) may be used to facilitate participation and capture reflections from participants. As implementation advances, subsequent cross-fertilisation workshops will progressively shift their focus towards implementation experiences, transferability considerations and replication opportunities.

9.2. Replication logic

The replication logic in periASTY is structured around the interaction between Initiator LLs (WP3) and Responder LLs (WP4). While Initiator LLs are responsible for implementing and demonstrating solutions, responder LLs assess and explore how these practices, approaches or solutions may be adapted to their own contexts.

The objective of replication is not direct copying, but rather understanding under which conditions solutions or practices may work effectively elsewhere. This reflects the principle of replication through adaptation, recognising that peri-urban areas have different governance structures, territorial realities, user needs and operational conditions.

Table 42. Roles of Initiator and Responder Living Labs in the periASTY replication process

All LLs are expected to share:	All LLs are expected to assess:
• Solutions and approaches developed, • implementation approaches and experiences, • governance arrangements, • stakeholder engagement methods, • barriers and enabling factors, • Adaptations made to the local context, • and lessons learned.	• Relevance to their local needs and challenges, • local feasibility, • governance and regulatory compatibility, • stakeholder readiness and citizen acceptance, • operational and infrastructure requirements, • financial and resource implications, • adaptations required for their own context.

Although Initiator and Responder LLs have different roles within WP3 and WP4, knowledge exchange and replication under T1.7 will operate as a two-way process. Responder LLs will therefore not only assess experiences emerging from Initiator LLs but will also contribute their own practices, challenges, adaptations, and lessons, while Initiator LLs may similarly draw on relevant experiences from responder LLs and other LLs. Replication is consequently not based on a fixed one-to-one transfer pathway, any LL may draw inspiration from one or several LLs and from the wider pool of periInnovations and experiences generated across the project.

Replication opportunities will therefore be identified based on thematic relevance, common challenges, territorial similarities, stakeholder needs, and implementation feasibility. This logic allows LLs to draw

inspiration from multiple LLs and from the broader pool of periInnovations developed in WP2, rather than relying on a one-to-one transfer model.

To support future replication and knowledge exchange, LLs will be encouraged to systematically document and reflect on their implementation experiences, including the barriers encountered, enabling factors, adaptations made throughout the process, stakeholder feedback, and the contextual conditions that influenced transferability. They will also be invited to identify recommendations for future replication based on their experiences. These reflections will provide the foundation for subsequent cross-fertilisation workshops and thematic knowledge exchange activities, while also informing the progressive refinement of the transferability framework throughout the project.

In parallel, the framework will consider a number of key scalability factors when assessing the potential for transferring solutions across different peri-urban contexts. These include the adaptability of solutions to different territorial settings, governance complexity and coordination requirements, resource intensity and operational capacity, citizen uptake and social legitimacy, as well as the integration of solutions with the periInnovations developed under WP2.

As implementation progresses, the framework will remain iterative and will be continuously refined based on evidence emerging from the LLs, including implementation experiences, lessons learned and transferability insights gathered through WP3 and WP4 activities. The resulting knowledge will contribute to the further development of the framework in D1.3 and support the wider replication, exploitation and capacity-building objectives of periASTY including knowledge transfer to the 10 Observer periASTIES and, through WP5 activities, to other peri-urban areas and relevant external initiatives beyond the consortium.

Building on this replication logic, the initial transferability framework identifies the main contextual conditions to be considered when assessing whether a solution, approach or practice could be adapted to another LL peri-urban context, both within and beyond the periASTY LLs.

The initial transferability framework provides the first structure for assessing whether and how periASTY solutions, practices and methodologies may be adapted across different peri-urban contexts.

At this stage, transferability will focus on understanding the contextual conditions that support or limit adaptation.

The following key variables have been identified in Table 43:

Table 43. Initial variables for assessing transferability across peri-urban contexts.

Variable	Description
Territorial context	Spatial structure, connectivity and peri-urban characteristics
Governance conditions	Institutional arrangements and decision-making processes
Stakeholder readiness	Availability and willingness of relevant actors to engage
Operational requirements	Infrastructure, human resources and practical feasibility
Social acceptance	User willingness, behavioural patterns and inclusion aspects
Financial feasibility	Cost implications, business models and funding conditions
Regulatory compatibility	Alignment with local and regional policy frameworks

9.3. Learning monitoring and feedback mechanisms

Systematically capturing lessons learned is an important component of the T1.7 approach, as cross-fertilisation and future replication depend not only on understanding what solutions are being developed, but also on understanding the experiences, conditions and challenges associated with their development and implementation. The purpose of the learning process is therefore to create a structured feedback loop through which experiences from the LLs can be documented, exchanged and progressively used to strengthen subsequent knowledge exchange and transferability activities.

Learning will be captured throughout the project and will draw on several complementary sources. These include the co-design activities and resulting Solution Concept Design and BIGM outputs developed under T1.3, the social embracement and behavioural insights generated under T1.6, implementation experiences emerging through WP3 and WP4, and the cross-fertilisation workshops, peer-learning sessions, bilateral exchanges and other activities organised under T1.7. This approach will enable the Framework to build on information already generated elsewhere in the project rather than creating parallel reporting requirements for the LLs.

In line with this operational framework, LLs will be encouraged to reflect on both positive experiences and implementation challenges. Attention will be given to barriers encountered, enabling factors, adaptations made in response to the local context, stakeholder feedback and engagement experiences, conditions affecting transferability, and recommendations that may support other LLs. These dimensions provide a common structure for capturing lessons while remaining sufficiently flexible to reflect the diversity of mobility, energy, industry and governance solutions being developed across the periASTY project.

The depth and focus of these reflections will evolve according to the maturity of the LL activities. During the early stages, the emphasis will be on lessons emerging from co-design, including stakeholder engagement, assumptions challenged during the process, common barriers and areas where LLs may benefit from peer support. As the project moves towards pre-deployment and demonstration, the focus will progressively expand towards implementation conditions, operational challenges, adaptations made, enabling factors and the potential transferability of solutions and practices.

The first cross-fertilisation workshop, currently planned for the October 2026 General Assembly in Ljubljana (Slovenia), will provide the first structured opportunity to test this learning approach. Building on the initial T1.3 co-design activities, the session is expected to capture early lessons on stakeholder engagement, co-design experiences, challenges encountered, assumptions that may have changed through stakeholder dialogue, and areas where LLs would like to learn from or support one another. Interactive tools may be used to facilitate this process and capture reflections in a concise and comparable format. The exact workshop format will remain flexible and may be further refined based on the evolution of the LL activities before the General Assembly.

Insights generated through these activities will be consolidated into short workshop summaries and learning outputs, which will be used to identify priority themes for subsequent peer-learning and thematic exchanges, inform future initiator–responder discussions, and progressively refine the T1.7 transferability framework. Relevant findings may also be shared with the responsible task, and WP leads where they can support further solution development under T1.3, or implementation and demonstration activities under WP3 and WP4. Finally, the accumulated learning and transferability evidence will contribute to the further assessment of cross-fertilisation and replicability in D1.3.

Beyond the internal project learning process, relevant lessons and transferability insights generated through T1.7 will also feed into the wider knowledge-transfer and upscaling activities of WP5. This includes supporting knowledge exchange with 10 Observer periASTIES and complementing the cross-pollination activities undertaken under T5.6. The T5.6, led by EPF, connects periASTY with EU and international R&I initiatives, policymakers, organisations and networks, including the EU Cities Mission, Driving Urban Transitions (DUT), EIT/KICs and CIVITAS, with the aim of building synergies, exchanging knowledge, and communicating relevant periASTY lessons beyond the consortium. In this way, learning generated through the LLs can contribute to replication and capacity building both within periASTY and across the wider European ecosystem.

10. Conclusions

D1.1 establishes a shared basis for moving the periASTY Living Labs from initial intervention concepts towards implementation and evaluation. Its principal contribution is the connection between territorial evidence, stakeholder-informed solution design, business and governance arrangements, and measurable outcomes. This connection makes the proposed measures more operationally explicit while identifying the assumptions and dependencies that still require resolution. The resulting SCDs, BIGMs and preliminary IEF should therefore guide the next stages of the project as evolving working references.

A first conclusion is that achieving climate neutrality in peri-urban areas requires integrated responses to interconnected constraints. Improving access to shared mobility, for example, is unlikely to generate sustained modal shift without safe routes, reliable public transport connections and affordable services. Similarly, electrification depends on available grid capacity, coordinated charging and viable energy-sharing arrangements. The value of the periASTY portfolio consequently lies not only in individual innovations, but also in how they are combined with the infrastructure and services already present in each territory.

The co-design outputs also show that implementation readiness cannot be assessed solely through technical maturity. A solution may be technically feasible while remaining dependent on unresolved permits, operator commitments, data-sharing agreements, financing or maintenance responsibilities. The BIGMs make these dependencies visible and provide a basis for addressing them alongside technical development.

Inclusion is equally important to implementation success. Affordability, physical accessibility, digital access and compatibility with everyday routines influence whether the intended users can benefit from the measures. Continued engagement should therefore reach beyond already-active stakeholders and use accessible participation and service channels. Questionnaire findings and pilot feedback will be particularly valuable for distinguishing initial interest from actual uptake and sustained behavioural change.

Methodologically, the first co-design cycle supports a common process with flexible local application. Accessible canvases and extended templates provide a useful link between stakeholder discussions and implementation planning. However, a single workshop cannot resolve every technical, financial or institutional question. Differences in measure maturity and local governance therefore require targeted follow-up, staged engagement and further validation.

Finally, transferability should focus on the conditions that make an approach workable rather than on reproducing an identical solution. Cross-Living-Lab exchange will be most useful when it documents barriers, enabling factors, adaptations and operational experience alongside achievements. By linking this learning with technical monitoring and social evaluation, periASTY can progressively identify which components are transferable and which require local redesign.

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Annex

1. Datasets used for KPIs calculations

Table 44. Data sources used for the calculation of the KPIs

Variable	Source
LL1-DUBLIN-BALBRIGGAN	
GIS Data	- https://data-osi.opendata.arcgis.com/
Energy from fossil fuels	- https://www.seai.ie/data-and-insights/seai-statistics/electricity
Established and operational LECs	- https://www.seai.ie/plan-your-energy-journey/for-your-community/sustainable-energy-communities/sec-map?view=map&county=Dublin
Free-flow travel time	- https://www.openstreetmap.org/#map=13/53.60402/-6.20024&layers=H
Non-renewable grid electricity	- https://www.seai.ie/data-and-insights/seai-statistics/electricity
Number of households	- https://data-osi.opendata.arcgis.com/
Number of trips by sustainable modes	- https://www.nationaltransport.ie/planning-and-investment/transport-modelling/data/
Number of VRU related accidents	- https://www.rsa.ie/road-safety/statistics/collisions#
Observed travel time	- https://www.nationaltransport.ie/planning-and-investment/transport-modelling/data/
Pollutant concentration	- https://airquality.ie/ https://www.epa.ie/publications/monitoring--assessment/air/air-quality-in-ireland-2024.php
Population	- https://data-osi.opendata.arcgis.com/datasets/osi::cso-small-areas-national-statistical-boundaries-2022-ungeneralised/explore?location=53.602313%2C-6.179259%2C14
Population exposed	- https://airquality.ie/station/EPA-61
Population living in areas with access to ≥3 key destination categories	- https://data.fingal.ie/datasets/FingalCoCo::fingal-county-council-adopted-development-plan-zoning-2017-to-2023fcc/about - https://data.gov.ie/dataset/national-public-transport-access-nodes-naptan
Total annual energy expenditure of participant household	- https://www.seai.ie/data-and-insights/energy-data-portal
Total number of trips	- https://www.cso.ie/en/media/csoie/census/documents/powsccar2022/Commuting_Data_EDtoED_2022.zip
Total energy consumption	- https://www.seai.ie/data-and-insights/energy-data-portal
Total transport related GHG emissions	- https://data-osi.opendata.arcgis.com/datasets/osi::railway-stations-national-250k-map-of-ireland - https://www.seai.ie/sites/default/files/publications/Energy-in-Ireland-2022.pdf - https://www.seai.ie/data-and-insights/seai-statistics/transport - https://www.statista.com/statistics/411866/annual-greenhouse-gas-emissions-of-the-transport-sector-in-ireland/?srsltid=AfmBOoruxGVL_x-W_TC_h_hE_nfArjhNWwg1QlkS5W683NfffvZuTezQ
LL2-LIMASSOL-KOURION	
GIS Data	- https://data-osi.opendata.arcgis.com/
Population	- https://cystatdb23px.cystat.gov.cy/pxweb/en/8.CYSTAT-DB/8.CYSTAT-DB__Population__Census%20of%20Population%20and%20Housing%202021__Population__Population%20-%20Place%20of%20Residence/1891114E.px/table/tableViewLayout1/
SUMP	- https://www.mcw.gov.cy/mtcw/pwd/pwd.nsf/4515C2CE13D294B9C225874B00289C98/$file/Επισυναπτόμενο%203_Final_SUMP_Report_Lim_ExSum_EN.pdf
Average travel time index (TTI)	- https://www.google.com/maps - https://www.openstreetmap.org/
LL3-MARSEILLE	
Number of commuting trips by private vehicles	- https://www.insee.fr/fr/accueil
Number of low-income households	- https://www.insee.fr/fr/accueil
Number of public transport trips	- https://data.ampmetropole.fr/explore/dataset/ol-points-d-arret-des-reseaux-de-transport-en-commun/information/ - https://www.data.gouv.fr/datasets/points-darret-des-reseaux-de-transport-rtm-regie-des-transports-de-marseille
Number of shared mobility trips	- Shared mobility operators participating to Periasty : Lime, Voi and Citiz
Number of shared trips by low-income household	- https://www.rtm.fr/sites/default/files/docs/013bis%20RTM%20en%20chiffres_2024%201.pdf
Population	- https://www.insee.fr/fr/accueil
LL4-LJUBLJANA	
Bus	- https://rt.gtfs.derp.si/
Ljubljana boundaries	- https://www.igismap.com/download-slovenia-administrative-boundary-gis-data-for-national-municipality-and-more/
Population	- https://pxweb.stat.si/SiStat/en/Podrocja/Index/100/population

SUMP 2027	- discussed during the meeting of the 3 of June 2026 about the WP3 LL KPIs: SUMP is under preparation
Total number of e-bike trips	- discussed during the meeting of the 3 of June 2026 about the WP3 LL KPIs: since this will be a brand-new e-bike station, baseline is 0
Total number of trips made using DRT services	- discussed during the meeting of the 3 of June 2026 about the WP3 LLs KPIs: since DRT will be a newly introduced service, the baseline coverage is 0
Train	- https://ipi.eprostor.gov.si/jgp/data
Train time tables and routes	- https://rt.gtfs.derp.si/
LL5-GUIMARAES	
GHG emissions per capita (2023) - GUI municipality	- https://memmais.tecnico.ulisboa.pt/
Guimaraes surface	- https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE
Number of trips by private vehicles	- https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE
Guimaraes population	- https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE
Portugal inhabitants	- https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE
Portugal surface	- https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE
Satisfaction ratings	- Operating company
Total greenhouse gas emissions	- https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE - https://apambiente.pt/clima - https://memmais.tecnico.ulisboa.pt/ ;!!D9dNQwwGXtA!WNNUvQZupjQH6RcPQHqsCTPC2luP265wZnFBmledflf0tzxznhK0ROTtK1q9XqelHYEAKSc6fpKX4RVWjEK8mkkT6TUlwaIH$
Total number of trips made using DRT services	- Operating company
Number of households in Guimaraes peri-urban area	- Open Street Maps
Vehicles per household	- https://www.pordata.pt/
LL6-HELMOND-BZOB	
GHG emissions	- https://unfccc.int/sites/default/files/resource/2026-0022%20National%20Inventory%20Document%201990-2024%20NLD.pdf
Electricity produced by PV systems	- https://www.brabant.nl/publish/pages/2903/grote_oogst_pva_hoogeind-bzob_helmond.pdf
Number of households and businesses	- https://www.openstreetmap.org/#map=13/51.46158/5.72044&layers=H
Other vehicles	- https://www.helmond.nl/Internet/Site-Root/Media/45/45-d-TL-Bedrijventerrein-BZOB.pdf
Other vehicles	- https://pas.commissiemer.nl/files/nl/3155/bijlage-9-mer-effectrapport-01-verkeer.pdf
PT to BZOB (buses)	- https://transitapp.com/nl/region/north-brabant/bravo/bus-320
PT to BZOB (buses)	- https://appassets.mvtdev.com/map/39/l/101/522452.pdf
Total annual electricity expenditure	- https://www.globalpetrolprices.com/Netherlands/
Total energy consumption in industrial processes	- https://www.brabant.nl/publish/pages/2903/grote_oogst_pva_hoogeind-bzob_helmond.pdf
Total greenhouse gas emissions	- https://www.brabant.nl/publish/pages/2903/grote_oogst_pva_hoogeind-bzob_helmond.pdf
Total number of mobility access points available in the intervention area	- https://www.openstreetmap.org/#map=13/51.46158/5.72044&layers=H
Total production output	- https://www.brabant.nl/publish/pages/2903/grote_oogst_pva_hoogeind-bzob_helmond.pdf - https://www.helmond.nl/Media%20Helmond.nl/Documenten%20Helmond/Bewoners/Duurzaamheid/Klimaatmissie/CCC%20Eindhoven-Helmond%20-%20Climate%20Action%20Plan%20-%20FINAL.pdf
LL7-KALAMATA	
Average time of delay	- https://astikoktelkalamatas.gr/tilematiki/
CO2 emissions	- https://netzerocities.app/resource-4185
Distance operated by public transport services	- https://overpass-turbo.eu/
Fleet of vehicles	- https://www.statistics.gr/en/statistics/-/publication/SME18/
Key destinations	- https://www.openstreetmap.org/#map=11/36.9971/21.8806&layers=H
Population	- https://www.statistics.gr/documents/20181/17286366/APOF_APOT_MON_DHM_KOIN.pdf/41ae8e6c-5860-b58e-84f7-b64f9bc53ec4
Population	- https://www.pna.gr/messinia/dimos-kalamatas/82895-o-monimos-plethysmos-sto-demo-kalamatas
Total commuters, visitors and tourist considered	- https://www.statistics.gr/en/home/
Total energy consumption in industrial process	- https://netzerocities.app/resource-4185
Total energy consumption in waste management processes	- https://netzerocities.app/resource-4185
Total GHG from waste collection	- https://netzerocities.app/resource-4185
Total number of industries in the area	- https://www.openstreetmap.org/#map=11/36.9971/21.8806&layers=H
Total output industrial processes	- https://netzerocities.app/resource-4185
Total output total waste collection	- https://netzerocities.app/resource-4185

LL8-SOFIA	
-	-
-	-
LL9-SISSLERFELD	
Emission factors	- https://www.hbefa.net/en/software#online-version
Emissions accounts for households and businesses, by economic sector	- https://www.bfs.admin.ch/bfs/de/home/statistiken/raum-umwelt/umweltgesamtrechnung/luftemissionen.assetdetail.36187688.html
Heating and cooling energy consumption	- https://opendata.swiss/de/dataset/energie-reporter/resource/53325381-175e-4d0a-b4f4-f7d450be654a
Locally generated renewable energy	- https://opendata.swiss/de/dataset/energie-reporter/resource/53325381-175e-4d0a-b4f4-f7d450be654a
Officially approved policies	- https://www.sisslerfeld.ch/assets/uploads/files/berichte/05-00-20241104_rSP_Sisslerfeld_Sachplantext.pdf - https://www.gemeinde-stein.ch/publikationen/538876 - https://www.sisslerfeld.ch/download/ - https://www.sisseln.ch/sisslerfeld
Population (4 municipalities)	- Statistical data for four municipalities making up Sisslerfeld: - 1) Stein (3661 from https://www.gemeinde-stein.ch/gemeindeinzahlen); - 2) Eiken (2594 - https://www.eiken.ch/gemeindeinzahlen); - 3) Sisseln (1655 - https://www.sisseln.ch/aktuellesinformationen/2722625); - 4) Munchwilen (1095 - https://www.muenchwilen-ag.ch/unser-dorf/zahlen-fakten.html/59) - total = 9005 (from 2025 data)"
Sisslerfeld surface (km2)	- Provided by the LL leader
Total energy consumption	- https://opendata.swiss/de/dataset/energie-reporter/resource/53325381-175e-4d0a-b4f4-f7d450be654a
Vehicle activity during peak hour	- https://www.ag.ch/de/themen/staat-politik/daten-und-zahlen/geoportal/geodaten/geodatenliste?rewriteRemoteUrl=/details/AGIS.avk_vkzsmeas/GeoPackage

2. Helmond Questionnaire (T1.6)

The following survey presents the complete questionnaire developed for the Helmond Living Lab and is included as a representative sample of the nine questionnaires developed for the nine Living Labs within the periASTY project. The Helmond questionnaire covers all four periASTY pillars—mobility, energy, industry, and governance—and therefore provides a representative example of the questionnaire structure and content developed under T1.6. To keep the deliverable concise and avoid reproducing nine questionnaires with overlapping content, the complete Helmond questionnaire is included in this appendix as the representative example.

A Survey to Assess Social Embracement, Readiness, Behavioural Change and Efficiency in Helmond

"*This survey is being conducted as part of the periASTY project, funded by the European Union's Horizon Europe research and innovation program (Project 101239401).*

periASTY aims to support the transition of peri-urban areas towards climate neutrality by developing innovative solutions in mobility, energy, industry and governance, while taking into account the needs and experiences of local communities.

Great news! ***Helmond*** *is one of the study areas of the periASTY project. As part of periASTY, several initiatives will be developed and tested in Helmond and its peri-urban areas.*

Your participation matters! By completing this questionnaire, you can share your current travel habits and preferences, your views on mobility and energy, your experiences and perceptions of local industry, and your views on governance. Your responses will help identify local need and assess how the project can contribute to a more connected.

The questionnaire consists of five sections:

- *Sociodemographic Characteristics*
- *Mobility*
- *Energy*
- *Industry*
- *Governance*

Overall, the questionnaire includes **93 questions.**

According to your role (citizen or answering on behalf of an organization) you will be asked to answer specific questions.

Thank you for taking the time to participate and for contributing to the future development of Helmond and its peri-urban areas."

About your participation

Protecting your personal data is our top priority. To ensure that, we have put in place robust measures to safeguard the data you provide. Our data processing always complies with the obligations set by the legal framework, especially the General Data Protection Regulation (GDPR). By submitting the questionnaire, you consent to this data processing. Please note, that the questionnaire is anonymous and completed on a voluntary basis. You are free to withdraw from the questionnaire at any time.

1. **Sociodemographic Characteristics**
    1. In **what role** are you completing this questionnaire**?**
        - o As a resident/ citizen
        - o On behalf of an organization
    2. If you answer on behalf of **an organization,** what best describes your **role?**

    Mark only one

        - o Business owner
        - o Industrial operator
        - o Local authority / municipality
        - o Waste management company
        - o Researcher / consultant
        - o Transport Provider
        - o Other (Specify)
    3. What is your **gender**?

    Mark only one

        - o Female
        - o Male
        - o Non-binary
        - o Prefer not to say
    4. What is your **age group**?

    Mark only one

        - o 18-30 years old
        - o 31-40 years old
        - o 41-50 years old
        - o 51-65 years old
        - o Older than 65
        - o Prefer not to say
    5. If you answer as a **citizen**, what is the approximate **size of your household**?

    Mark only one

    If you represent an organization, please skip the question

        - o 1–2 people
        - o 3–5 people
        - o 5+ people
    6. If you answer on behalf of an **organization**, what is the approximate **size of your organization**?

    Mark only one

    If you are a citizen, please skip the question

        - o Small business (1–10 employees)
        - o Medium business (11–50 employees)
        - o Large organization (50+ employees)
    7. What is your **highest level of education**?

    Mark only one

- Primary School or less
- Secondary or High School
- Bachelor
- Master or PhD
- No education
- Prefer not to say

8. If you answer as a citizen, what is your **current employment status**?

   Mark only one

   If you represent an organization, please skip the question

   - Student
   - Employed (public or private sector)
   - Self-employed/ Entrepreneur/ Freelancer
   - Skilled or Manual Worker (e.g., construction, factory, crafts, domestic work, farming)
   - Unemployed / Seeking Employment
   - Retired
   - Prefer not to say

9. How would you describe your **monthly individual income level compared to the national average**?
   - Well below average
   - Below average
   - About average
   - Above average
   - Well above average
   - Prefer not to say

1. Approximately what **percentage of your budget** do you spend on commuting in a month?

   Mark only one

   - 0-10%
   - 10-20%
   - 20-30%
   - 30-40%
   - 40-50%
   - more than 50%
   - I don´t know
   - Prefer not to say

2. Do you have any **physical disabilities, long-term health condition or accessibility need that affect your mobility**?

   Mark only one

   - Yes
   - No
   - Prefer not to say

2. MOBILITY SECTION

1. What is the approximate **in-vehicle travel time (in minutes)** required for your daily trip using each transport mode?

   Mark only one oval per row.

	I do not use this mode	Do not Know	1-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	More than 90
Private Car	O	O	O	O	O	O	O	O	O	O	O	O
Taxi	O	O	O	O	O	O	O	O	O	O	O	O
Public Transport	O	O	O	O	O	O	O	O	O	O	O	O
Motorcycle	O	O	O	O	O	O	O	O	O	O	O	O
Bicycle	O	O	O	O	O	O	O	O	O	O	O	O
Walking	O	O	O	O	O	O	O	O	O	O	O	O

2. What is the **average walking time (in minutes)** required for you to reach the nearest **public transport stop or station**? Please provide an estimate.

	0-5	5-10	10-15	15-20	20-25	More than 25 min	I do not know	I do not use public transport
Closest Bus stop	O	O	O	O	O	O	O	O
Closest Train/Metro/Tram Station	O	O	O	O	O	O	O	O

3. What is the **average waiting time (in minutes)** at public transport stops or stations? Please provide an estimate.

	0-5	5-10	10-15	15-20	20-25	More than 25 min	I do not know	I do not use public transport
Closest Bus stop	O	O	O	O	O	O	O	O
Closest Train/Metro/Tram Station	O	O	O	O	O	O	O	O

4. In your opinion, how **reliable is the public transport system in Helmond**?

   Please rate on a **scale from 1 to 6, with 1 being "very unreliable" and 6 "very reliable"**

	1 Very Unreliable	2	3	4	5	6 Very Reliable

Multimodal transport is a transport system or journey in which two or more different modes of transport are used in combination to travel from an origin to a destination (e.g. Walking then Bus then Metro).

5. Which of the following statements **best describes the transport system in** Helmond**?**

   Mark only one

   - The BZOB industrial area is very multimodal, offering seamless integration of various transport modes like buses, trains, cycling, and walking.
   - The transport system in BZOB industrial area offers some multimodal options, but there is room for improvement in connecting them smoothly
   - While there are different transportation modes available in BZOB industrial area, they operate more independently than in an integrated manner.
   - The BZOB industrial area is not multimodal, primarily relying on singular or isolated modes of transportation

6. To what extent is the **public transport system accessible and inclusive for pedestrians, elderly people, persons with disabilities and parents/carers with prams (for example, ramps, audio announcements, priority seating)**?

   By accessible and inclusive, we mean that people can easily reach, enter, use, and transfer within the public transport system regardless of age or mobility. For example, this may include step-free access, ramps or lifts at stations, accessible buses, low-floor vehicles, clearly marked pedestrian crossings, and information that is easy to understand.

   Please rate the overall inclusiveness on a **scale from 1 to 6, with 1 being "Not accessible/inclusive at all" and 6 "Highly accessible/inclusive"**

	1 Not accessible/inclusive at all	2	3	4	5	6 Highly accessible/inclusive

7. Overall, how **satisfied** are you with the **transport services available in BZOB industrial area?**

   Please rate on a scale from **1 to 6, with 1 being "very dissatisfied" and 6 "very satisfied"**

	1 Very dissatisfied	2	3	4	5	6 Very Satisfied

A mobility hub is a strategically located place where different transportation modes and mobility services are physically and/or digitally integrated, allowing users to conveniently transfer between them.

1. When the mobility hub is available to BZOB industrial area, how likely would you be to use it for your regular trips?

   Please rate on a scale from **1 to 6, with 1 being "very unlikely" and 6 "very likely"**

	1 Very unlikely	2	3	4	5	6 Very likely

Shared mobility refers to transportation services in which users share access to vehicles or transport services, either simultaneously or sequentially, rather than owning and using a vehicle exclusively.

2. How **familiar** are you with the concept of **shared mobility?**

   Please rate on a **scale from 1 to 6, with 1 being "Not familiar at all" and 6 "Very familiar".**

	1 Not Familiar at all	2	3	4	5	6 Very Familiar

3. "I can easily find the information needed to efficiently use Public Transport Systems available in BZOB industrial area."

   Please indicate your **level of agreement** on a **scale from 1 to 6, with 1 being "strongly disagree" and 6 "strongly agree".**

	1 Strongly Disagree	2	3	4	5	6 Strongly Agree

4. "I can easily find the information needed to efficiently use the shared mobility services available in BZOB industrial area."
   Please indicate your **level of agreement** on a **scale from 1 to 6, with 1 being "strongly disagree" and 6 "strongly agree".**

	1 Strongly Disagree	2	3	4	5	6 Strongly Agree

Micromobility refers to small, lightweight modes of transport used for short-distance trips, such as bicycles, e-bikes, electric scooters, and shared bicycles or scooters.

Micro-Mobility Services

5. Have you **ever used micro-mobility services** in **BZOB industrial area** (e.g., shared e-scooters, shared bicycles)?
   - o Yes
   - o No - Skip to question 16

For users of micro-mobility:

6. Please indicate your **level of agreement with the following statements**.

   Please rate on a **scale from 1 to 6, with 1 being "strongly disagree" and 6 "strongly agree".** Mark only one oval per row.

	1 Strongly Disagree	2	3	4	5	6 Strongly Agree
Combining micro-mobility services and other public transport modes might be difficult	O	O	O	O	O	O
Micro-mobility allows me to reduce my total door-to-door travel time	O	O	O	O	O	O
BZOB industrial area's facilities allow me to use safely micro-mobility.	O	O	O	O	O	O
It is not easy to use a micro-mobility service app.	O	O	O	O	O	O
I use a micro-mobility service because my family/friends do as well.	O	O	O	O	O	O
Using micro-mobility is not pleasant.	O	O	O	O	O	O
I intend to continue using micro-mobility services in the future.	O	O	O	O	O	O

For potential users of micro-mobility:

7. Please indicate your level of agreement with the following statements.

   Please rate on a **scale from 1 to 6, with 1 being "strongly disagree" and 6 "strongly agree".**

	1 Strongly Disagree	2	3	4	5	6 Strongly Agree
Combining micro-mobility services and other public transport modes might be difficult	O	O	O	O	O	O
I think micro-mobility would allow me to reduce my total door-to-door travel time	O	O	O	O	O	O
I think BZOB industrial area's facilities would allow me to safely use micro-mobility services.	O	O	O	O	O	O
I think if I used micro-mobility services, I would easily find a vehicle to use	O	O	O	O	O	O
I think using a micro-mobility service app might not be easy.	O	O	O	O	O	O
If my family/friends/ coworkers use a micro-mobility service, I might try it too	O	O	O	O	O	O
I think using a micro-mobility service would not be pleasant	O	O	O	O	O	O
I intend to use micro-mobility services in the future	O	O	O	O	O	O

On-demand services are services that are provided when requested by the user, rather than operating according to a fixed schedule or route. For example, an on-demand minibus that can be booked through an app or by phone to pick up and drop off passengers at requested locations.

On-demand Shuttle Services

8. Have you ever used on-demand shuttle services in **BZOB industrial area**?
   - o Yes
   - o No – Skip to question 19

For users of on-demand shuttle services:

9. Please indicate your **level of agreement with the following statements**

   Please rate on a **scale from 1 to 6, with 1 being "strongly disagree" and 6 "strongly agree".** Mark only one oval per row.

	1 Strongly Disagree	2	3	4	5	6 Strongly Agree
Combining on-demand shuttle services and other public transport modes might be difficult	O	O	O	O	O	O
On-demand shuttle services allow me to reduce my total door-to-door travel time.	O	O	O	O	O	O
BZOB industrial area's facilities allow me to safely use on-demand shuttle services.	O	O	O	O	O	O
Using on-demand shuttle services, I can easily find an available vehicle.	O	O	O	O	O	O
It is not easy to use an on-demand shuttle service app.	O	O	O	O	O	O
I use on-demand shuttle services because my family/friends do as well.	O	O	O	O	O	O
Using on-demand shuttle services is not pleasant.	O	O	O	O	O	O
I intend to continue using on-demand shuttle services in the future.	O	O	O	O	O	O

For potential users of on-demand shuttle services:

10. Please indicate your **level of agreement with the following statements.**

    Please rate on a **scale from 1 to 6, with 1 being "strongly disagree" and 6 "strongly agree".** Mark only one oval per row.

	1 Strongly Disagree	2	3	4	5	6 Strongly Agree
Combining on-demand shuttle services and other public transport modes might be difficult	O	O	O	O	O	O
I think on-demand shuttle services would allow me to reduce my total door-to-door travel time	O	O	O	O	O	O

I think using an on-demand shuttle service app might not be easy	O	O	O	O	O	O
I think BZOB industrial area's facilities would allow me to safely use on-demand shuttle services	O	O	O	O	O	O
I think if I used on-demand shuttle services, I would easily find a vehicle to use	O	O	O	O	O	O
If my family/friends use on-demand shuttle services, I might try it too	O	O	O	O	O	O
I think using on-demand shuttle services would not be pleasant	O	O	O	O	O	O
I intend to use on-demand shuttle services in the future	O	O	O	O	O	O

11. What is your primary mode of transport for daily trips?
    - o Private car (alone)
    - o Carpooling
    - o Bus
    - o Tram/train
    - o Bicycle
    - o Bike-sharing service
    - o Walking
    - o E-scooter/micromobility
    - o Combination of modes
    - o Other _____
12. How often do you use public transport?
    - o Never
    - o Rarely
    - o 1-2 times per week
    - o 3-4 times per week
    - o Daily

In the following section, you will be asked to **describe your more recent trips**.

If you represent an organization, please skip this section

- You may describe **up to three (3) trips**.
- You will **not be asked to provide exact locations or exact travel times**.
- Please assume that your **first trip starts from your home**.

13. How many **vehicles are available in your household**?

Please select 0, 1, 2, 3 or more. *Mark only one per row.*

	0	1	2	3 or more
Conventional car	O	O	O	O
Electric car	O	O	O	O
Truck, Bus or Van	O	O	O	O
Motorcycle	O	O	O	O
Bicycle or e-bike	O	O	O	O
e-scooter	O	O	O	O

Trip #1

14. **Where** did you **start** your journey?

    Please provide only an approximate area/neighbourhood

15. **Where** was your **destination**?

    Please provide only an approximate area/neighbourhood

16. Which **transport mode** did you use to reach your destination?

    Please select the main mode of transport used.

    Mark only one

    - o Private Car
    - o Taxi
    - o Metro, tram, suburban railway, etc.
    - o Bus
    - o Walking
    - o Private bicycle (or e-bike)
    - o Private motorcycle
    - o Private e-scooter (or other micro-vehicle)
    - o On-demand Shuttle service
    - o Shared car
    - o Shared motorcycle
    - o Shared bicycle (or e-bike)
    - o Shared e-scooter (or other micro-vehicle)

17. What was the **purpose** of this trip?

    Mark only one

    - o Work
    - o Education
    - o Recreation, sports, events, etc.
    - o Shopping

- Health reasons or provision of care
- Administration or personal services
- Return to home
- Other activities

18. During which time period did this trip occur?

Mark only one

- 05:00-08:00
- 08:00-11:00
- 11:00-14:00
- 14:00-17:00
- 17:00-20:00
- 20:00-23:00
- 23:00-05:00 (next day)

19. Did you make another trip on the same day?

Mark only one

- Yes
- No

Trips #2 and #3

If more than one trip is reported, respondents are requested to answer the same set of questions for each trip as for Trip #1.

3. ENERGY SECTION

1. **What type of energy do you currently use most for electricity?**
   - Grid electricity
   - Solar PV
   - Wind energy
   - Mixed sources
   - I do not know
2. **What energy sources are used for space heating?**
   - Electric resistance heating
   - Natural gas boiler
   - Oil boiler
   - Heat pump
   - Biomass or wood boiler
   - District heating
   - Solar thermal

3. **What energy sources are used for space cooling?**
   - Air conditioner (fixed system)
   - Air conditioner (Portable unit)
   - Heat Pump
   - Fans

- Building Passive Cooling Design

4. **How would you rate your current energy costs?**
   - Very low
   - Low
   - Moderate
   - High
   - Very high
5. **Are you currently producing your own renewable energy (e.g., rooftop solar, wind turbines)?**
   - Yes
   - No
   - Planning to install

A Renewable Local Energy Community (RLEC) is a type of community-based organization where citizens, businesses and public authorities collectively produce, consume, manage and sometimes sell renewable energy within their local area.

6. **Are you familiar with the concept of Renewable Energy Communities (RLECs)?**
   - Yes
   - Somewhat
   - No
7. **How interested would you be in joining a local renewable energy community?**
   - Very interested
   - Interested
   - Neutral
   - Not interested
8. **What benefits would motivate you to participate? (multiple choice)**
   - Lower energy costs
   - Energy independence
   - Contribution to environmental sustainability
   - Local economic development
   - Community cooperation

9. **What barriers might prevent participation?**
   - High investment cost
   - Lack of information
   - Regulatory complexity
   - Technology concerns
   - Lack of trust in management
10. **If you answer on behalf of an organization, how important do you think renewable-powered charging hubs for freight vehicles are for sustainable transport?**

    If you are a citizen, please skip this section

    - Very important

- Important
- Neutral
- Not important

11. **Would you support a local renewable energy charging hub that distributes excess energy to nearby industries and households?**
    - Strongly support
    - Support
    - Neutral
    - Oppose
12. **What concerns would you have about such infrastructure?**
    - Grid unreliability
    - Land use
    - Implementation, Maintenance, and Operational Costs
    - Overload the system
    - Maintenance
    - None
13. **Which of the following energy-saving measures would you be willing to adopt?**
    (multiple choice)
    - Smart energy management systems
    - Energy-efficient building retrofits
    - Dynamic occupancy energy control
    - Shared mobility and digital services
    - Smaller or shared living/work spaces
14. **If you answer as a citizen, to what extent do you believe that changes in individual and household behaviour can reduce energy demand?**

    If you represent an organization, please skip this question

    - Not at all
    - Slightly
    - Moderately
    - Very much
    - Extremely
15. **If you answer on behalf of an organization, to what extent do you support policies that encourage energy-efficient buildings and lower energy use?**

    If you are a citizen, please skip this question

    - Yes
    - Maybe
    - No
16. **If you answer on behalf of an organization, which policies would accelerate renewable energy adoption in your area? (multiple choice)**

    If you are a citizen, please skip this question

    - Financial incentives/subsidies
    - Tax reductions
    - Simplified permitting
    - Community energy programs

- Public awareness campaigns

17. **If you answer on behalf of an organization, who should lead the development of renewable energy communities?**

    If you are a citizen, please skip this question

    - Municipalities
    - Energy providers
    - Citizens
    - Public-private cooperation

18. **If you answer on behalf of an organization, how important do you think it is for local communities to be involved in decisions about local energy planning?**

    If you are a citizen, please skip this question

    - Very important
    - Important
    - Neutral
    - Not important

19. **If you answer on behalf of an organization, how would you like to participate in an energy community?**

    If you are a citizen, please skip this question

    - Energy Provider
    - Energy consumer
    - Prosumer (producer and consumer)
    - Investor
    - Technology provider
    - Not interested

20. **If you answer on behalf of an organization, which type of energy community business model do you find most attractive?**

    If you are a citizen, please skip this question

    - Cooperative model (community-owned)
    - Public-private partnership
    - Utility-led model
    - Private investment model
    - Hybrid model

21. **If you answer on behalf of an organization, which factors are most important for a successful energy community business model? (multiple choice)**

    If you are a citizen, please skip this question

    - Financial viability
    - Transparent governance
    - Fair energy pricing
    - Local participation
    - Technological reliability

22. **How important is local ownership in renewable energy projects?**

- Very important
- Important
- Neutral
- Not important

23. **How acceptable would dynamic energy pricing be for you (prices varying by time of day or demand)?**

    Dynamic Energy Pricing is a pricing mechanism in which the cost of electricity varies over time based on real-time or near real-time market conditions, including supply and demand fluctuations, grid constraints, and generation costs.

    Unlike fixed-rate tariffs, dynamic pricing reflects the actual cost of producing and delivering electricity at different times, often resulting in higher prices during periods of peak demand and lower prices during off-peak periods

    This pricing model aims to improve energy system efficiency, encourage demand response, and promote more flexible and sustainable electricity consumption patterns by incentivizing users to shift their energy use to periods of lower demand.

    - Very acceptable
    - Acceptable
    - Neutral
    - Unacceptable

24. **Would you adjust your energy consumption if prices were lower during off-peak hours?**
    - Yes, definitely
    - Possibly
    - Unlikely
    - No
25. **Which pricing incentives would encourage energy efficiency?**
    - Lower off-peak tariffs
    - Financial rewards for reduced consumption
    - Community energy credits
    - Flexible contracts
    - Smart energy management tools
26. **Are you willing to participate in demand-response programs (adjusting energy use based on grid demand)?**
    - Yes
    - Maybe
    - No
27. **Who should lead the development of renewable energy community business models?**
    - Local government
    - Private companies
    - Citizen cooperatives
    - Public-private partnerships
    - Energy utilities

4. **INDUSTRY SECTION**

If you are a citizen, please skip this section

1. **How familiar are you with the circular economy concept?**
   - Very familiar
   - Somewhat familiar
   - Slightly familiar
   - Not familiar

Circular economy is an economic model designed to reduce waste and make the most of resources by keeping products, materials and energy in use for as long as possible.

2. **How would you describe your current waste management practices?**
   - Advanced recycling and separation
   - Basic recycling
   - Limited recycling
   - No recycling practices
3. **What types of waste are most commonly generated in your activities? (multiple choice)**
   - Construction materials
   - Industrial waste
   - Organic waste
   - Plastic and packaging
   - Electronic waste
   - Metal waste
4. **What are the biggest challenges in waste management in your area?**
   - Lack of recycling infrastructure
   - Limited awareness
   - High waste management costs
   - Poor sorting practices
   - Lack of incentives
5. **Which circular economy practices are currently applied in your organization/household?**
   (multiple choice)
   - Reusing materials
   - Repairing products
   - Recycling waste
   - Refurbishing equipment
   - Sharing resources
6. **How willing would you be to adopt circular economy plans or strategies?**
   - Very willing
   - Willing
   - Neutral
   - Unwilling
7. **Which types of support would encourage the implementation of circular economy practices?**
   - Training and skills development

- Financial incentives
- Digital platforms for material exchange
- Regulatory support
- Technical guidance

5. **GOVERNANCE SECTION**

Peri-urban areas are areas on the outskirts of cities where urban and rural characteristics come together.

1. **How well do you feel your peri-urban area is represented in decisions made by your city or regional government?**
   Please rate on a scale from 1 to 6, with 1 being "Not represented at all" and 6 "very well represented"

	I do not know	1 Not Represented at all	2	3	4	5	6 Very well represented

2. **How fairly do you feel peri-urban areas are treated compared to city centre areas in terms of public services and infrastructure investment?**

   Please rate on a **scale from 1 to 6, with 1 being "Much less fairly" and 6 "Much more fairly"**

	I do not know	1 Much less fairly	2	3	4	5	6 Much more fairly

3. **If you answer on behalf of an organization, in your experience, how well do transport, energy and waste services in your area work together in a coordinated way?**

   Please rate on a **scale from 1 to 6, with 1 being "Not coordinated at all" and 6 "Very well coordinated"**

   If you answer as a citizen, please skip the question

	I do not know	1 Not coordinated at all	2	3	4	5	6 Very well coordinated

4. **If you answer as a citizen, do you feel that decisions about transport, energy and waste in your area take into account the needs of all residents including vulnerable groups?**

Please rate on a **scale from 1 to 6, with 1 being "Never" and 6 "Always"**

If you represent an organization, please skip the question

	I do not know	1 Never	2	3	4	5	6 Always

5. **Have you ever been invited to participate in any planning or decision-making process in your peri-urban area?**
   - Yes, regularly
   - Yes, occasionally
   - No, never
   - I was not aware this was possible

6. **If you have participated, how much do you feel your input actually influenced decisions?**

   Please rate on a **scale from 1 to 6, with 1 being "No influence at all" and 6 "Very significant influence"**

	Not applicable	1 No influence at all	2	3	4	5	6 Very significant influence

7. **How willing are you to participate in co-design activities to help shape future services and solutions in your area?**

   Please rate on a **scale from 1 to 6, with 1 being "Very unwilling" and 6 "Very Willing"**

	1 Very unwilling	2	3	4	5	6 Very willing

8. **Are you aware of any climate neutrality targets or plans for your peri-urban area?**
   - Yes, fully aware
   - Somewhat aware
   - Not aware at all
   - I am not sure

9. **Do you feel your local authority is doing enough to lead the transition towards climate neutrality in your peri-urban area?**

   Please rate on a **scale from 1 to 6, with 1 being "Not doing enough at all" and 6 "Doing everything possible"**

	I do not know	1 Not doing enough at all	2	3	4	5	6 Doing everything possible

10. **If you answer as a <u>citizen</u>, how supported do you feel as a resident in making more sustainable choices in transport, energy and waste in your daily life?**

    Please rate on a scale from 1 to 6, with 1 being "No support at all" and 6 "Very well supported"

    If you represent an organization, please skip the question

	1 No support at all	2	3	4	5	6 Very well supported

11. **If you answer on behalf of an <u>organization</u>, which of the following best describes the governance structure of your peri-urban area?**

    If you answer as a citizen, please skip the question

    - Governed primarily by a single local municipality
    - Shared governance between multiple municipalities
    - Governed primarily at regional level
    - Part of a metropolitan governance structure
    - No clear governance structure for peri-urban areas
    - I do not know
    - Other (please specify)

12. **If you answer on behalf of an <u>organization</u>, how would you rate the current level of governance coordination between your peri-urban area and the following governance levels on climate neutrality planning?**

    If you answer as a citizen, please skip the question

Dimension	I do not know	1 - Very poor	2	3	4	5 - Very good
Local / municipal authority	O	O	O	O	O	O
Regional authority	O	O	O	O	O	O

National government	O	O	O	O	O	O
European Union institutions	O	O	O	O	O	O

13. **If you answer on behalf of an organization, which of the following multi-level governance barriers are most significant in your peri-urban area? (Select up to 3)**

If you answer as a citizen, please skip the question

- Fragmented responsibilities between multiple authorities at different levels
- Insufficient downward flow of climate policy from national to local level
- Inadequate upward representation of peri-urban needs in regional and national planning
- Conflicting regulatory frameworks across governance levels
- Limited financial flows from higher governance levels to peri-urban areas
- Lack of cross-border governance coordination
- Insufficient EU-level recognition of peri-urban governance challenges
- I do not know
- Other (please specify)

14. **If you answer on behalf of an organization, who is currently most underrepresented in governance and planning processes in your peri-urban area? (Select all that apply)**

If you answer as a citizen, please skip the question

- Citizens and residents
- Vulnerable and disadvantaged groups
- Private sector and industry
- Civil society and community organizations
- Energy communities
- Transport operators
- Small and medium enterprises
- I do not know
- Other (please specify)

15. **If you answer on behalf of an organization, what mechanisms are currently in place for cross-sectoral collaboration in your peri-urban area? (Select all that apply)**

If you answer as a citizen, please skip the question

- Formal inter-departmental coordination committees
- Joint planning processes across sectors

- Shared data platforms across sectors
- Regular multi-stakeholder consultation events
- Co-design and participatory planning processes
- Public-private partnership structures
- None currently in place
- I do not know
- Other (please specify)

16. **If you answer on behalf of an organization, what regulatory or policy gaps most hinder climate neutrality transition in your peri-urban area? (Select up to 3)**

    If you answer as a citizen, please skip the question

    - Lack of specific peri-urban climate policy at national level
    - Inadequate regulatory frameworks for shared mobility in low-density areas
    - Insufficient regulatory support for local energy communities
    - Unclear legal frameworks for cross-sectoral data sharing
    - Fragmented land use regulations across administrative boundaries
    - Lack of incentives for industry green transition in peri-urban areas
    - Insufficient regulatory recognition of peri-urban areas in EU climate policy
    - I do not know
    - Other (please specify)

17. **If you answer on behalf of an organization, how ready is your organisation to commit to a Local Green Deal formalising your contribution to climate neutrality targets?**

    If you are a citizen, please skip the question

    - Ready to commit now
    - Ready with additional guidance and support
    - Possibly ready within 1 to 2 years
    - Not ready at this stage
    - Not applicable to our organization

18. **If you answer on behalf of an organization, If ready or potentially ready, which sectors would your Local Green Deal commitment cover? (Select all that apply)**

    If you are a citizen, please skip the question

    - Mobility and transport
    - Energy and renewables
    - Construction and built environment
    - Tourism
    - Waste management and circular economy
    - Industry and manufacturing
    - Other (please specify)

19. **If you answer on behalf of <u>an organization</u>, what funding mechanisms does your organisation consider most viable for scaling up climate-neutral solutions? (Select up to 3)**

    If you are a citizen, please skip the question

    - EU Cohesion Funds
    - Horizon Europe follow-up projects
    - European Investment Bank / ELENA facility
    - National government funding programmes
    - Public-private partnerships
    - Local authority budgets
    - Energy community investments
    - Private investment
    - I do not know
    - Other (please specify)

20. **If you answer on behalf of an <u>organization</u>, which governance model would work best for integrated peri-urban and urban climate planning in your area?**

    If you answer as a citizen, please skip the question

    - A single unified authority responsible for the whole Functional Urban Area
    - A formal coordination body bringing together multiple existing authorities
    - A collaborative governance platform with shared decision-making across sectors
    - Existing structures strengthened by clearer regulatory frameworks
    - A new dedicated peri-urban governance institution
    - I do not know
    - Other (please specify)

21. **If you answer on behalf of an <u>organization</u>, which level of government should take primary responsibility for peri-urban climate neutrality planning?**

    If you answer as a citizen, please skip the question

    - Local / municipal authority
    - Regional authority
    - National government
    - Collaborative governance across all levels
    - European level coordination
    - I do not know
    - Other (please specify)