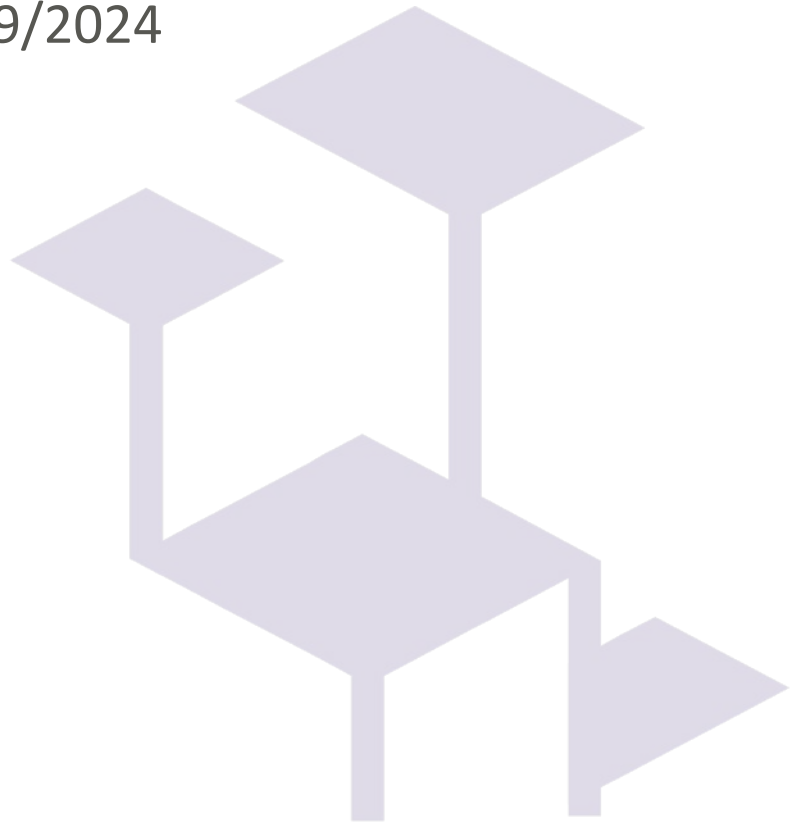


SPARCS

Replication Summary Report

30/09/2024



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Deliverable administration

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Description of the related task and the deliverable. Extract from DoA	<p>D5.1 Replication Summary Report (FHG) D5.1 is a joint effort of Task 5.1 and Task 5.6. All information generated through the tasks in the Replication Work package will be aggregated in the Summary report. It will provide an overview of all the activities carried out under the work package (R/PU, M60)</p> <p>Description WP5: The overarching goal of this work package is the replication and upscaling of solutions contributing to Energy Positive Districts in Espoo and Leipzig within the Lighthouse Cities (LHCs), in the Fellow Cities (FCs), and beyond (e.g. in Observer Cities – OCs) in a systematic and methodological way. In close cooperation with all other work packages, WP5 will develop and execute the replication strategy built on four pillars: 1) knowledge exchange platform 2) Replication strategy and execution in FCs 3) upscaling and replication of solutions in LHCs and 4) Joint Procurement of highly integrated and energy efficient solutions. The main results of WP5 will consist of early-stage scale-up projects in the LHCs and mature replication projects in the FCs linked together by a coherent strategy and vision. These projects will be based on successful demonstrations in LHCs, captured as Use Cases and Packaged Solutions - which at the same time will provide the basis for a wider pilot of joint procurement of relevant smart city technology. WP5 objectives are:</p> <p>To develop robust knowledge transfer mechanisms between LHCs, FCs, OCs and beyond by effectively capturing and transferring the knowledge gained by LHCs and their partners in a structured and transferable method.</p> <ul style="list-style-type: none"> To prepare FCs and LHCs for implementation and scaling up of Positive Energy Districts in a holistic manner. To develop an implementation plan for integrated and innovative district level energy solutions for each FC. To enable detailed conceptualisation and initiation of the interventions adapted to the FCs needs and requirements by guiding FCs through the entire process of configuring, planning, consultation and securing investments for implementation of the chosen Solutions. <p>To develop features to enable Joint Cross Border Procurement and to demonstrate benefits through a pilot case of joint procurement between FCs and LHCs.</p>		
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Dissemination level

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CO	Confidential, only for members of the consortium (including the Commission Services)	

About SPARCS

Sustainable energy Positive & zero cARbon Communities demonstrates and validates technically and socioeconomically viable and replicable, innovative solutions for rolling out smart, integrated positive energy systems for the transition to a citizen centred zero carbon & resource efficient economy. SPARCS facilitates the participation of buildings to the energy market enabling new services and a virtual power plant concept, creating VirtualPositiveEnergy communities as energy democratic playground (positive energy districts can exchange energy with energy entities located outside the district). Seven cities will demonstrate 100+ actions turning buildings, blocks, and districts into energy prosumers. Impacts span economic growth, improved quality of life, and environmental benefits towards the EC policy framework for climate and energy, the SET plan and UN Sustainable Development goals. SPARCS co-creation brings together citizens, companies, research organizations, city planning and decision making entities, transforming cities to carbon-free inclusive communities. Lighthouse cities Espoo (FI) and Leipzig (DE) implement large demonstrations. Fellow cities Reykjavik (IS), Maia (PT), Lviv (UA), Kifissia (EL) and Kladno (CZ) prepare replication with hands-on feasibility studies. SPARCS identifies bankable actions to accelerate market uptake, pioneers innovative, exploitable governance and business models boosting the transformation processes, joint procurement procedures and citizen engaging mechanisms in an overarching city planning instrument toward the bold City Vision 2050. SPARCS engages 30 partners from 8 EU Member States (FI, DE, PT, CY, EL, BE, CZ, IT) and 2 non-EU countries (UA, IS), representing key stakeholders within the value chain of urban challenges and smart, sustainable cities bringing together three distinct but also overlapping knowledge areas: (i) City Energy Systems, (ii) ICT and Interoperability, (iii) Business Innovation and Market Knowledge.

Partners



Table of Contents

- Executive Summary8**

- 3. Introduction10**
 - 3.1 Purpose and target group 11
 - 3.2 Contributions of partners 11
 - 3.3 Relations to other activities 11
 - 3.4 Overview 11

- 4. Replication process in the fellow cities14**
 - 4.1 The Morgenstadt City Lab Process 14
 - 4.1.1 Preparatory phase and the adaptation of the Morgenstadt Framework..... 14
 - 4.1.2 Understanding phase: Elaboration of a city profile 15
 - 4.1.3 Co-creation phase: Project ideas 15
 - 4.1.4 Design Phase 16
 - 4.2 Project Development20
 - 4.3 Market Consultation23

- 5. Project upscaling25**

- 6. Knowledge Exchange and Training.....27**
 - 6.1 Packaged Solutions 27
 - 6.2 Knowledge transfer process28
 - 6.2.1 Identification of knowledge gaps and needs..... 29
 - 6.2.2 Planning and execution of knowledge exchange 29
 - 6.3 Certified Professional Smart City Training33

- 7. Conclusions.....36**
 - 7.1 Summary of achievements 36
 - 7.2 Impacts 37
 - 7.3 Other conclusions and lessons learnt 37

- 8. Acronyms and terms39**

- 9. References40**

- 10. Appendices42**

LIST OF FIGURES

Figure 1. Replication process components within SPARCS..... 12

Figure 2. Knowledge Exchange and Training component 13

Figure 3. City Lab Process (Fraunhofer IAO 2022) 14

Figure 4. City Lab Assessment Framework..... 15

Figure 5. Example of drafted catalogue of project outlines from virtual onsite assessment 16

Figure 6. Selected project outlines for further development during the innovation workshop 18

Figure 7. Selected projects within the scope of SPARCS..... 19

Figure 8. Snapshot from Innovation Workshop: Maia (SPARCS, 2022)..... 20

Figure 9: Virtual workshop with SPARCS LHCs and FCs using MURAL 21

Figure 10: Structured Project Development Process to Guide all five FCs..... 22

Figure 11: SPARCS Business Model Canvas (BABLE, 2023)..... 23

Figure 12: Project Upscaling Process for the Lighthouse Cities 25

Figure 13: Distribution of Modules in Smart City and Urban Energy Competencies. 35



LIST OF TABLES

Table 1: Example use of the project ranking tool (Maia)..... 17

Table 2: Insights from the Create Process Workshop 21

Table 3. Workshops and webinars organised and conducted for the purpose of knowledge exchange..... 29

EXECUTIVE SUMMARY

The overarching goal of Work Package (WP) 5, the Replication work package, is the replication and upscaling of solutions. These solutions are systematically and methodologically designed to support Positive Energy Districts, also referred to as PEDs, in the SPARCS Lighthouse Cities, Fellow Cities and for implementation beyond the scope of the project in the future.

The key activities carried out in WP5, centres on the replication of successful sustainable solutions developed in the LHCs to the FCs. These activities include the application of the modified Morgenstadt Framework, City Labs, on-site assessments, innovation workshops, and knowledge transfer process. These efforts aim to facilitate the successful implementation of sustainable solutions in the FCs, thereby contributing to the overall goals of the SPARCS project.

The replication strategy encompasses five integral process components:

1) City Lab Methodology: The process is divided into four different steps comprising of preparation, data collection, onsite assessment and the results phase. The FHG experts carryout each steps with the cities to identify the current status and areas of improvement in the cities.

2) Project development: A guided step-by-step process for implementation has been defined. This eight-step process was used to support cities, starting with the definition and assessment of the solution and its functionalities, followed by feasibility analysis, implementation planning, and securing funding. Finally, it prepares a call for tender, along with planning for monitoring, evaluation, and reporting on the impacts.

3) Market consultation: It aimed to improve procurement by engaging with the market. This digital tool enables cities to first connect with a growing European-wide network of innovative suppliers and filter them based on the solutions they offer. Second, it allows the creation of a market consultation invitation, detailing the project, challenges, requirements, and any uncertainties. Finally, it facilitates the publication of the invitation to relevant companies, which are notified and invited to participate.

4) Upscaling: A guided process to upscale pilot solutions in LHCs. Starting with the adaptation of the Project Development task to the LHCs to upscale one of their interventions, followed by the selection of one use case implemented during SPARCS to be a lighthouse project and continue with the legacy of SPARCS. Finally, supporting cities in all the process of upscaling (scoping, engagement, feasibility, financing).

5) Knowledge exchange and training: The Knowledge Exchange framework was built on three pillars. It began with Packaged Solutions, where each solution was created with structured information relevant for replication, based on interventions from the LHC and complemented by additional research. Next is the Knowledge Exchange, which involves identifying knowledge gaps in FCs through surveys, then designing and planning knowledge exchange activities based on the survey results. Finally, the Smart City Training component included the development of online surveys to identify cities' knowledge gaps and needs.

The replication activities conducted in the LHCs, and FCs enabled cities to enhance their energy sector performance and serve as exemplary models for others pursuing energy transitions. Comprehensive packaged solutions that encompass technology, processes, and implementation support offer significant benefits to other cities and businesses in the energy sector. Additionally, workshops within the Innovation Labs promote collaboration among stakeholders, researchers, local authorities, and communities to create customised solutions.

Information gained through the development and execution of the replication strategy is of great importance for imminent progress in transforming cities. This summary report aims to collect and combine all generated information, providing an overview of all the activities completed within the scope of the replication WP.

1. INTRODUCTION

The purpose of this report is to inform and share with the reader the relevant aspects of the Replication Strategy applied within SPARCS, and to present an objective overview of key activities undertaken. SPARCS focuses on developing and implementing innovative measures and solutions to tackle the challenges of urbanisation, including climate change, energy efficiency, and social inclusion. The SPARCS initiative consists of two Lighthouse Cities (LHCs), Espoo and Leipzig, and five Fellow Cities (FCs). The LHCs serve as models in a variety of areas, including building energy efficiency, renewable energy utilisation, electric transportation, and integrated infrastructure. Through a collaborative effort involving various stakeholders, the project aims to promote knowledge exchange, capacity building, and replicability of sustainable urban transformation initiatives. This report highlights the key activities carried out in WP5. It centres on the successful replication of solutions, including:

- 1) building capacity in the cities to design and implement projects,
- 2) assessing and developing project roadmaps, guiding implementation in FCs,
- 3) upscaling and replicating what's successful in LHCs

These activities include the application of the modified Morgenstadt Framework “City Labs”, on-site assessments, innovation workshops, and knowledge transfer process. These efforts aim to facilitate the successful implementation of sustainable solutions in the FCs, thereby contributing to the overall goals of the SPARCS project.

The Fellow City Replication Strategy task involves identifying innovative projects and measures that are formulated during the on-site assessment, in consultation with the relevant stakeholders, and developing a strategy for replicating them in other cities. In addition, the knowledge transfer process undertaken during the SPARCS project involved identifying the knowledge gaps and needs of the FCs through an online survey and developing a scope for knowledge exchange and professional training. The knowledge-transfer structure encompassed webinars, City Cafes, and City Forums, which allowed for free discussion and knowledge exchange between the cities.

The SPARCS Replication Framework offers an outline for the development process of the solutions to be replicated or upscaled by each of the cities, a framework carefully elaborated to meet the different challenges that a replication process proposes. In addition, different accompanying tools have been established, such as the Business Model Canvas and the Market Consultation tool, which seek to contribute to the Project Scoping and Market Consultation phases of the Project Development Process.

In addition to this, it is important to emphasise the SPARCS Knowledge Sharing Framework, which offers to generate greater impact through three channels:

- 1) the Packaged solutions, aimed to create rich, expert-curated, neutral information packages about the solutions the lighthouse cities are implementing, which can support other cities to replicate these solutions under their local circumstances,
- 2) Knowledge exchange
- 3) Smart City training, to better prepare the cities for knowledge transfer and replication opportunities, an initial online survey was conducted at the beginning of the project to identify the knowledge gaps and needs.

Overall, this report provides insights into the innovative and collaborative approach adopted by the SPARCS project to create sustainable and liveable cities for the future. It highlights the importance of stakeholder engagement and knowledge exchange in

promoting sustainable development and offers valuable lessons for other similar initiatives.

1.1 Purpose and target group

The replication activities encompassed within SPARCS involve the participation from FCs, following examples set by the SPARCS LHCs. This work involved the tailoring of replication activities according to the individual profiles of the FCs as well as actions taken in response to external events. The purpose of this deliverable is to record all aggregated strategic processes and cooperation implemented by Fraunhofer and BABLE within the WP into an accessible report containing information to support future urban transformation, specifically regarding replication and upscaling solutions.

The target group for this deliverable are researchers, local authorities and companies interested in the development of PEDs and sustainable city strategies.

1.2 Contributions of partners

Fraunhofer leads the development of the content of this deliverable, with contribution from BABLE. Content within the report includes input from SPARCS partners involved in the replication and upscaling strategies.

1.3 Relations to other activities

This deliverable encompasses all the activities entailed within WP5; therefore, it is related in general to all other activities within the SPARCS project. More specifically, the replication process in FCs, which is part of WP5, is closely linked to WP3 and WP4, which deal with the demo projects in LHCs, as well as to Subtask 1.1.2 of WP1, which focuses on the development of Use Cases.

1.4 Overview

The objective of WP5 is the development and implementation of a replication strategy for the purpose of systematically and methodologically replicating and upscaling solutions concerning Positive Energy Districts (PEDs) in the LHCs, FCs and beyond. This encompasses gathering insight and results from LHCs and assisting FCs with the process of implementing the solutions in their own cities.

The replication process in SPARCS is structured in two major lines: a) the replication process oriented for the FCs, which includes the Morgenstadt City Labs and the detailed Project Development components, and b) the replication process designed for the LHCs, mainly concerning the upscaling of solutions. The market consultation tool is designed to be used by FCs and LHCs as well. Each of the steps will be described in detailed form in the coming sections. The Figure 1 represents a graphical overview of the entire process applied in the project.

The replication efforts are complemented with leveraging knowledge gained from the LHCs and supporting FCs by allocating the necessary information at their disposal. This transaction occurs through three channels: 1. Packaged solutions, 2. Knowledge exchange, and 3. Smart City Training. The Figure 2 illustrates the general processes encompassed by each.

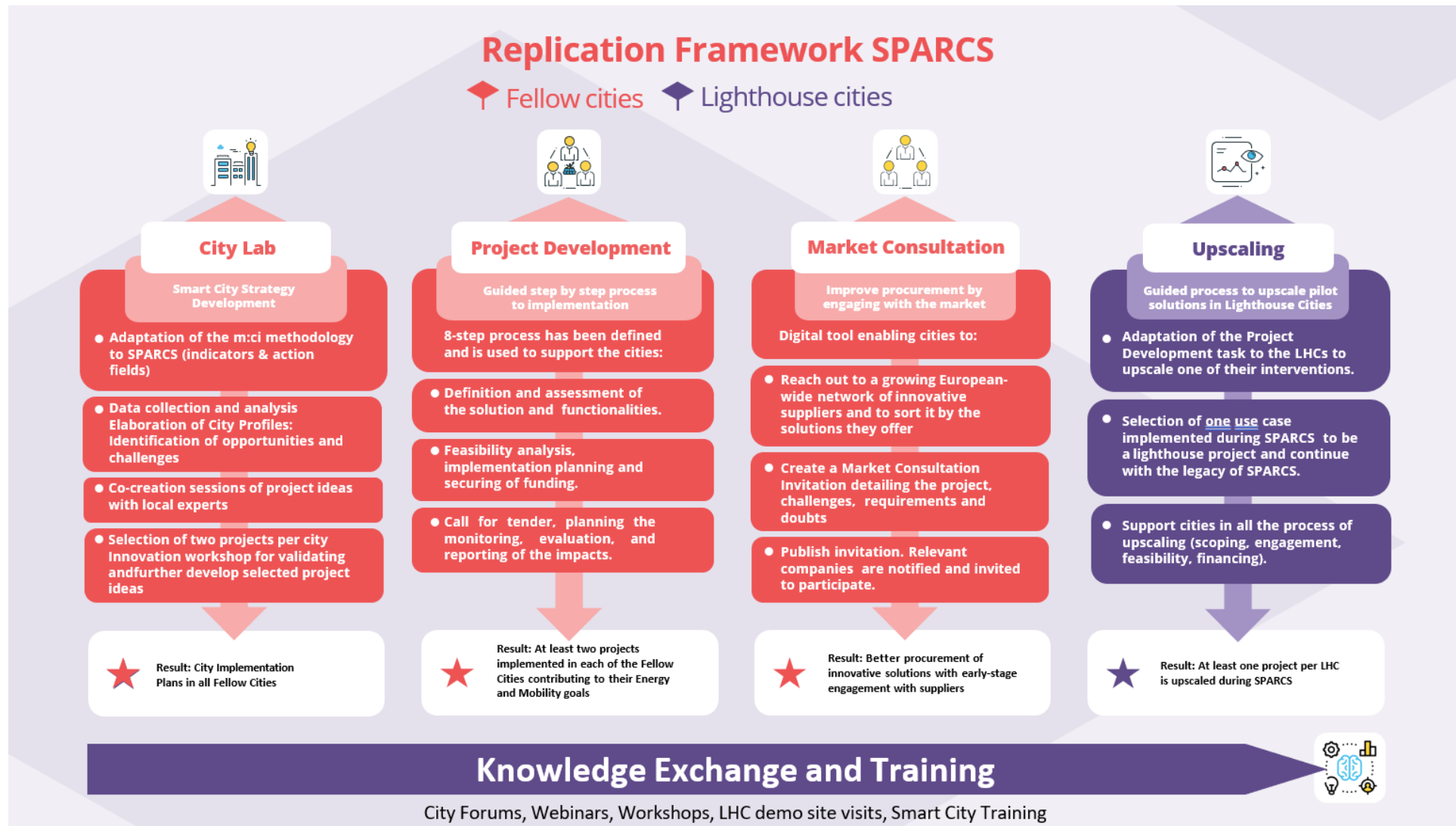


Figure 1. Replication process components within SPARCS

Knowledge Exchange framework

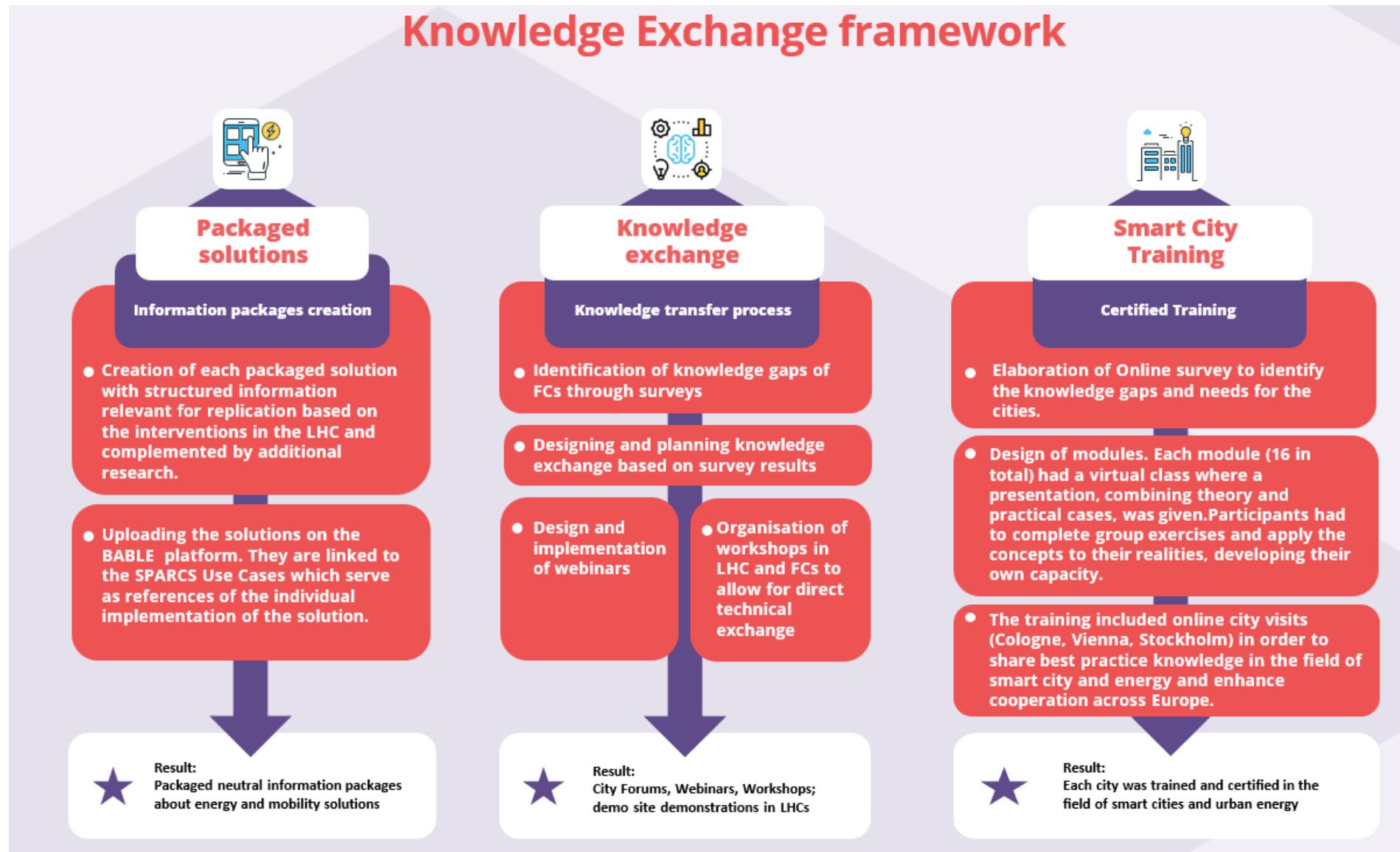


Figure 2. Knowledge Exchange and Training component

2. REPLICATION PROCESS IN THE FELLOW CITIES

The replication process carried out in the FCs is based on the Morgenstadt assessment framework and, more specifically, its City Lab Methodology for sustainable urban development. Refer to D5.4, D5.5, D5.6, D5.7 and D5.8 for the City Lab Methodology (SPARCS 2022, SPARCS 2022a, SPARCS 2022b, SPARCS 2023, SPARCS2022c). This section describes in detail the two major components involved in the replication process conducted in FCs within SPARCS.

2.1 The Morgenstadt City Lab Process

The Morgenstadt assessment framework, developed by Fraunhofer Research Institutes and partners (Fraunhofer IAO, 2022; Padilla et al., 2016; Radecki, 2019), focuses on sustainable urban development through the City Lab Methodology. The model, established in 2011, has three levels of analysis: quantitative key performance indicators, qualitative action fields, and impact factors. These tools help evaluate the current sustainability performance of cities, identify data availability, and understand specific urban challenges and opportunities. The analysis extends to city-specific drivers and barriers influenced by unique characteristics, providing a tailored sustainability roadmap for each city. The Figure 3 illustrates the Morgenstadt City Lab Process.

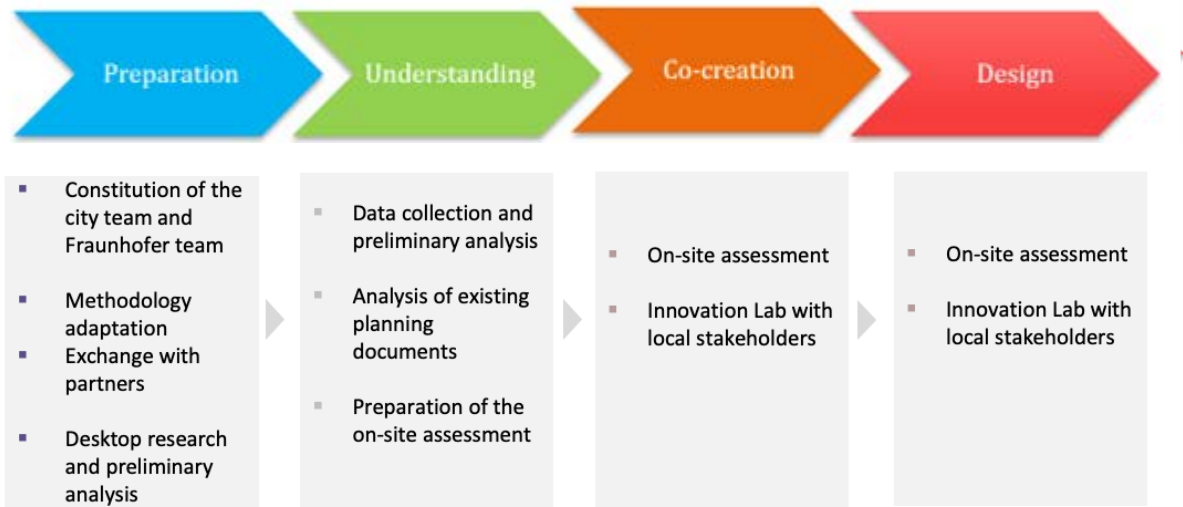


Figure 3. City Lab Process (Fraunhofer IAO 2022)

2.1.1 Preparatory phase and the adaptation of the Morgenstadt Framework

The SPARCS project, focusing on energy and mobility impacts, uses a selection of indicators and action fields from the Morgenstadt framework, initially containing more than 100 indicators (Fatima et al., 2022). This selection process involved feedback from SPARCS partners and further refinement before data collection in cities. The

project also developed benchmarks and a scoring system for international city comparison.

The assessment includes 62 indicators selected for the quantitative measurement of the city's sustainability performance, particularly in energy but also covering mobility, society, economy, ICT, and environment. 35 action fields are assessed qualitatively through 118 yes/no questions, which assess how cities address sustainability, focusing on key areas like renewable energy, intelligent traffic management, and building refurbishment. Each action field can score up to 10 points. The assessment process is outlined in Figure 4.

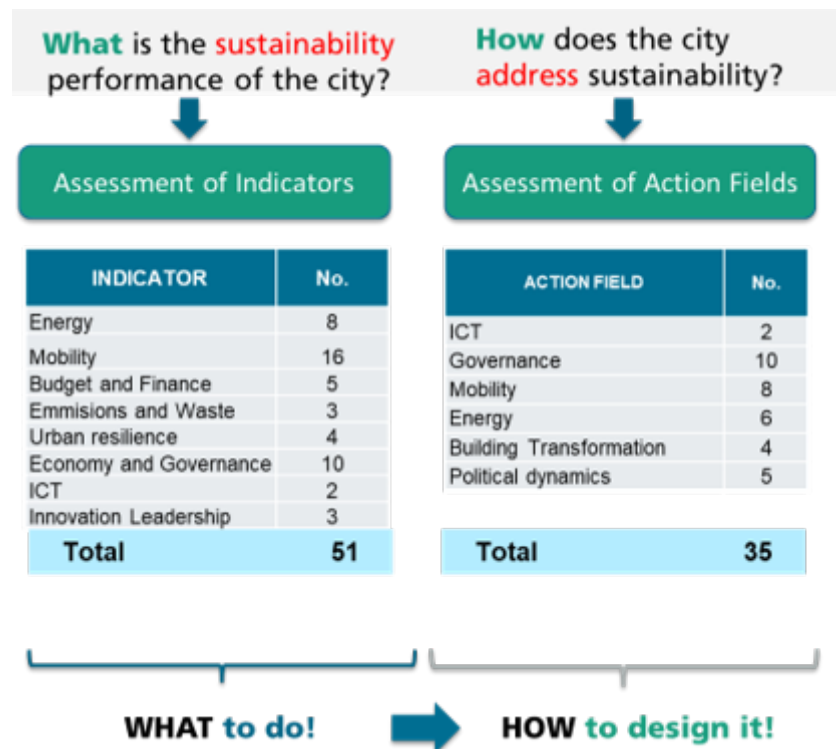


Figure 4. City Lab Assessment Framework

2.1.2 Understanding phase: Elaboration of a city profile

The initial evaluation stage, or understanding phase, involved analysing strategic documents and collecting data on the energy sector through online research and desktop analysis. Fraunhofer's assessment team reviewed strategic papers and plans from the five SPARCS FCs, resolving any information gaps through conference calls with local teams. Alongside this, cities collected indicators and action fields for assessment by research teams. Preparations for onsite assessments included formulating research inquiries, identifying interview partners, and planning site visits. This comprehensive collection and analysis of data aided in creating a sustainability profile for each city, providing insights crucial for developing strategies in energy and related fields, addressing challenges, and formulating project outlines and roadmaps.

2.1.3 Co-creation phase: Project ideas

The results obtained during the understanding phase were leveraged in the subsequent co-creation phase, where the focus was on collaborating with local experts and the FC's team to develop innovative project ideas. This was done in the form of an onsite assessment which due to the pandemic was done online. The process included more than 10 expert co-creation interviews, led by a Fraunhofer researcher

where the project ideas were jointly generated. The interviews were made sure to cover all important aspects of the specific sectors and consider all key stakeholders representing all relevant groups. The interviews were coordinated and arranged by the city team under the Fraunhofer guidance. They were carried out using different tools as digital maps, PowerPoint presentation and videos to virtually get to know the city better. Each session aimed for the joint ideation of solutions for the problems previously identified using the opportunities in the city.

Given that the co-creation efforts are part of the larger replication WP within the SPARCS project, it is imperative to draw inspiration from successful projects implemented in the LHCs. This approach ensured that the developed measures were both contextually relevant and based on the internal best practices.

Through the co-creation sessions, stakeholders were able to draw their own expertise and backgrounds to think proactively about how to address city challenges and transform their cities. This allowed them to formulate solutions and specific situations that were relevant to their local context. The creative sessions generated several project ideas in each FC, as shown in the Appendices A-E. They were further discussed and subjected to detailed analysis during the innovation workshop. This enabled a rigorous evaluation of their feasibility and potential impact, thereby ensuring that only the most promising ideas were selected for further development. The Figure 5 shows examples of drafted catalogue of project outlines from virtual onsite assessment.

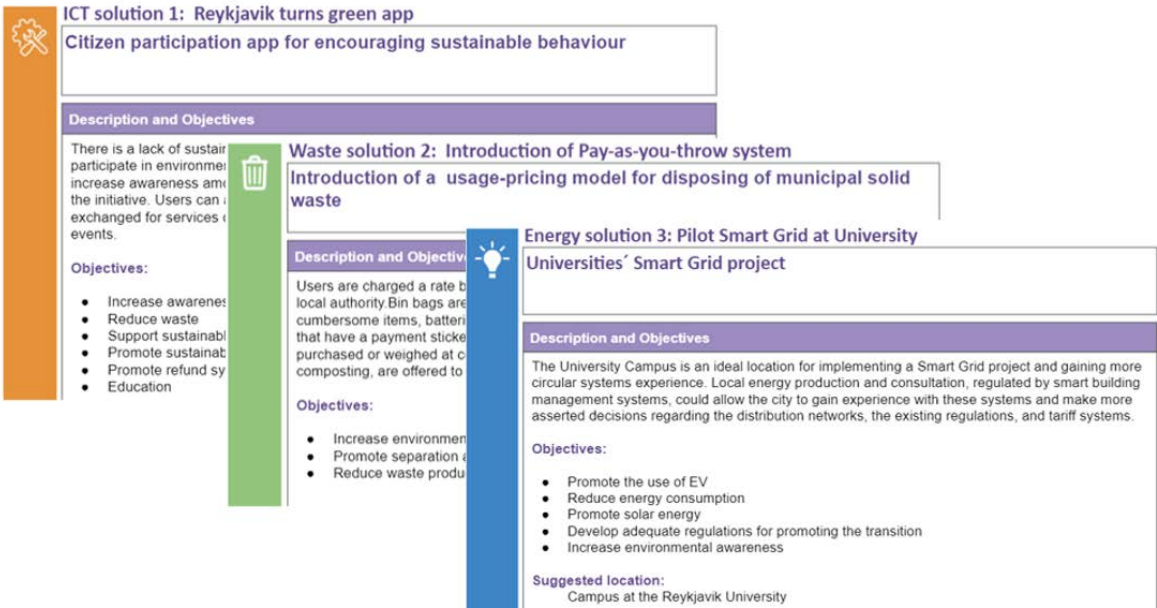


Figure 5. Example of drafted catalogue of project outlines from virtual onsite assessment

2.1.4 Design Phase

The catalogue of project ideas developed in each city was further evaluated with the aim of prioritising some actions to be taken forward towards implementation within the SPARCS activities. This was done using a project filtering tool designed for the project as well as an innovation workshop. Refer to Implementation plans of FCs in D5.4, D5.5, D5.6, D5.7 and D7.8 (SPARCS 2022, SPARCS2022a, SPARCS2022b, SPARCS 2023, SPARCS2022c).

a) Project filtering

Fraunhofer developed a Project Filtering tool to help narrow down the project ideas developed in previous stages and guide discussions about which projects to pursue in the subsequent SPARCS tasks presented below. The city team conducted the project filtering process and selected a reduced number of projects to be discussed during the City Lab Innovation Workshop. The filtering process used the following seven criteria:

- Stakeholder engagement: measures citizen interest and acceptance of the project based on interviews and expected implementation.
- Regulation constraints: considers modifications to regulations required for implementation.
- Funding potential: assesses potential for public or private funding.
- Political support: evaluates political interest and backing for the project.
- City Strategy alignment: measures the project's alignment with the city's established goals and agenda.
- Quick win: considers the ease of project implementation.
- Potential to be a lighthouse project: evaluates the project's potential to become a typical lighthouse project as known in H2020 proposals.

The local SPARCS team undertook the filtering and involved local key experts in the process for assessing each project idea regarding the seven criteria presented above. An example Table 1 from the city of Maia showcases the relative rankings of the projects, based on these critical analysis parameters. The ultimate selection of two promising project ideas is accomplished through cogent deliberations during the innovation workshop, taking into account both the quantitative and qualitative analysis outcomes.

Table 1: Example use of the project ranking tool (Maia)

Sr. No.	Project	Stakeholder Engagement	Regulations constraints	Eventual funding potential (Incl. Private co-funding)	Political support	City Strategy alignment	Quick Win	Potential to be a lighthouse project
M.4	Improve the competitiveness of the Public Transport System	High	Medium	High	High	High	Low	High
IC.1	Urban Data Platform for Maia	Medium	Low	High	High	High	Low	High
E.1	Rehabilitation of municipal buildings and installation of RES-e generation technologies	High	Medium	High	Medium	High	Medium	High
W.6	Environmental Zone in Maia	Medium	Medium	High	High	High	Low	High
M.5	Mobility hubs in Maia that offer and connect alternative modes of transport	High	High	Medium	High	High	Low	High
E.2	Pilot Smart Grid at city district, considering an energy community	High	High	High	Medium	High	Medium	High
IC.3	City Digital Transformation	Medium	High	High	High	High	Low	High

The Figure 6 depicts the projects that are selected after filtering for subsequent detailed work during the innovation workshop and final implementation within the SPARCS initiative, for each respective FC.

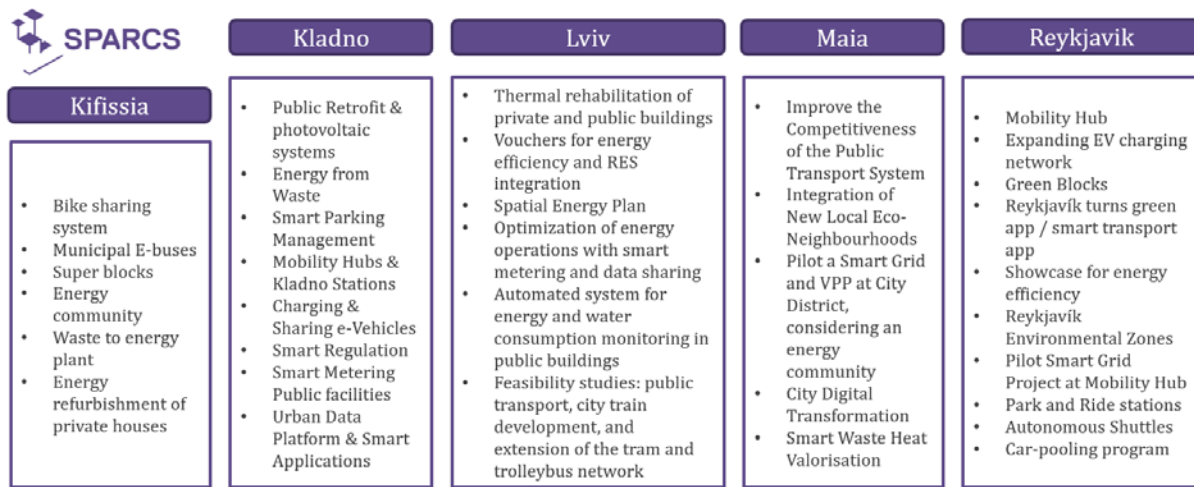


Figure 6. Selected project outlines for further development during the innovation workshop

b) Innovation workshops

The primary objective of these workshops was to present, validate, deliberate, and enhance the existing concepts for innovative projects and measures that were formulated during the onsite assessment, in consultation with the relevant stakeholders. (FHG et al., 2022).

From all the projects evaluated, selected few were chosen to be the focus in the Innovation Workshop. These were categorised into five principal areas, namely: Sustainable Mobility, Citizen Engagement, Energy Transition, Information and Communications Technologies, and Environment and Circular Economy, which represented pivotal themes within the domain of sustainable development.

The workshop was organised in a collaborative effort between the Fraunhofer team and the local city team, accompanied by the city municipalities.

The City Lab Innovation Workshop was arranged according to a structured co-creation process, which involved the formation of working groups focused on the selected project ideas. Each group was facilitated by either a city representative or a Fraunhofer researcher and utilised various interaction techniques and methodologies. The discussions were designed to facilitate stakeholder interaction, whereby every member was given an opportunity to contribute their unique expertise and background. The key points of the workshop are presented below.

- Welcome & Introduction: the SPARCS project; Strategic objectives of the SPARCS project in FCs.
- Methodology & onsite assessment facts, results: City Lab co-creative methodology and main results of the onsite assessment held in the FCs.
- Workshop methodology: In groups discuss, verify, and improve the selected ideas for innovation projects. First concepts and approaches for integrating public and private stakeholders from the city, and possible financing opportunities identified.

- Presentation of the results and open discussion in plenum: Identifying synergies. Possible ways of collaboration between projects.
- Conclusions and next steps.

Subsequent to the Innovation Workshop, the local team made a deliberate choice to narrow down the selection to only two projects, as outlined in the SPARCS agreement (refer to *Figure 7*), to advance towards the implementation phase (Task 5.4), as detailed in the subsequent sections. The criteria for project selection were based on several factors, including the level of complexity of the project components, their cross-sectional nature, and alignment with the central themes of the SPARCS initiative.

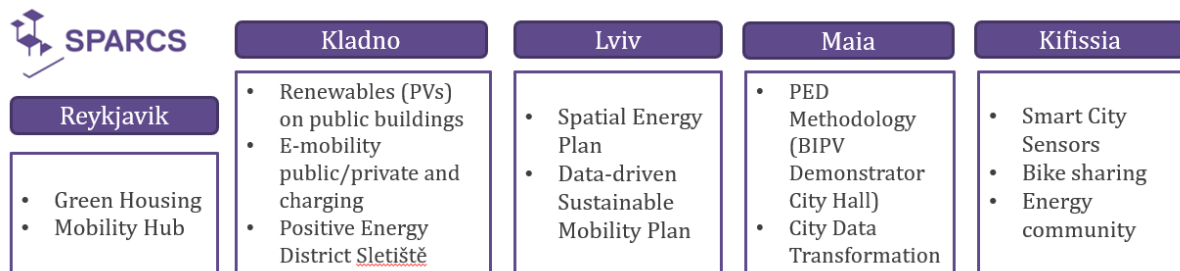


Figure 7. Selected projects within the scope of SPARCS

Finally, each working group presented their findings to all participants, thereby fostering a collaborative exchange of experiences and encouraging a close and constructive dialogue among all parties involved. Such an approach not only enhanced the overall quality of the workshop outcomes, but also served as a means of promoting knowledge transfer and cross-fertilisation of ideas. This inclusive and participatory method encourages inclusivity and engages stakeholders in the decision-making process and is widely recognised as a sound practice in contemporary sustainable development initiatives.

During the design phase, the information gathered from the previous stages, including the results of the interviews were consolidated. This resulted in the development of a finalised implementation plan containing specific project proposals based on the interventions implemented in the LHCs as part of the SPARCS project. The implementation plans focus on measuring the sustainability performance of the cities, including their strengths and weaknesses in regard to carbon transformation. The implementation plans are adapted by each of the FCs to fit their unique profiles. The Figure 8 shows a snapshot of the virtual innovation workshop in Maia.

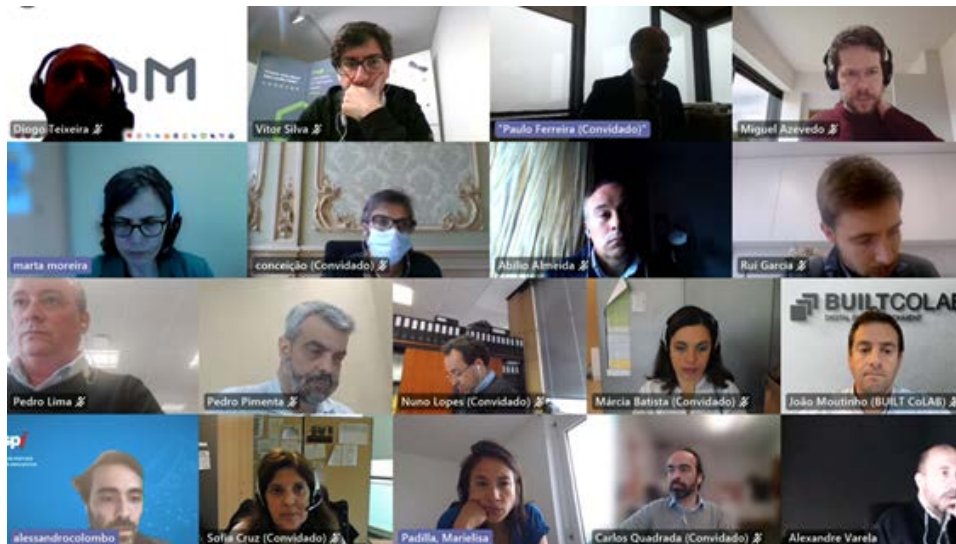


Figure 8. Snapshot from Innovation Workshop: Maia (SPARCS, 2022)

2.2 Project Development

To develop a project with concrete objectives, it is necessary to have a solid foundation. This is where a framework comes in. A framework provides an outline and structure so that the project team can focus on achieving its objectives. With a framework in place, cities can work more efficiently and effectively to make their project succeed.

The framework developed for the SPARCS project development provides a comprehensive process that can be followed by all cities both within and outside the Horizon 2020 SCC projects, with a desire to set and deliver on sustainability goals through the development of innovative urban projects. Although the process is seemingly linear, some steps are iterative and may have to be revisited multiple times to ensure that the right goals are set and communicated effectively for their successful delivery. For the SPARCS project, some steps may be skipped depending on the city's status and its position in the process.

Following all the inputs and further research done, 9 phases have been conceptualised in the project development process, ranging from solutions roadmap to upscaling. Each phase is broken down into steps, with the goal, tasks, outputs, and best practices for each step outlined. The [Cities4Zero strategy](#) from the SmartEnCity project provides a comprehensive list of tools that can be used in each stage of the project development. (SmartEnCity, 2017)

In a bid to further develop the existing framework, a virtual workshop was conducted with representatives from the SPARCS LHCs and FCs to get their perspective on what the project development process of public projects looked like to them based on their experience. For the workshop, Mural, an online workspace for visual collaboration, was utilised (Figure 9).

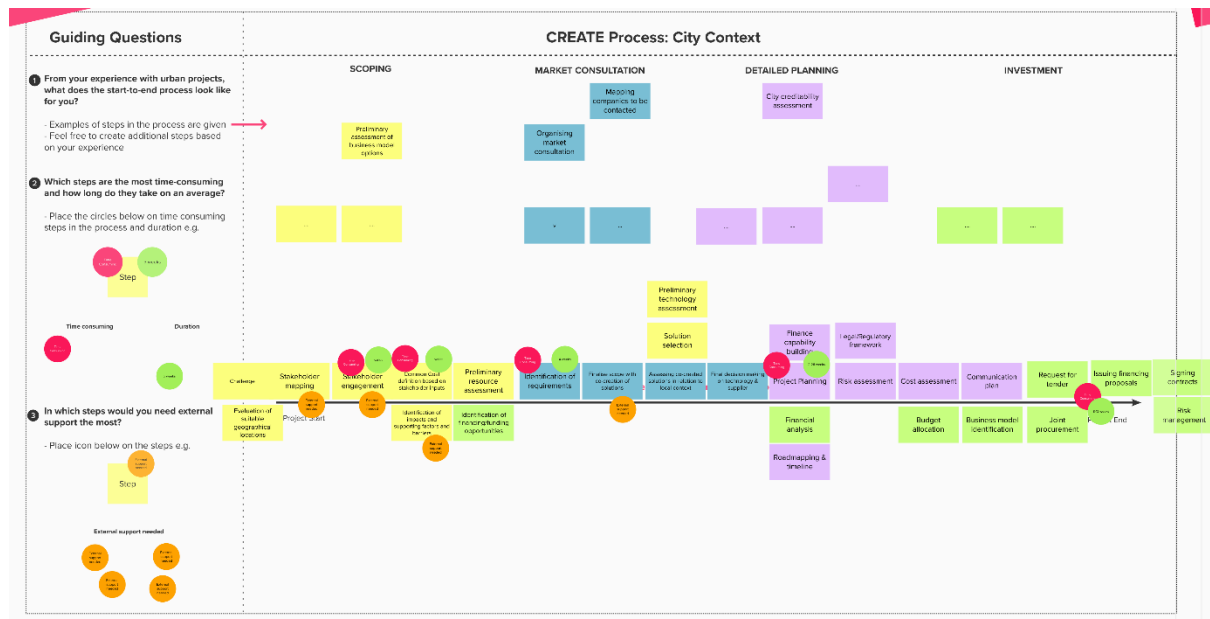


Figure 9: Virtual workshop with SPARCS LHCs and FCs using MURAL

The overall aim of the workshop was to get a start-to-finish flow of the project development process for urban projects from a city perspective and to know which steps are usually the most time-consuming ones and where external support is required. Details of this assessment can be found in Table 2. Following the analysis of the results from the workshop, the framework was modified to reflect the insights gained.

Table 2: Insights from the Create Process Workshop

Create Process Workshop	Challenges	
City Context	Time Consuming	External Support
LHCs	Solution Selection	Identification of supporting factors and barriers
	Stakeholders mapping/ engagement	Stakeholders mapping/ engagement
	Identification of financing/funding opportunities	Assessing co-created solutions concerning local context
	Financial analysis	Finalise scope with co-creation of solutions
FCs	Solution Selection	Cost Assessment
	Stakeholders engagement	Joint Procurement
	Issuing financing proposals	Preliminary technology assessment
	Signing contracts	Business Models identification

For the cities, the first step before commencing with the project development process was creating a local working group including municipal employees and external experts. The creation of this collaborative task force with a mix of expertise was fundamental to ensure good results throughout the entire process and enables the effective management of all aspects related to the project. Next step was to develop a communication and dissemination plan. A comprehensive list of the various channels and media that can be utilised throughout the lifetime of the project was provided (citizen engagement strategies for project development).

This structured process was used to guide all five FCs through scoping of up to two projects from the Implementation plans developed in T5.3, consulting relevant

stakeholders, a detailed planning, and securing investments. The process was based on the learnings from other projects, methods and tools available. The Figure 10 shows the structured project development process in the FCs.

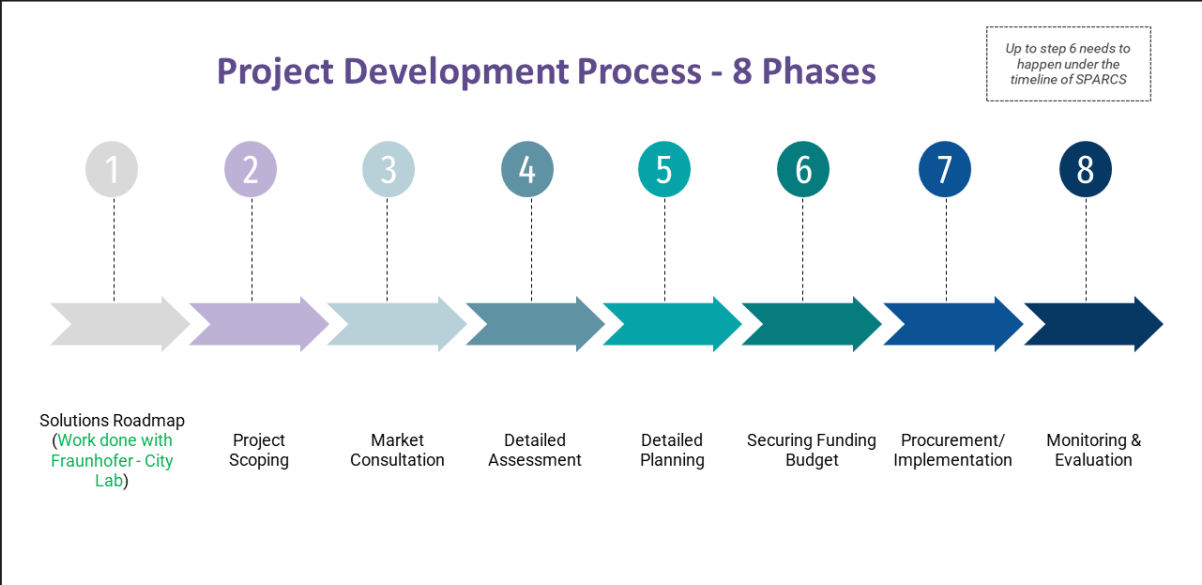


Figure 10: Structured Project Development Process to Guide all five FCs

Each city team and the BABLE Team met on a regular basis to check on progress, challenges, and ways to address them.

All the experience, learning and work carried out by the FCs following the Project Development Process is reflected in the deliverables D5.9, D5.10, D5.11, D5.12 and D5.13 respectively for Maia, Reykjavik, Kladno, Lviv and Kifissia (SPARCS, 2024a; SPARCS, 2024b, SPARCS, 2024c, SPARCS, 2024d, SPARCS, 2024e).

Business Models for cities

With the aim of ensuring the enduring success and financial health of their projects while also accounting for extended societal benefits, the cities have been supported in defining the right business models for their projects.

For this purpose, a Business Model Canvas was developed, having taken into consideration three sources: the [Social Business Model Canvas](#), and the Canvases from the [MAtchUP](#) and the [MOVE2CCAM](#) projects. These references were chosen because they each provide a unique evaluation framework and have a significant impact from a social and city perspective.

A meticulous selection was made to identify the segments that hold the utmost significance and necessity for the work within SPARCS. The canvas is shown in the Figure 11.

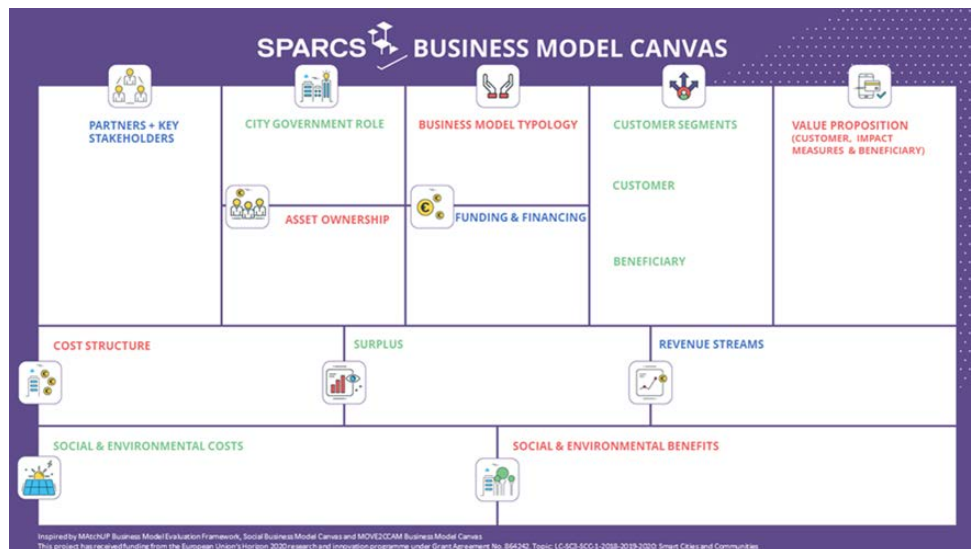


Figure 11: SPARCS Business Model Canvas (BABLE, 2023)

The SPARCS Business Model Canvas was developed during spring 2023 and it was tested with the partners in a 3-hour in-person workshop during the consortium meeting in June 2023. The focus was on the Use Case Owners, which can either be the Lighthouse City, Fellow City or the technical partner.

A Use Case is an application of technology to reach a specific goal in a specific context and whose impacts can be measured independently and also replicated. Each Use Case has various supporting factors such as lessons learned, financial details, providers, end users, results, and additional benefits that enable its implementation in a specific setting. For Lighthouse Cities, the Use Cases explain information about the planning, implementation and monitoring of each demonstration action; and for Fellow Cities, the Use Cases were their two projects to implement.

Prior to the workshop, the Use Case owners were requested to pre-fill the template based on the assigned Use case. During the workshop, the participants had more time to discuss and reflect on the challenges of each use case.

It was observed that since cities were between the planning and implementation stages of their projects, the full benefit of using the Business Model Canvas would have been more visible had it been done at an earlier stage in the project. Nonetheless, the canvas serves as a planning tool for cities as it allows to review the Use Case before, during and after implementation, thereby allowing corrective and complementary actions to be taken when needed.

Further details on this exercise with the Business Model Canvases are explained in WP3 leading by Espoo City as part of the deliverable for task T3.7, in WP4 leading by Leipzig City as part of the deliverable for task T4.7, and in deliverable D6.7 "Recommendations on cross-cutting issues" (SPARCS, 2024).

2.3 Market Consultation

The joint cross-border procurement process (JCBP) was enabled in the 2014 Procurement Directive to allow contracting authorities from EU member states to collaborate in procurement. The JCBP allows contracting officers in one country to use public contracts already awarded by another member state in their procurement procedure. Member states can also set up joint entities for procurement purposes under EU or national laws (Ponzio, 2017)

According to BABLE, the experiences of JCBP are mainly limited to processes between countries sharing borders, health sector procurements and partnerships between national governments. Furthermore, there is no expert consensus whether the benefits outweigh the costs.

Although this solution produced limited success, it encountered several challenges during its implementation:

1. The countries had different existing procurement processes.
2. There are language and cultural barriers.
3. The need for substantial coordination and agreement is required.
4. Defining the standard technical requirements are highly complex tasks when very diverse cities are involved.

Consequently, the research by BABLE found that most of the expected benefits of the JCBP could be achieved through a formal joint market consultation. Market consultation serves the dual function of informing a tender preparation process and notifying suppliers and service providers about the procurement plans by the city or other public authority.

BABLE then created a new tool to simplify the process for cities to reach a wider market early in the project. The BABLE [market consultation tool](#) informs public sector representatives about the smart city solutions they intend to procure and then automatically alerts suppliers in such fields about this intention. It allows cities to reach suppliers/service providers from markets they might not have explored. The BABLE Market Consultation tool was developed and released in the BABLE platform at no cost for all cities. The tool was piloted by FC of Maia (Portugal) to implement building-integrated photo voltaic (BIPV) in a demo site. Using the tool, Maia provided a detailed description of the required solutions, describing a clear goal of the project, system specifications, mandatory requirements, architectural plans, and pictures to help prospective providers understand the city's needs and minimum expectations. These details were published on the [BABLE platform](#), to which a large community of providers had access. In this way, only providers who met all the listed requirements would be registered to in the market consultation.

Some recommendations to get the most out of this tool are:

1. If a city wishes to start a procurement process to implement its smart city initiatives, the best way to optimise this process is with a Preliminary Market Consultation to interact with the market in the early stages of procurement.
2. This tool does not replace any official tendering process but rather exists as a complement that will increase the number of suppliers that respond on the cities' tendering portal. It helps cities think about how they can improve their tendering process through the Preliminary Market Consultation.

To gain more insights about the tool, including its main features and other insights, refer to the deliverables D5.16 "Market consultation feature publicly available on BABLE" and D5.17 "Public Market Consultation Results".

3. PROJECT UPSCALING

The aim of this task is to support the upscaling of a solution within the LHCs and identify the opportunities for replication. This task supported the definition of a project which could become a lighthouse project for Espoo and Leipzig, during SPARCS and beyond. The task complements the actions taken in T3.9 and T4.7 and supports the replication project by taking one project concept idea until the phase where investment will be secured.

The process follows a similar structure to the one identified in T5.4 and reflected in the Project Development Toolkit while acknowledging aspects related to the scale of the project and upscaling characteristics. The adaptation of the actions is also following a consultation process with LHCs from past projects to learn from their experiences.

This process emphasises the Preliminary Assessment which includes 3 sub-sections: Project definition, Assessment of potential for upscaling and finally the Assessment of Business Models and Financial Analysis; with the objective of covering the strategy which will determine the type of scaling up, further dissemination and advocacy strategies, organisational processes, costs and resources optimisation as well as monitoring and evaluation of the steps taken. The project upscaling process defined is shown in the *Figure 12*.

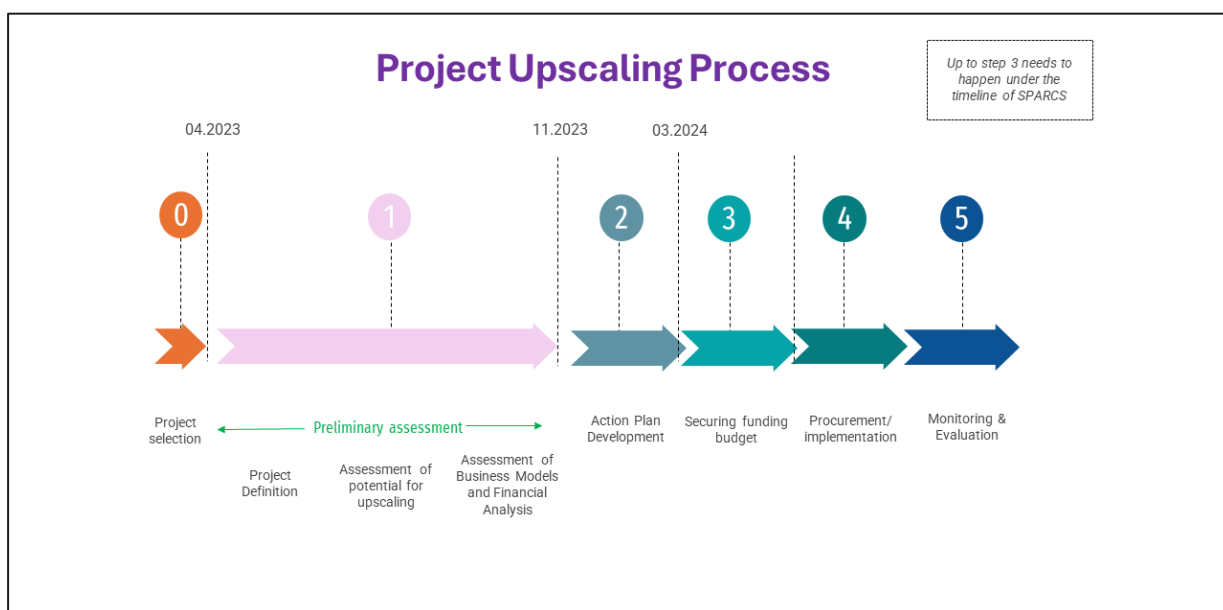


Figure 12: Project Upscaling Process for the Lighthouse Cities

Monthly discussions were held with each of the LHCs to identify projects suitable for the upscaling process, which align with the cities' agenda and current programs, SPARCS objectives, as well as the present funding landscape. Moreover, discussions on potential project partners have taken place.

Each LHC had a different starting point in identifying the project to be scaled up. As a result, specific workshops were developed to address the distinct needs of each city. After several meetings and workshops, the projects to be scaled up was identified, and the next steps outlined in the "Project Upscaling Process" to be followed.

Further details on this process and its results are explained in the deliverables D5.14 and D5.15.

Ultimately, this activity explored how to best support the LHCs in designing and executing a large-scale project, which builds on the learnings and experiences from SPARCS, and boosts its application and impacts. In the same vein, the team explored transversal challenges that arise from going from pilot to large-scale application, such as securing the right funding or financing, limitations on city hall's mandates, and cooperation within the public organisation and with other key stakeholders.

4. KNOWLEDGE EXCHANGE AND TRAINING

Knowledge exchange between LHCs and FCs focuses on sharing lessons learnt from the ongoing efforts of LHCs to develop sustainable and positive energy communities. Various knowledge transfer programmes were organised, specifically tailored to the interests of FCs, inviting their representatives to share their knowledge and experience. The main objective of this knowledge exchange was to create a platform for direct discussions between LHCs and FCs, focusing on issues such as challenges, strengths, lessons learnt, and advice derived from project participation. Structured around the thematic interests of the FCs, it facilitated direct interactions and provided insights into the technical demonstrations conducted in Espoo and Leipzig. By involving representatives and partners who are intimately familiar with these demonstrations, participants gained valuable perspectives. The overall goal of the programme went beyond individual project insights and aimed to explore how cities were organising services within the Smart City framework.

4.1 Packaged Solutions

The packaged solutions aim to create rich, expert-curated, neutral information packages about the solutions the lighthouse cities were implementing, which can support other cities to replicate these solutions under their local circumstances.

The content and structure of the Solutions aimed to break down the complexity of the technical systems (Products) offered by the market and aggregate information from individual applications (Use Cases). In collaboration with a European community of experts, BABLE structured the packaged solutions for smart cities in a way that they were modular, configurable, standardised, and neutral.

The Solutions were structured as follows:

- **Description:** main definition of what the general system can do and the goals to be achieved by using it in an urban context.
- **Problems to be solved:** the challenges and issues the specific solutions can support in tackling.
- **Functions:** mandatory (what the minimum requirements of the system to provide the basic functionalities are) and optional (what other additional options are that could be adapted to the local needs) configurations of the system.
- **Variants:** identification of the different options that exist as part of that solution.
- **Benefits:** how can the solution improve the city or some aspects/areas of it.
- **City context:** local factors enabling or limiting the success of such a solution.
- **Supporting factors:** aspects, characteristics, methods promoting the uptake of the solution.
- **Government initiatives:** Policies supporting the implementation of such solutions (EU-level, national level, or local level).
- **Stakeholder mapping:** the main actors involved in the implementation, provision, and maintenance of the product/service, and their interactions.
- **Market potential:** market size, development in the past years, and customers.
- **Cost structure:** resources needed to design, implement, and maintain the system, and fixed and variable costs.
- **Operating models:** reference on who owns the system, who operates it, and who may provide the funding for it.

- **Legal regulation:** list of relevant regulations governing the application of the solution at the EU or national level.
- **Data and standards:** relevant references to existing open standards, data models relevant for the solution.

This information is relevant for cities because it helps them understand what they can get from the market and what benefits the solution may create to make more informed decisions. While also supports them at the procurement stage providing key information that should be included in the tender documents like the description of the system, variants, and desired functionalities.

The solutions prove to be useful for product/service providers as well since their offers can be connected to the relevant solution supporting them in their communication to the public sector. The products of companies are linked to solutions and Use Cases within the SPARCS project.

As part of this task, the following Solutions have been researched and made available online based on the planned implementations by the cities of Leipzig and Espoo. Each of them includes a link to the specific webpage where they are publicised.

Energy Solutions

1. [Energy Storage Systems](#)
2. [Energy Efficient Retrofitting of Buildings](#)
3. [Smart Microgrids](#)
4. [Building Energy Management Systems](#)
5. [Local Energy Systems](#)
6. [Municipal Energy Saving Systems](#)
7. [Peer to peer energy trading](#)
8. [Virtual power plant](#)
9. [District Heating and Cooling System](#)
10. [Smart Home System](#)

ICT

11. [Digital Twin](#)
12. [Urban Air Quality Platform](#)
13. [Urban Data Platform](#)

Mobility Solutions

14. [Bi-directional Electric Vehicle Charging](#)
15. [Public Charging System for EVs](#)
16. [Bike Sharing System](#)
17. [Smart Parking System](#)
18. [Electric Bus System](#)
19. [Vehicle Sharing System](#)
20. [Mobility Hubs](#)

4.2 Knowledge transfer process

Replication and scaling up of solutions involve the transfer of knowledge to others, and the approach can be tailored to meet the specific needs of stakeholders. In SPARCS, the replication efforts were adopted from LHCs to FCs. The knowledge transfer process comprised two key steps: first identification of the knowledge gaps of FCs, and second, designing and planning the process of knowledge exchange methods. This facilitated a direct exchange of ideas between the LHCs and FCs. The knowledge

exchange process was implemented in FCs through City Forums, webinars, workshops, and demo site demonstrations.

4.2.1 Identification of knowledge gaps and needs

The replication of solutions in cities requires a clear understanding of their development levels. The initial step in preparing the FCs for replication involved identifying knowledge gaps and needs (FHG et al., 2022). An online survey was selected for this purpose, inviting FC representatives from relevant departments—public engagement, governance, data, ICT, mobility, energy production, demand, and distribution—to participate. The survey primarily focused on the interventions of the LHCs while also addressing key areas such as data governance, smart city management, innovation, systems integration, and business models and finance.

Additionally, LHC representatives were invited to participate voluntarily, which was deemed crucial for the successful implementation of the SPARCS initiative. The survey results were analysed in collaboration with the FCs to outline the scope for knowledge exchange and professional training.

4.2.2 Planning and execution of knowledge exchange

To plan and execute the knowledge exchange effectively, an evaluation of the survey was necessary. Based on the analysis, a knowledge-transfer structure was established, including webinars, City Cafes, and City Forums, facilitating open discussions and knowledge sharing among cities. The City Cafe was a monthly half-hour discussion round where cities could address current challenges and seek input and lessons learnt. In contrast, the City Forum was a more structured gathering where cities, alongside the consortium, shared experiences on specific topics. These events were intended to take place in one of the LHCs or FCs, aligning with on-site activities.

Initially, the City Forums were planned as in-person events, but due to the pandemic, some were conducted online. Topics were gathered from the surveys, refined, and meticulously planned. Coordination was managed by Fraunhofer with support from consortium partners. The involvement of LHC technical partners was crucial, as they provided knowledge and expertise to assist the FCs in their implementations, contributing significantly to the success of this initiative.

The Table 3 presents an overview of the knowledge exchange carried out during the project within the replication WP in SPARCS:

Table 3. Workshops and webinars organised and conducted for the purpose of knowledge exchange.

Project Month	Type of Exchange	Description	Topics Discussed
M7	Workshop (onsite)	This workshop took place in Leipzig as a City Forum with the aim of allowing for an exchange between Leipzig and Kladno.	Leipzig-Kladno Exchange - Leipzig’s framework conditions – from a shrinking to a growing city/climate + energy topics - Kladno framework conditions: transformation, economics, ambitions - District Heating Strategy and SPARCS activities by Leipziger Stadtwerke

Project Month	Type of Exchange	Description	Topics Discussed
			- Citizen engagement in energy transition - Introduction to WP1 – City Vision
M9	Webinar	This webinar took place online as a City Forum with the aim of initiating discussions on citizen engagement, as one of the key topics within the project.	Citizen Engagement <ul style="list-style-type: none"> - eGovernment & Public Budgeting - Participation Platforms & Service Design - Participation Processes - Glossary of Concepts- Quality Assessment
M13	Workshop (online)	City Forum Workshop was organised for the 2020 SPARCS Consortium meeting to provide insight into the PED development journey within LHCs.	How to design a positive energy district <ul style="list-style-type: none"> - Building a common definition - Integrated Resource Planning & Optimisation (IRPopt) - Use Cases (ULEI): Designing PEDs, Decarbonising district heating
M16	Webinar	This webinar took place online as a City Forum with the aim of initiating and introducing the replication process.	SPARCS Replication Strategy <ul style="list-style-type: none"> - City Lab replication method: Towards an Implementation plan - Reykjavik & Maia Experiences - Interoperable Solutions, Smart city Training & Project Development - Workshops & Webinar outlook
M22	Webinar	This webinar took place online as a City Forum with the aim of obtaining in-depth understanding and exchanging of experiences regarding business ecosystems.	Services for Businesses and the Business Ecosystem within the Smart City Realm <ul style="list-style-type: none"> - Business Espoo: Helping companies thrive - A deep dive into the Smart Otaniemi - Smart City Challenge - Urban Transformation and Carbon Neutrality by 2050
M26	Webinar	This webinar took place online as a City Forum with the aim of showcasing of strategies concerning sustainability and e-Mobility utilised in LHCs.	Discussion on Sustainable Commitments and e-Mobility Hubs <ul style="list-style-type: none"> - Towards a sustainable city through joint commitment - Developing sustainable e-mobility hubs in Espoo - LeipzigMOVE – Creating a public & shared mobility network for Leipzig

Project Month	Type of Exchange	Description	Topics Discussed
M29	Webinar	This workshop took place online as a City Forum with the city representatives presenting their knowledge and experiences that are gained through their participation in the project so far.	PED Replication in FCs: A Roundtable Discussion <ul style="list-style-type: none"> - Challenges, Strengths, Learnings, Advice from FCs. - SPARCS wish list from FCs and LHCs.
M32	Webinar	This webinar took place online as a City Forum with the aim of obtaining insight from Maia and Leipzig's experiences with Urban Data Platform.	Urban Data Platform: Experiences from the Project Cities Leipzig and Maia <ul style="list-style-type: none"> - City Data Platform and eV Infrastructure in Cities - Urban Data Platform - Experiences, use-cases, challenges. Digital Twins, 3D models, advice from FCs.
M36	Workshops Leipzig (onsite)	The workshops took place in Leipzig as part of LHC onsite visits and demo showcasing for FCs, further enhancing the distribution of knowledge, internal participation and interaction between partners.	Leipzig onsite visit <ul style="list-style-type: none"> - Transformation of a city's energy and heating system; - Virtual Energy Districts; - Engaging citizens in energy transformation; - Urban Data Platform & Digital Twins: Use Cases from Leipzig municipality
M37	Workshops Espoo (onsite)	The workshops took place in Espoo as part of LHC onsite visits and demo showcasing for FCs, further enhancing the distribution of knowledge, internal participation and interaction between partners.	Espoo onsite visit <ul style="list-style-type: none"> - DH demand response, market predictions - Building X - AI enabled applications - EV chargers - Sustainable development - Citizen engagement
M38	Combined Workshop (WP3, WP4, WP5) in KFS (onsite)	This workshop took place in Kifissia in during the 2022 Consortium meeting. The workshops focused on enhanced exchange between technical partners and the FC teams.	Roundtable discussion between technical partners and FCs <ul style="list-style-type: none"> - Virtual Energy Districts - Virtual and Physical Energy Districts - Integrative Energy Systems - Mobility - Citizen Engagement

Project Month	Type of Exchange	Description	Topics Discussed
M38	Webinar	This webinar took place online as a City Forum with the aim of gaining insight of key learnings from KONE's experience in modelling business models.	KONE lessons learnt from business model co-design in mobility context <ul style="list-style-type: none"> - Co-creation process example and SPARCS playbook - Lessons learnt from platform business co-design work - Do-it-Yourself Business Model Co-Design
M43	Webinar	This webinar took place online in April 2023 together with LHCs, FHG and SPI.	Key Learnings: Engaging Different Actors <ul style="list-style-type: none"> - Dos and Don'ts in co-creation and citizen engagement - SPARCS project's engagement actions - co-creation model and citizen engagement platform
M45	Combined Workshop	This workshop took place at the fourth Consortium meeting at Reykjavik in June 2023. The workshop aimed to develop viable business models using Business Model Canvas.	Business Model Canvas Development by Intervention Lead from the LHCs and the FCs- SPARCS Business Model Canvas <ul style="list-style-type: none"> - Business model development on selected projects - Feedback on thematic table - Planning tool
M51	Combined Workshop (WP5 and Scalable Cities)	This workshop took place at the fifth SPARCS Consortium meeting at Leipzig in December 2023. The workshop had a panel discussion with FCs and Scalable Cities (City of Prague, City of Pula, City of Gelsenkirchen, City of Munich and City of Grevena) and a poster session on replication.	Replication and implementation of replication projects <ul style="list-style-type: none"> - replication in the context of SPARCS and the city - poster presentation by FCs on replication and upscaling strategies - Replication plans of cities - Role of SPARCS in FCs future
M54	Workshop	This workshop took place from the 20 th to the 21 st of March 2024 at the Extended Advisory Board Meeting in Maia, Portugal. The workshop aimed at discussing possible structures and contents for	Result documentation of the Replication Strategy <ul style="list-style-type: none"> -scientific publication on a literature review on replication - publication on replication recommendations for practitioners from SPARCS experiences

Project Month	Type of Exchange	Description	Topics Discussed
		two result publication formats of the WP.	
M55	Workshop	The City Forum at data week Leipzig was co-organised with the H2020-project ASCEND. Several solution presentations as well as open exchange and discussion formats fostered networking and knowledge exchange.	View on replication from two EU-projects , exchange on challenges and good practices - Tangible challenges - Intangible challenges - Good practices
M57	Workshop	City Forum at URBIS conference in Brno	Discussion: Latest Findings from international Projects on PEDs Showcase Workshop on the idea behind SPARCS and the various projects realised in the LHCs and FCs. - Presentation of individual measures - good practices
M60	Workshop	Panel Discussion at the SPARCS Final event, Espoo	Cities in the Spotlight - Discussion with LHCs and FCs representatives on experience from SPARCS and city future plans - Share of experience on challenges with citizen engagement

4.3 Certified Professional Smart City Training

Each city sent up to four staff members to join a comprehensive smart city professional training and become a “**Certified Smart City Manager with a Profile on Urban Energy**”. The course had a length of approx. 6 months and comprised distance learning modules as well as three best-practice visits. The conveyed contents and methods went beyond the insights and expertise gained within SPARCS and included best-practice knowledge in the field of smart city developments with a focus on energy projects on the European scale. As a blended learning format, it enhanced the cooperation between city and company employees and provided a platform for international and interdisciplinary exchange. An exploitation plan made sure that training and certificates developed via SPARCS can be offered as standard training to city and business representatives on a large scale after successful delivery of the first certifications.

The development of the training program is described below:

To better prepare the cities for knowledge transfer and replication opportunities, an initial online survey was conducted at the beginning of the project to identify the knowledge gaps and needs. The survey included questions related to contents for the training that would be most beneficial for the cities; areas of interest for knowledge transfer; interventions of the LHCs; and systemic areas of data governance, smart city management, innovation, systems integration, business models, and finance that needed to be tackled.

The questionnaires were completed by city representatives. Based on the responses from the city representatives, 16 modules were developed for the training. They include:

1. Smart City as an Urban Development Approach
2. Financing a Smart City & Procurement
3. Smart City Policies
4. Stakeholders in the Urban Environment
5. Open Systems
6. Data and Privacy
7. Living Labs & co-creation
8. Digital Planning
9. Introduction to Positive Energy Districts
10. Energy Regulations
11. Sustainable Energy & Climate Action Plans (SECAPs)
12. Generation and Storage
13. Energy efficient buildings
14. Smart and flexible grids
15. Cross-sectoral integration of Energy and Mobility
16. The Future of Urban Energy

Figure 13 shows the distribution of Modules in Smart City and Urban Energy Competencies. The training kicked-off on the 16th of October 2020 and lasted until the 9th of April 2021. It was conducted over Microsoft Teams, with one module given per week and each module lasting for 2–3 hours. The contents of the modules were developed through a collaboration between BABLE, Fraunhofer FOKUS, Fraunhofer ISE, and VTT. In addition to the trainings, three best practice visits to the City of Stockholm, Cologne, and Vienna were also organised, however due to COVID, the city visits were converted to online events. Figure 13 shows the distribution of Modules in Smart City and Urban Energy Competencies.

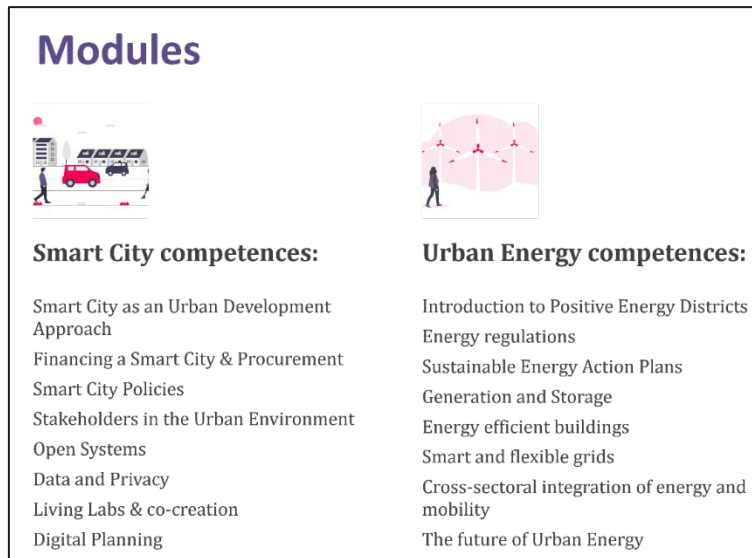


Figure 13: *Distribution of Modules in Smart City and Urban Energy Competencies*

To gain more insights about the Certified Professional Smart City Training, including its timeline and collaborators, main modules, Tests & Certifications and other insights, refer to the deliverable D5.3 “Smart City Manager Certificates (Profile Urban Energy)” (SPARCS, 2021).

5. CONCLUSIONS

The Replication Summary report offers a comprehensive overview of the replication strategies employed by the FCs within the SPARCS project. Drawing inspiration from the Morgenstadt Framework, the SPARCS replication framework is tailored to the specific requirements of individual cities. This framework facilitates knowledge exchange between FCs and LHCs, allowing FCs to glean insights from the implementation of innovative positive energy projects and navigate challenges faced during replication. The report further outlines diverse project upscaling approaches, encompassing market consultation and upscaling processes within the LHCs. Knowledge transfer tools such as City Forums, webinars, workshops, and site visits were utilised by FCs, with Packaged Solutions for cities playing a pivotal role in identifying potential projects and addressing associated challenges.

5.1 Summary of achievements

Within the SPARCS project deliverables of the replication activities, considerable effort was made to progress towards the realisation of replicating and upscaling solutions for positive energy districts within the LHCs and FCs. Through the active participation and collaboration of key stakeholders and partners, several important processes were undertaken, and successful outcomes were achieved (Fatima et al., 2022; SPARCS 2024a; SPARCS 2024b; SPARCS 2024c; SPARCS 2024d; SPARCS 2024e).

In order to facilitate strategic replication, the indicators and action fields encompassed by the Morgenstadt Framework was adapted to the SPARCS project, alongside with the updating of corresponding benchmarks. Each stage of the City Labs was conducted in the FCs for in-depth analysis and assessment of their sustainability performances, consequently producing individual sustainability city profiles, emphasising the drivers, barriers, and opportunities in the cities.

In total, five City Labs took place within the scope of the project, in each of the FCs: Maia, Kladno, Reykjavik, Kifissia and Lviv. The local FC teams, together with the project partners developed project outlines within the analysed system elements, and future points of action. The City Lab process identified several potential solutions per city, resulting in 10–30 project outlines in each FC. The outlined projects were further filtered and evaluated in detail through expert interviews, virtual site visits and innovation workshops. The filtering process leading to the selection of only two projects per city was required to perform the project development activities as defined within the SPARCS project agreement. The research and study results were compiled and were presented in the Implementation Plans of the FCs, serving as a guide and roadmap to implement the developed solutions to tackle key focus areas of the cities for carbon transformation.

The facilitation of mature replication projects in the FCs was assisted and enhanced through knowledge exchange within the project cities. Fraunhofer organised nine workshops and eight webinars throughout the SPARCS project duration for knowledge exchange and replication strategies.

The framework developed by BABLE for the SPARCS Project Development Process provided a comprehensive process that was followed by the FCs and LHCs in their replication and upscaling process, showing their desire to set and deliver on sustainability goals through the development of innovative urban projects. Although

this was a seemingly linear process, some steps were iterative and were revisited multiple times to ensure that the right goals were set and communicated effectively for their successful delivery.

This framework has been instrumental in aiding cities to take concrete steps towards the development of their projects. It has also helped cities to identify instances where it may be necessary to refine and reformulate certain actions before proceeding further. Moreover, the individualised support provided by a BABLE team member has enabled a more customised approach to address the specific needs of each city. This has allowed the BABLE team to offer additional tools to help cities tackle any challenges encountered during the course of their projects.

The various tools, such as the Market Consultation and Business Model Canvas, acted as facilitators in identifying potential opportunities and better ways for the cities to approach their projects. It is essential to note that the feedback and input provided by the cities for each of these tools were of enormous value because they contributed to the improvement of these tools and to the impact they are able to achieve.

5.2 Impacts

The City Lab process led to a very successful co-creation of project ideas in each FC. Two of them continued to be developed in the work with BABLE and were implemented within the project execution time. This successful replication allowed the cities to gain expertise in specific areas and become more confident for further replications.

Furthermore, the rest of the project ideas generated during the city labs are currently being pursued to some extent, creating even more impact in the cities.

The knowledge exchange gives the consortium the opportunity to get deep insights into technical topics, connect with other experts, and create synergies and progress in their own city plans.

5.3 Other conclusions and lessons learnt

During the implementation of the replication strategy, there were common challenges in implementing sustainable development strategies and plans in the FCs. There were difficulties in collecting accurate and up-to-date data, engaging different stakeholders, identifying and overcoming bureaucratic constraints, securing funding for projects, and surmounting unexpected world crises such as energy crisis, war, the pandemic. In addition, there was consensus over the board regarding the importance of knowledge sharing and collaboration with other cities and partners to learn from their experiences and identify solutions. Despite these challenges, the cities were committed to achieving their goals and working towards a more sustainable future. They were persistent, resilient, and adaptable, recognising the need to continuously update their plans and strategies to reflect changing circumstances and new developments.

Learning from the experiences of others is crucial for increasing the chances of success in any activity. Not only does it allow to build on existing knowledge, such as frameworks and methodologies, but it also helps to understand what has worked well in the past to achieve a certain end goal, in this case, replication. For most cities, their participation in the SPARCS project was an inspiring and worthwhile experience because of these points:

- For many FCs, this Lighthouse Project was their first experience within a European project, which allowed them to draw inspiration from the previous experiences of other cities with more experience, not only referring to the technical part but also to the part concerning the commitment and desire to deliver a project that improves the lives of their citizens.
- Although different tools and actions were available to carry out the replication, cities mention that these challenges prevailed until the end of the project: (1) Stakeholder engagement is the most prevalent challenge throughout the project; divided into two main sub-challenges, on one hand, Enhanced collaboration capacity, dependence on others partners to be able to continue with the development of the project, and on the other hand, Interdepartmental Communication, there is a notable communication gap between the departments of the municipalities; and (2) Obtaining financing, the funding sources are not always available, moreover, in many cases, quick results are expected, which adds more pressure when time is short.

The different spaces for exchanging experiences and information gained throughout the project in person for each city and technical partners were highly valued. They allow for greater synergy and collaboration.

6. ACRONYMS AND TERMS

FC	Fellow City
FHG	Fraunhofer Gesellschaft
JCBP	Joint Cross-Border Procurement Process
LHC	Lighthouse City
PEDs	Positive Energy Districts
SPARCS	Sustainable energy Positive & zero cARbon CommunitieS
WP	Work Package

7. REFERENCES

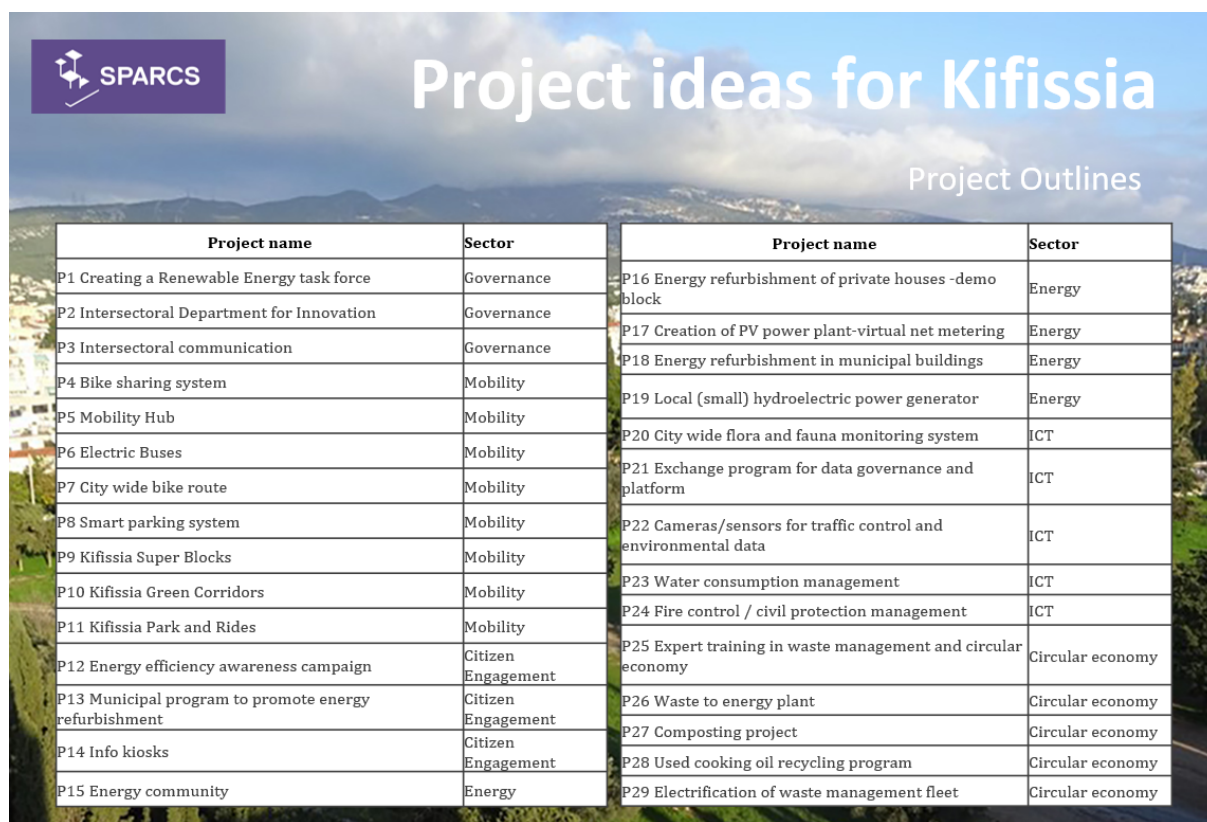
- BABLE. (2023). *Maia*. <https://www.bable-smartcities.eu/connect/cities/city/maia.html>
- Fatima, Zarrin; Padilla, Marielisa; Kuzmic, Michal; Huovila, Aapo; Schaj, Gretel; Effenberger, Niklas (2023): *Positive Energy Districts: The 10 Replicated Solutions in Maia, Reykjavik, Kifissia, Kladno and Lviv*. In: *Smart cities 6 (1)*, S. 1–18. DOI: 10.3390/smartcities6010001, DOI: <https://doi.org/10.3390/smartcities6010001>.
- Fraunhofer IAO. (2022). *Morgenstadt: City Labs*. Fraunhofer Institute for Industrial Engineering IAO. https://www.morgenstadt.de/en/projekte/city_labs.html
- Radecki, A. M. von. (2019). *Transformationsmodell für nachhaltige Stadtsysteme. Schriftenreihe zu Arbeitswissenschaft und Technologiemanagement: Band 48*. Fraunhofer Verlag, URN: <https://nbn-resolving.de/urn:nbn:de:bsz:93-opus-ds-106549>
- SmartEnCity. (2017). *Integrated and systemic SmartEnCity urban regeneration strategy (Deliverable 2.8)*. Retrieved from <https://smartencity.eu/media/del.2.8..pdf>
- SPARCS (2021) *D5.3 Smart City Manager Certificates (Profile Urban Energy)* <https://sparcs.info/en/deliverables/d5-03-smart-city-manager-certificates-profile-urban-energy/>
- SPARCS (2022). *D5.4 Implementation Plan Maia*. <https://sparcs.info/en/deliverables/d5-04-implementation-plan-maia/>
- SPARCS (2022a). *D5.5 Implementation Plan Reykjavík*. <https://sparcs.info/en/deliverables/d5-05-implementation-plan-reykjavik/>
- SPARCS (2022b). *D5.6 Implementation Plan Kladno*. <https://sparcs.info/en/deliverables/d5-06-implementation-plan-kladno/>
- SPARCS (2022c). *D5.8 Implementation Plan Kifissia*. <https://sparcs.info/en/deliverables/d5-08-implementation-plan-kifissia/>
- SPARCS (2023). *D5.7 Implementation Plan Lviv*. <https://sparcs.info/en/deliverables/d5-7-implementation-plan-lviv/>
- SPARCS. (2023a). *Kifissia*. <https://sparcs.info/en/cities/kifissia/>
- SPARCS. (2023b). *Kladno*. <https://sparcs.info/en/cities/kladno/>
- SPARCS. (2023c). *Lviv*. <https://sparcs.info/en/cities/lviv/>
- SPARCS. (2023d). *Reykjavik*. <https://sparcs.info/en/cities/reykjavik/>
- SPARCS (2024). *D6.6 Recommendations on cross-cutting issues*. <https://sparcs.info/en/deliverables/d6-6-recommendations-on-cross-cutting-issues/>
- SPARCS (2024a). *D5.9 Project Development Report Maia*. <https://sparcs.info/en/deliverables/#>
- SPARCS (2024b). *D5.10 Project Development Report Reykjavik*. <https://sparcs.info/en/deliverables/#>
- SPARCS (2024c). *D5.11 Project Development Report Kladno*. <https://sparcs.info/en/deliverables/#>
- SPARCS (2024d). *D5.12 Project Development Report Lviv*. <https://sparcs.info/en/deliverables/#>

SPARCS (2024e). D5.13 Project Development Report Kifissia.
<https://sparcs.info/en/deliverables/#>

Padilla, Marielisa; Hawxwell, Tom; Wendt, Willi (2016): City Lab Lisbon-Development of a smart roadmap for the city of the future. In: REAL CORP 2016-SMART ME UP! How to become and how to stay a Smart City, and does this improve quality of life? Proceedings of 21st International Conference on Urban Planning, Regional Development and Information Society. CORP-Competence Center of Urban and Regional Planning, S. 151–159, available online: <https://core.ac.uk/download/pdf/55284793.pdf>.

8. APPENDICES

8.1 Appendix A



The image shows a presentation slide titled "Project ideas for Kifissia" with the subtitle "Project Outlines". It features the SPARCS logo in the top left corner. The main content is a table listing 29 project ideas, each with a project name and a sector. The projects are numbered P1 through P29. The sectors include Governance, Mobility, Energy, ICT, Citizen Engagement, and Circular economy.

Project name	Sector	Project name	Sector
P1 Creating a Renewable Energy task force	Governance	P16 Energy refurbishment of private houses -demo block	Energy
P2 Intersectoral Department for Innovation	Governance	P17 Creation of PV power plant-virtual net metering	Energy
P3 Intersectoral communication	Governance	P18 Energy refurbishment in municipal buildings	Energy
P4 Bike sharing system	Mobility	P19 Local (small) hydroelectric power generator	Energy
P5 Mobility Hub	Mobility	P20 City wide flora and fauna monitoring system	ICT
P6 Electric Buses	Mobility	P21 Exchange program for data governance and platform	ICT
P7 City wide bike route	Mobility	P22 Cameras/sensors for traffic control and environmental data	ICT
P8 Smart parking system	Mobility	P23 Water consumption management	ICT
P9 Kifissia Super Blocks	Mobility	P24 Fire control / civil protection management	ICT
P10 Kifissia Green Corridors	Mobility	P25 Expert training in waste management and circular economy	Circular economy
P11 Kifissia Park and Rides	Mobility	P26 Waste to energy plant	Circular economy
P12 Energy efficiency awareness campaign	Citizen Engagement	P27 Composting project	Circular economy
P13 Municipal program to promote energy refurbishment	Citizen Engagement	P28 Used cooking oil recycling program	Circular economy
P14 Info kiosks	Citizen Engagement	P29 Electrification of waste management fleet	Circular economy
P15 Energy community	Energy		

Figure 1a: Project outlines for Kifissia (Image source: SPARCS, 2023a)

8.2 Appendix B

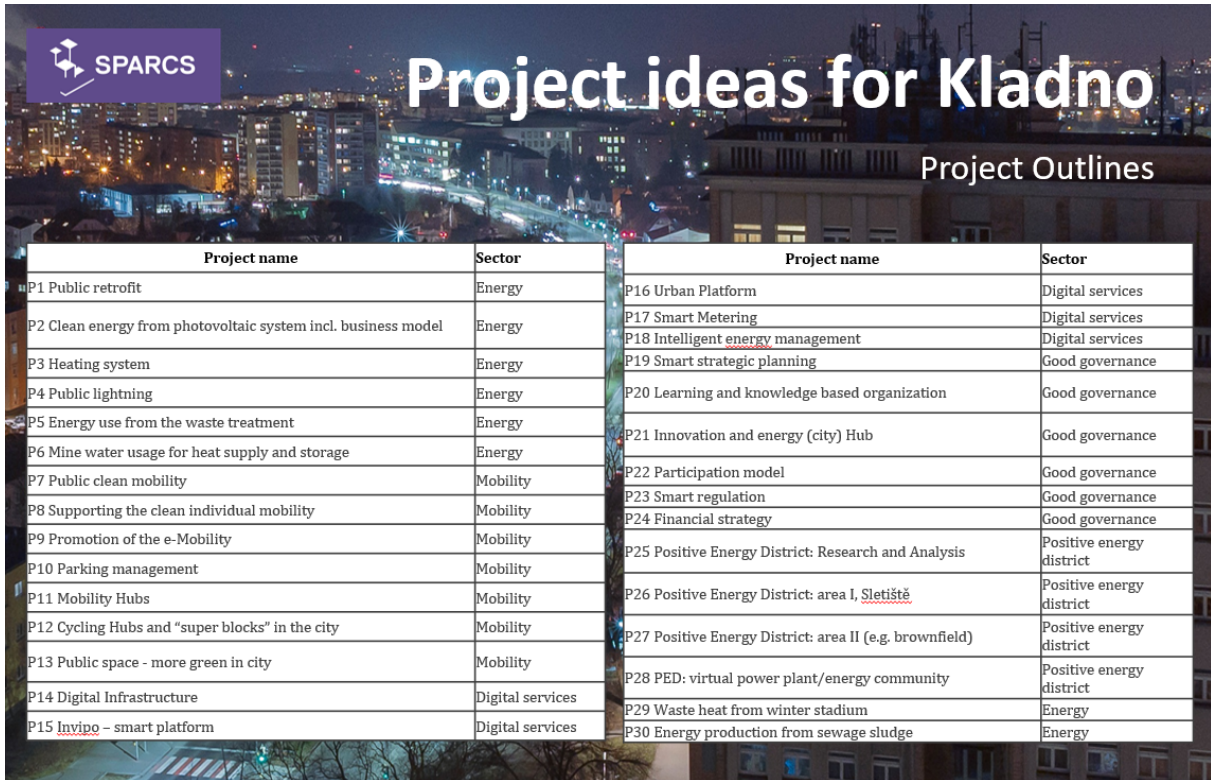


Figure 2b: Project outlines for Kladno (Image source: SPARCS, 2023b)

8.3 Appendix C



The slide features a night-time photograph of a city street with illuminated buildings and streetlights. In the top left corner, there is a purple box with the SPARCS logo. The main title 'Project ideas for Lviv' is centered at the top in a large white font. Below the title, the text 'Project Outlines' is positioned on the right side. A table with two columns, 'Project name' and 'Sector', is centered on the slide. The table lists 14 projects, each with a unique ID (P1-P14) and a corresponding sector.

Project name	Sector
P1 City council Responsibility mapping	Governance
P2 Strategic Urban Development Board	Governance
P3 S-train system like knowledge exchange (Inner-city Railway Passenger transport)	Mobility
P4 Feasibility studies for PT line extensions	Mobility
P5 Park and Ride catchment parking in suburbs - Mobility hubs	Mobility
P6 Improvement of Public transport hubs	Mobility
P7 Subsidization of micro-mobility service extensions	Mobility
P8 Educational program & Transition program around mobility card system	Citizen Engagement
P9 Education and Communication Team	Citizen Engagement
P10 Networking Experiences with Reykjavik	Citizen Engagement
P11 Sustainable energy buildings (central building infrastructure)	Energy
P12 Modernize public street lighting	Energy
P13 Smart meters	Energy
P14 Department consultation	Energy


Figure 3c: Project outlines for Lviv (Image source: SPARCS, 2023c)

8.4 Appendix D



Figure 4d: Project outlines for Maia (Image source: BABLE, 2023)

8.5 Appendix E



Project ideas for Reykjavik

Project Outlines

Project name	Sector	Project name	Sector
P1 Creating an independent innovation unit	Governance	P16 Electrification of long liner ships	Mobility
P2 A project bank/library for funding and research	Governance	P17 Electrification of tourist boats	Mobility
P3 An accelerator for innovation projects	Governance	P18 Sustainable behaviour contest	Citizen Engagement
P4 "Reykjavik green" certificate	Governance	P19 Showcase for energy efficiency	Energy
P5 Promotion of high occupancy in private cars	Mobility	P20 Pilot Smart Grid at a city district	Energy
P6 "Reykjavik Environmental Zones"	Mobility	P21 Pilot Smart Grid at University	Energy
P7 Reykjavik green blocks	Mobility	P21 Pilot Smart Grid at Mobility Hub	Energy
P10 Park and Ride stations	Mobility	P22 Expanding EV charging network	Energy
P11 Mobility Hub	Mobility	P23 Reykjavik turns green app	ICT
P12 Mobility Card	Mobility	P24 Exchange program for data governance and platform	ICT
P13 Smart transport App	Mobility	P25 Data collection program at city level	ICT
P14 Autonomous Shuttle	Mobility	P26 The collection and use of descriptive statistics	ICT
P15 Car-pooling program	Mobility	P27 Developing a predictable model for waste collection	Waste
		P28 Introduction of Pay-as-you-throw system	Waste
		P29 Find market opportunities for the produced methane	Waste
		P30 Development of local treatment plants	Waste

Figure 5e: Project outlines for Reykjavik (Image source: SPARCS, 2023d)