



# D7.2 Demand-driven Holistic Smart City Service Roadmap for Impact Enhancement

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*Hendrik Frieling<sup>1</sup>, Gabriel Villegas de la Ossa<sup>1</sup>, Gabriele Bielinskaite<sup>1</sup>, Pieter Bult<sup>1</sup>*  
*<sup>1</sup> Fraunhofer Gesellschaft IAO, Nobelstraße 12, 70569 Stuttgart*

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Author(s)		Hendrik Frieling <sup>1</sup> , Gabriel Villegas de la Ossa <sup>1</sup> , Gabriele Bielinskaite <sup>1</sup> , Pieter Bult <sup>1</sup> <sup>1</sup> Fraunhofer Gesellschaft IAO, Nobelstraße 12, 70569 Stuttgart					
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## 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



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## Acronyms and terms

3DCM	3D City Model
APIs	Application Programming Interface
A&VR	Augmented & Virtual Reality
CAP	Espoo Climate Action Programme
D3	Deliverable corresponding to Tasks in SPARCS Workpackage 3
D4	Deliverable corresponding to Tasks in SPARCS Workpackage 4
DYS	Do-It-Yourself
EKSP	Leipzig Energy and Climate Protection Plan 2014-2020
EVs	Electric Vehicles
GHG	Greenhouse Gas Emissions
ICT	Information and Communication Technologies
KETS	Espoo Energy Efficiency Agreement for Municipalities
LHC	Lighthouse Cities
FC	Fellow Cities
LSW	Leipziger Stadtwerke
LVB	Leipziger Verkehrsbetriebe
ODUP	Open Urban Data Platform
RA	Roadmap Action
RES	Renewable Energy Sources
SEAP	Espoo Sustainable Energy Action Plan
SECAP	Espoo Sustainable Energy and Climate Action Plan
SMB/SME	Small and medium-sized businesses
SPARCS	Sustainable Energy Positive & Zero Carbon Communities
UVT	Urban Virtual Twin
V2G	Vehicle to grid
VPP	Virtual Power Plant
WP	Workpackage



## 1. EXECUTIVE SUMMARY

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SPARCS develops a new form of smart cities framework with the ultimate goal of achieving zero carbon emissions in European cities by 2050. A multi-disciplinary consortium of over 30 European partners has been formed to define strategic methodologies, actions and evaluation processes with the aim to transform European cities into citizen-centred, environmentally friendly smart cities. To achieve citizens' inclusive free carbon urban community, within SPARCS the following key factors are integrated: technologies for energy positivity in buildings and districts, citizen engagement, city planning and governance, flexible grid management, and energy storage and e mobility as an energy system element. SPARCS targets to tackle the multifaceted challenges that cities face by creating the ecosystems necessary for the urban energy transformation in cities. The cornerstones of SPARCS are two lighthouse cities Espoo in Finland and Leipzig in Germany.

This deliverable presents a holistic roadmap for additional and complementary smart city services to enhance the impact of the actions considered that are being implemented in Espoo and Leipzig. The scope of Task 7.2 and the respective deliverable D7.2, is the inventarisation and development of additional holistic smart city services to enhance impact of planned SPARCS actions in Lighthouse Cities, as well as inspire and inform Fellow Cities (Kifissia Greece, Kladno Czech Republic, Lviv Ukraine, Maia Portugal and Reykjavik Iceland) for future smart city interventions. Through analysis of the baseline and planned actions of Lighthouse Cities and a workshop with both local consortia, an urban energy roadmap suggest to cities and local consortiums potential next steps for additional services and which stakeholder types should or could be involved for further development.

Deliverable 7.2 forms a basis for further analysis into urban challenges and opportunities arising in the SPARCS Lighthouse districts that can be further pursued in a start-up competition in T7.4.

## 2 INTRODUCTION

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### 2.1 Purpose and target group

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This deliverable provides Leipzig and Espoo with a holistic roadmap for additional and complementary smart city services related to urban energy to enhance the impact of the actions considered that are being implemented, as described in SPARC's Deliverables 3.1 and 4.1. It functions as a basis for further analysis into challenges & opportunities in the SPARCS districts that will be pursued in the Start-up competition as described in T7.4. Besides, it serves as an inspiration for Fellow Cities to consider these services, adding to the projects as developed in the Implementation Plans resulting from Task 5.3.

The roadmap was developed through idea setting, feedback rounds, workshops with the Lighthouse Cities and synthesizing these outcomes to be impactful as a basis for the start-up competition. Therefore, it can guide cities, looking to transform towards smart cities, learning from the SPARCS Lighthouse Cities and enhancing the impact of initial smart city implementation actions. Besides, it serves as inspiration towards SME's to be able to provide impactful support to cities during and after these transformation processes. Initially, this deliverable was to be based on the District Assessment Tool (DAT). However, after a first investigation, the DAT has been found inadequate to reach the foreseen outcomes of a roadmap since it does not allow to screen for additional services of planned activities, it focuses only on existing measures.

This Deliverable starts with a general introduction to the need and impact of smart city services, followed by a targeted summary of D1.1 City Characterization Report, D3.1 Action Plan Espoo and D4.1 Action plan Leipzig. Chapter 4 explains the methodology after which the results are presented. First, a generic list of smart city services within the urban energy context, based on the Lighthouse City actions, is listed, followed by a more detailed roadmap on how these services can be further developed and implemented.

### 2.2 Contributions of partners

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Fraunhofer IAO as a Task leader is responsible for the deliverable and has provided the structure of this document, as well as the key methodology and content of the task. Technical Partners from VTT, CVUT, CIVIESCO, SUITE5, BABLE and NEW joined the initial identification of additional services and provided feedback. The local consortia in the cities of Leipzig (City of Leipzig, Leipziger Stadtwerke, Fraunhofer IMW, Leipzig University, WSL, SEECON, and CENERO) and Espoo (City of Espoo, VTT, CityCon, RIL, KONE, and Siemens) contributed with inside knowledge during the workshops carried out on the 18<sup>th</sup> and 28<sup>th</sup> of January. The deliverable was finalised after feedback rounds with SPI, CIVIESCO & VTT, and additional input on chapter 6 from the Leipzig & Espoo local consortia.





## 2.3 Relations to other activities

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This deliverable builds upon activities in Work package 1 (D1.1 City Characterization Report) and Work package 3 and 4 (D3.1 and D4.1, Action Plans of Espoo and of Leipzig) and is linked to other activities within Work package 7 (T7.4 Start-up competition). Based upon information collected by, and action plans developed in the two Lighthouse Cities, an initial synthesis and idea exploration was carried out. The resulting services suggested in this Deliverable aim to serve as a pool of possible ideas for and basis for further analysis into SPARCS-district challenges that can be pursued during the start-up competition and to be carried out in T7.4 led by GOPA with the support of Fraunhofer and CIVIESCO. This deliverable also aims to inspire and inform the Fellow Cities to consider additional and complementary services to their Implementation Plans resulting from activities in Task 5.3.

### 3 SMART CITY DEVELOPMENT: WHY ARE ADDITIONAL SERVICES NECESSARY?

The Sustainable Energy Positive & Zero Carbon Communities (SPARCS) project is an ambitious step towards smarter and promising urban futures for European cities. Despite its over 30 stakeholders in 7 cities covering a wide variety of domains such as energy efficiency, forms of governance, and mobility, the entire potential of sustainable urban development has not been exploited up to this point. Additional services aim to tackle possible gaps, use existing opportunities and widen the scope and impact of the program. Such services strive to boost the already ongoing transformation processes in the lighthouse cities and provide insights about tailored solutions around the SPARCS' tasks and actions. The proposed additional services are an attempt to envision the outreach of the project, to cover finer grounds, and to foster the fulfilment of future demands.

The grounding dilemma in SPARCS regards whether it will be possible to co-design future-proof public services, which needs to be intelligent, green and people-oriented. The catalogue of cities' additional services should take into account the weight of the digital transformation also ensuring both new distributed revenue streams and more inclusive and efficient public services.

Based on a wide analysis of the Lighthouse cities (D1.1) and its socio-economic and environmental conditions, as well as on the SPARCS' objectives, different specific needs are identified, and a strategic roadmap is delineated. The envisioned additional services are also an attempt to promote a joint vision between business, public administration, and civil society.

Furthermore, the conception of additional services aims to diversify future business ecosystems, give space to small and medium-sized businesses (SMBs/SMEs), and shape commercial enterprises in a smart, open, and competitive fashion. The diversification of commerce will take place while cities migrate to energy decentralization, mobility integration, streamlined digital interactions, and more dynamic forms of participatory governance. Open businesses endorse the value of open sources, open contents, transparency, stakeholder inclusion, and accountability. These additional services are an invitation for future start-ups to position themselves and play an active role in the cities' transformation.

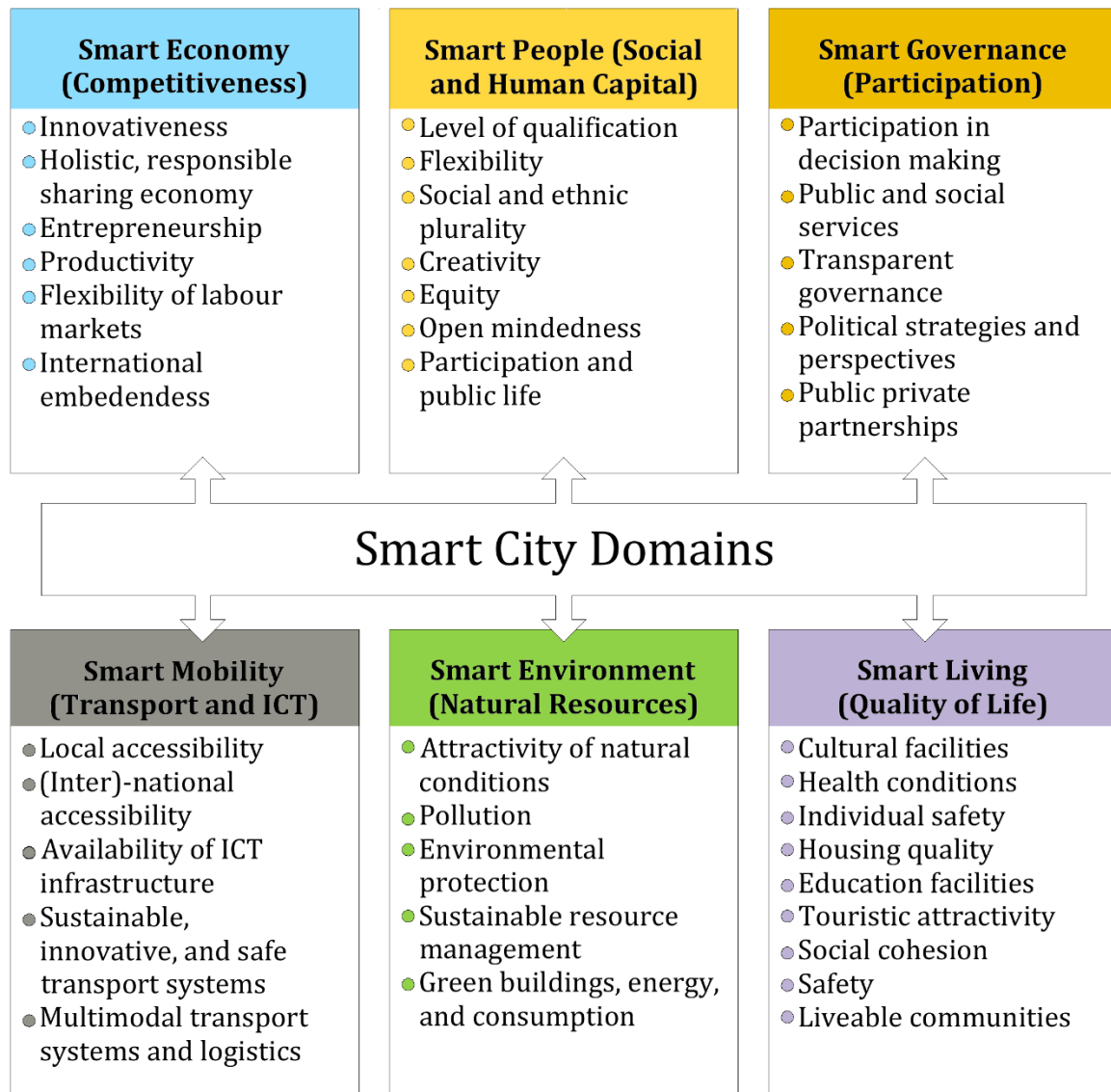
#### **3.2 Tackle possible gaps and boost sustainable transformation**

Within D3.1 (Espoo) and D4.1 (Leipzig), detailed plans for the smart city lighthouse demonstrations have been drafted. Comprehensive measures in the domains "positive energy blocks", "ICT", "e-mobility", "planning", "community engagement", "air quality" and "smart business development" have been developed aiming at the establishment of citizen-centred, carbon neutral economies. Taking these proposed actions as a baseline, the aim of T7.2. is to establish a set of future complementing actions in e.g., the energy domain, e-mobility, building upgrade, waste management, water treatment, and ICT/IoT, with a clear focus on the respective city demands. Therefore, the initial step was a



systematic analysis of the various proposed actions against the background of the most common smart city domains.

Within the vast array of literature on the smart city, different delineations of domains have been proposed, of which the six-dimensions model, put forward by Giffinger et al. (2007) is among the most used.



*Figure 1: Six Dimensions of the Smart City adapted from (Giffinger et al. 2007 & Staffans & Horelli, 2014)*

The model presented above provides a holistic view of the most important smart city domains. It was applied in Chapter three (Cities Characterisation) in order to, firstly, systematize the proposed lighthouse demonstrations and, secondly, provide a basis for the proposal of additional services, by laying bare the domains that are not yet covered to a sufficient degree.

### 3.3 Promote joint visions between businesses, public administration, and civil society

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The transformation of cities towards so-called smart cities has been an important part of the scientific discourse on the sustainable orientation of cities for several years. The underlying values of the smart city concept are mostly represented in the literature by the areas of sustainable urban development, economic growth and a better life for citizens (Castelnovo et al. 2016: 727). In the study and conception of smart city projects, a distinction is often made between different smart city dimensions such as ICT and Communication, Quality of Life, Infrastructure, etc., but the different city dimensions are rarely considered in terms of their interconnectivity (ibid.: 727). The perception of smart transformations that improve the living conditions of citizens often differs between different actors involved in smart city projects (van Waart et al. 2016: 713). At the same time, the mere transformation of a city system, e.g., in the field of ICT (internet and communication technology), cannot provide information about possible improvement potentials regarding the quality of life of citizens (Castelnovo et al. 2016: 725). The smart city governance approaches used in recent years, which often followed a top-down decision-making process, are therefore no longer up to date (ibid.: 731). Within the current scientific discourse on the design of smart cities, cooperative, holistic approaches are increasingly being formulated as solution concepts (cf. Castelnovo et al. 2016: 725).

For the economic and social success of smart city projects, the cooperation between different stakeholder levels (e.g. adoption of a multilevel governance perspective), and the implementation of joint visions are of decisive importance. The aim is to bring about (social) innovations in the exchange between actors from the local economy, science and urban society, which can also be made economically and socially useful beyond the project term (Castelnovo et al. 2016: 731). In this way, the population can directly address acute problem areas of a city and needs-oriented products and services can be conceived through a cooperative design process between actors from the local economy, science and public administration. The exchange with actors from the city's population or administration can provide local economic actors with food for thought on new topics or problem areas that were not adequately covered in the city's project (van Waart et al. 2016: 720). Thus, within the conception of joint visions within SPARCS, the exchange between the actor levels offers the possibility of developing new innovative products and services that were not initially envisaged in the project and which can also be made usable beyond the project scope due to their orientation towards the specific urban contexts of Leipzig and Espoo. Joint visions of the different stakeholder levels with regards to Smart City strategies are also decisive for efficient project planning, its design and for the economic success or failure of Smart City projects. It is important to translate joint visions conceived in consultation with the various stakeholder levels into clear strategic objectives, which must be oriented towards the availability of various resources in the city, such as human capital, technology or finances in order to guarantee the long-term success of the projects (Castelnovo 2016: 734). The advantage of a cooperative holistic planning approach is that the available resources (human capital, technology, financial resources) can be used as efficiently as possible due to the embedded administrative and citizen perspective (ibid.). This makes a cooperative planning approach crucial for the economically sustainable conception on the part of local enterprises as well as for the needs- and problem-oriented orientation and long-term usability of new, innovative products and services (Meijer et al. 2016: 653).



### **3.4 Diversify future business ecosystems**

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In its current composition and rollout structure, SPARCS already includes several established frontrunner companies. To add upon this and to establish a foundation for a healthy and diversified smart city business ecosystem, the inclusion of small and medium sized businesses as well as innovative Start-Ups is precisely the aim of T.7.2. As outlined by van Winden & van den Buuse (2017), many smart city projects struggle with the implementation of upscaling measures (e.g., roll-out, expansion and replication) due to projects fading out after the pilot phase, a lack of funding and the absence of knowledge transfer incentives. Especially start-ups and SMEs often lack the networks with relevant local actors such as the public sector and are not able to benefit from internal knowledge transfer, which is important for the success in local business environments. Therefore, it is necessary to discuss the inclusion of SMEs and upscaling activities at an early stage of the project implementation.

## 4 CITIES CHARACTERIZATION

This chapter connects summaries results from D1.1 City Characterization, D3.1. Espoo Action Plan and D4.1. Leipzig Action Plan gives an overview of the initial city diagnosis and planned Lighthouse activities in SPARCS, including the actions in the smart cities' domains of energy, mobility, ICT, and Governance.

### 4.1 Espoo

Within Espoo's efforts to co-create the smart city transformation, its stable economy stands out. Home to Aalto University, the VTT research institution and innovation companies such as Nokia and Rovio Entertainment, the industry has been the main reason for continued responsible innovation (Espoo's Fairtrade City status award, 2009). Espoo has concrete energy goals defined in the Espoo's Sustainable Energy Action Plan (SEAP) and Sustainable Energy and Climate Action Plan (SECAP), through conducting projects that already show the city's commitment to these goals, such as "The Espoo Clean Heat" project, aiming to create a carbon-neutral district heating. Espoo mostly indicates opportunities for improvement in the field of mobility (City of Espoo). Enhancing the public transport system's connectivity, promoting active mobility as a mode of transport, and incentivizing intramodality and sharing systems would highly contribute to mitigating its current challenges. Since the release of Espoo's Climate Action Programme (CAP) from the period 2016-2020, the city's carbon neutrality objective has been brought forward from 2050 to 2030, indicating the commitment the city has made to innovation and existing as a forerunner in the smart city community. The CAP focuses on public transit, cycling, improving housing to reduce cost and emissions, renewable energy sources, land-use planning, and internal city reduction in climate impact (City of Espoo, 2016).

### Energy

Espoo plans to be carbon-neutral by 2030 and is working to develop its district heating system responsible for almost half of the city's emissions as well as scaling up the use of renewables and waste heat. Other measures are the implementation of a new energy production plant, a biofuel heating plant, the development of the photovoltaic market by adding solar PV solutions for visibility, the Otaniemi geothermal plant pilot project, and utilization of waste heat (City of Espoo, 2020). According to the SECAP, reducing GHG emissions focuses on electricity, heating, and transportation emissions. Developing the carbon-neutral district heating system happens in cooperation with energy company Fortum.

Following Espoo's Sustainable Energy Action Plan (SEAP), energy efficiency will be enhanced in new construction and existing buildings, and educational advisory services for property owners will promote further reductions in energy consumption. Local businesses are encouraged to join energy efficiency agreements and the Energy Efficiency Agreement for Municipalities (KETS) is in place, which will last until 2025. The KETS includes guidelines for construction, land-use planning/zoning, energy consumption consumer advice, lighting, municipality owned vehicles, new business models, recycling of old construction materials in new buildings, cooperation with media for consumer education and training for municipal employees.





Espoo demonstration Solutions for Positive Energy Blocks and related demonstration actions follow a comprehensive approach to energy systems. Electricity, heat, cooling, clean fuels, energy flexibility, and storage capacity are controlled by smart solutions that minimize emissions and costs while ensuring reliability and local ownership. Two of the demo sites, Sello and Lippulaiva, comprise a shopping centre, residential buildings, libraries and other public services, accessible by rail and bus through terminals with improved e-mobility, cycling, and pedestrian options. The Kera replication site will be a new residential district, is currently under planning and due to be developed in the next 10-15 years. On all sites, promoting sustainable lifestyles is as important as adopting new technology. In Lippulaiva, Energy Actions focus on integration of Renewable Energy Sources (RES), increasing its impact through storage and load balance by the Virtual Power Plant. In Leppävaara, actions are aiming at smart energy solutions for self-sufficiency through predictive modelling and integration with the virtual power plant, EV charging and local district heating grid.

## **Mobility**

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Espoo's cold weather and extensive urban sprawl pose a unique set of challenges to overcome. The city's mobility goals look at the reduction of private transport emissions and increase of emission-free traffic by densifying urban areas, increasing the share of electric cars and buses, streamlining and increasing public transit use, developing mobility as a service concept, and providing the infrastructure for a transition to active mobility (City of Espoo, 2019). The city develops the widespread availability of biogas-, biodiesel- and electric charging, whilst establishing public-private partnerships to ensure continuation. To increase the modal split of cycling, Espoo plans to establish a cycling culture and focus on young people to bring up the next generation of bike-centred individuals. Main action points are improvement of the route network and connection of highly frequented zones and public transport nodes, also considering bike parking (City of Espoo, 2016).

Mobility hubs play an important role in the objective towards a more sustainable mobility network as they combine public transportation with active and e-mobility solutions and produce feasible solutions for replication elsewhere. Developments and plans in the Espoonlahti district, focused on Lippulaiva block, and Leppävaara district, with focus on Sello block, as well as Kera district show this commitment through EV-charging grid integration, E-mobility hub construction and Last-mile innovation concepts. The requirements, demands, and possibilities of e-mobility solutions are mapped and assessed, and their future applications for replication are examined.

## **Information & Communication Technologies**

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The trend towards greater digitalisation of the energy network has been enabled by advances in data, analytics and connectivity. Digitalisation can greatly increase the lifetime, efficiency and utilization of energy infrastructure and reduce costs. Connectivity in Espoo helps to connect different energy sectors, so that consumers and producers in any sector can actively participate across energy system operations, increasing the flexibility of the system to cope with imbalance of supply and demand. It reduces the cost of integrating new technologies like distributed generation, energy storages and electric

vehicles. Because of the transition from centralized electricity generation and distribution towards a mix of decentralized and renewable energy production in small facilities, connectivity plays a key role in ensuring a functioning energy infrastructure. This transition combined with electrification of transport and heat creates new challenges which can partly be mitigated by Virtual Power Plants (VPP). Such a VPP is developed in Sello, combining purchased electricity from Nordpool and locally produced electricity from PVs (750 kWh). Sello's power system includes microgrid functionality with integrated electrical equipment, mostly HVAC and stationary energy storage.

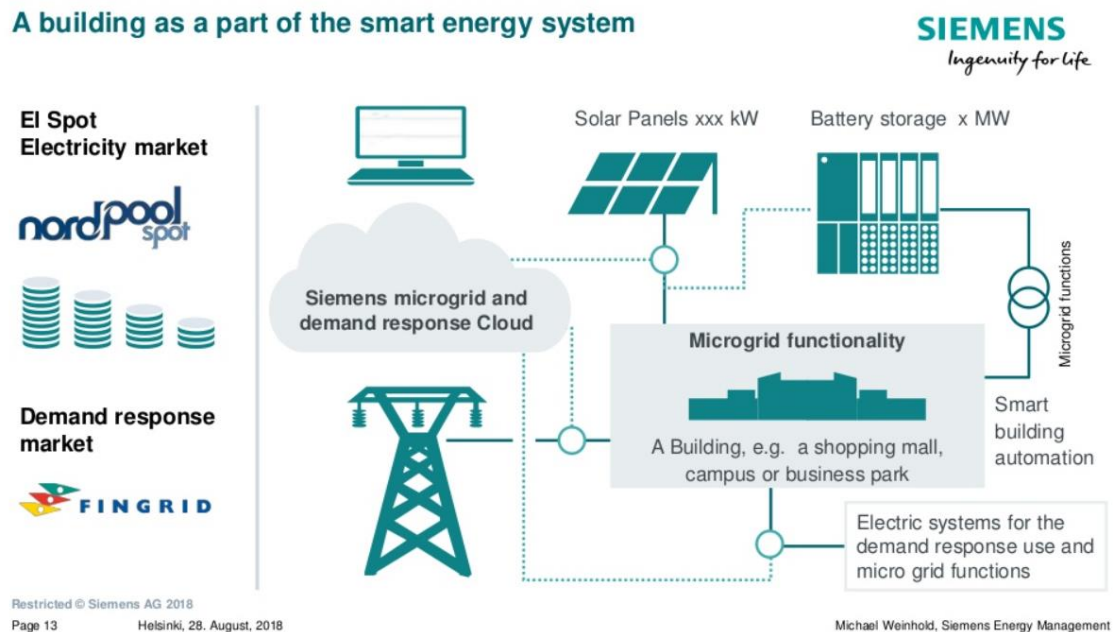


Figure 2: Sello's smart energy system (Siemens; D3.1 Action Plan Espoo, 2020)

Modern energy services can also be provided more efficiently, flexibly, and reliably if they use other ICT technologies such as 5G, Blockchain and IoT. These technologies enable control of a high number of new appliances and present new opportunities for optimized energy performance and innovation. For instance, in Kera and Espoo a project aims to develop autonomous transportation through 5G technologies (including SPARCS collaboration with the following projects in Espoo: LuxTurrim5G+ / Neutral Host Pilot -project; Six Cities: Low-carbon transport in mobility hubs -project).

Planning for a Digital Twin is ongoing and would facilitate using real-time monitoring, strategic decision making and provide new opportunities for citizen engagement. Integration of energy & mobility management would be a next step to be explored.

## Governance & Citizen Engagement

Regarding governance and citizen engagement, Espoo has defined an extensive set of objectives and measures, which sets a concrete plan in place with lofty ambitions it intends to pursue. These objectives and measures regard safety, growth, and cultural diversity and addresses challenges in an aging population and projected slow economic growth. Drawing on its strong position as the most sustainable city in Europe, the Espoo





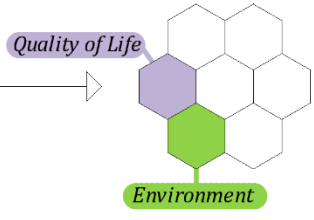
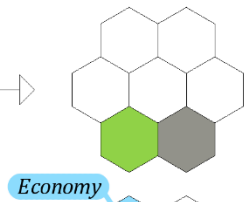
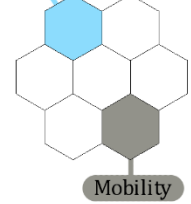

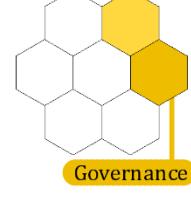
Story discusses plans for densification enabled by transit-oriented development and reinforcement of the existing five-city centres. Besides, there is a strong focus on access to urban services and the City as a Service model to fulfil citizens' basic needs and increase life quality through cultural and sporting events. The City plans to attract enterprises and innovation and maintain an open, participatory city administration based on trust and collaboration. As per the document, key objectives during the period include increased public participation, building upon the dynamic culture and economy, sustainability, and citizen health (City of Espoo, 2017b). One concrete example of that is the co-creation for positive energy behaviour in Espoo. The defined actions will provide user insight input for experimentation and piloting in Leppävaara and Espoonlahti districts and Lippulaiva and Kera's actions. It seeks to inform local citizens of construction progress, engaging in the design processes to and long-term commitment of youngsters with the Lippulaiva Buddy class initiative. That could also be connected to the additional service idea that students teach planners visual communication (City of Espoo, 2019).

Throughout literature covering Espoo's efforts as a smart city, co-creation and collaboration (both within and outside of city administration) stand as common themes. The city produced a "Make With Espoo" set of tools from the national 6Aika projects. The development program A Participatory Espoo, established knowledge-sharing platforms and contacts throughout Finland related to best practices of SCC1 projects. As part of this, Espoo openly distributes a 3D city model under a creative commons license to encourage citizens to participate in the urban planning process (Julin et al., 2018). Another example of a successful pilot project, Haukilahti Upper Secondary School, began utilizing Aalto University Campus facilities in 2015 to replace their own undergoing renovation. The experiment resulted in improvements in education quality due to student involvement in planning and the interchange of ideas between university professors and teachers, and students of the School and the university (City of Espoo, 2017). This project also merges into another called sustainable lifestyle. It includes close collaboration with local schools and introducing a buddy-class. The goal is to include sustainability in schools and kindergartens curricula, as children are more susceptible and can educate their parents and this could be extended with more ideas coming from additional services regarding sustainable lifestyle in Espoo.

## **Espoo's smart city domains**

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Systematisation following the introduced smart city domains of Espoo's activities in SPARCS results in the following figure. It discloses an emphasis on the Smart Environment as well as the Smart Mobility domain. It furthermore shows that the domains of Smart Economy and Smart Community are currently underrepresented and therefore offer an entry point for the establishment of future actions that go beyond the ones envisioned in SPARCS. Well-covered domains such as mobility and environment also offer entry points for additional services that can be linked to future business models whilst encouraging participatory approaches and the inclusion of citizens' perspectives wherever possible.

<i>SPARCS domain</i>	<i>Proposed actions</i>	<i>Covered Smart City domains</i>
<b>Positive Energy Blocks</b>	<ul style="list-style-type: none"> <li>○ RES integration and Energy Positive Blocks</li> <li>○ Smart Energy Solutions for self-solutions</li> <li>○ City planning for Positive Energy Blocks</li> <li>○ City scale smart heating and thermal demand response</li> </ul>	
<b>ICT &amp; Interoperability</b>	<ul style="list-style-type: none"> <li>○ Virtual Power Plant for optimized RES energy use</li> <li>○ Smart energy services</li> <li>○ Smart building energy management</li> </ul>	
<b>E-mobility Integration</b>	<ul style="list-style-type: none"> <li>○ Boosting e-mobility uptake Espoonlahti district, Lippulaiva Blocks</li> <li>○ New e-mobility hub in Leppävaara</li> <li>○ E-mobility solutions replication and uptake in Kera</li> <li>○ E-mobility urban planning requirements</li> </ul>	
<b>Planning of Positive Energy Districts in Espoo</b>	<ul style="list-style-type: none"> <li>○ Planning of Positive Energy Districts in Espoo</li> </ul>	
<b>Community Engagement in Espoo</b>	<ul style="list-style-type: none"> <li>○ People flow and daily journey</li> <li>○ Co-creation for energy positive behaviour</li> <li>○ Sustainable lifestyles</li> </ul>	

*Figure 3: Systematization of Espoo's lighthouse demonstrations (D3.1) according to the Smart City Metrics*



## 4.2 Leipzig

Leipzig is one of the fastest-growing cities in Germany in terms of population and economic development and has stated ambitious goals in converting fossil-fuelled energy systems to renewable energy sources. These targets are driven forward primarily by the Energy and Climate protection program (2014-2020). Besides, the Mobility Strategy 2030 aims at a behavioural switch in the population towards sustainable transport. By declaring a climate crisis in 2019 and thereby committing itself to combat global warming, all of Leipzig's municipal decisions must prioritize climate protection and the protection of the population from the consequences of climate change. The City of Leipzig is pursuing climate neutrality by 2050 at the latest, aiming to lower CO<sub>2</sub> emissions by 10% per year to a sustainable level of 2,5t CO<sub>2</sub> per capita (Leipziger Internet Zeitung, 2019). The City of Leipzig sets concrete goals for energy efficiency, use of renewable energies and energy conservation, controlled through yearly audits (Stadt Leipzig, 2014; Stadt Leipzig, 2020).

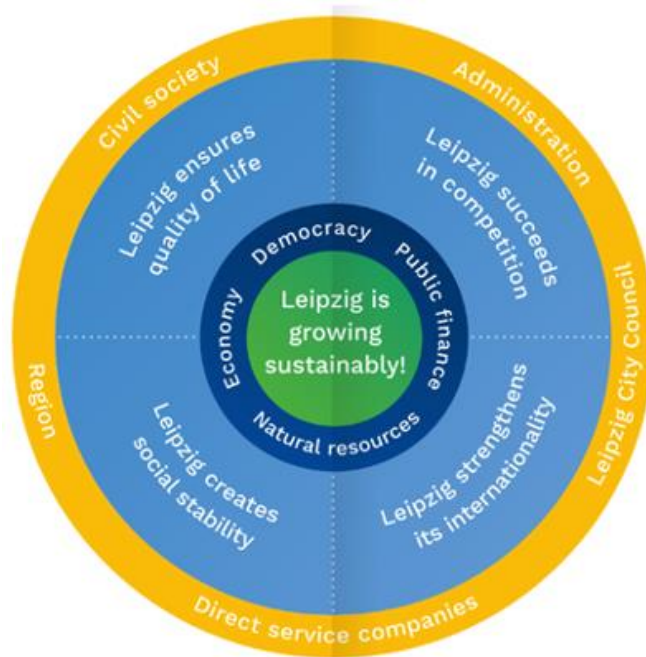


Figure 4: Strategic goals and action fields of Leipzig's integrated city strategy (Stadt Leipzig, 2018)

## Energy

In Germany, there is currently no statutory climate protection target for municipalities, but Leipzig nonetheless chose to set climate targets and goals and thus created a climate protection plan (Stadt Leipzig). After introducing several energy and energy quality standards, the integrated Energy and Climate Protection Plan 2014-2020 (EKSP) was created (City of Leipzig, 2020). Most relevant areas for the energy sector are hereby the climate-friendly communal buildings, environmentally responsible energy use and generation, and the climate protection in the mobility sector.

Leipziger Stadtwerke (LSW) supplies the city with energy. LSW is a multi-utility company and, with its subsidiary Netz Leipzig GmbH, provides a range of services surrounding the generation, transmission, and distribution of gas, electricity, and district heating (City of

Leipzig). To replace fossil fuels, especially coal, heating oil, and night storage heaters, LSW aims to transition to energy generation from a mix of innovative, renewable, and conventional energies (Leipziger, 2019). The goal is to phase-out coal-fired district heating by 2023, which will enable the City of Leipzig to become a role model and provide valuable lessons to other cities and regions depending on coal (Stadt Leipzig 2014). Making use of the city's growth, LSW aims to fit this transition within future demands on a social, environmental, and economic scale (Büttner & Rink, 2019). Furthermore, several companies operating as critical players in the energy sector are located in Leipzig, such as natural gas giant VNG, the biofuel producer Verbio AG, the EEX European Energy Exchange, and the service provider Energy2market, focusing on electricity trading. These companies, along with other SMEs in the energy field, strengthen Leipzig's position to become a pioneering city in the energy transition (Energiemetropole Leipzig).

Concrete examples in Leipzig are the demo sites of Leipzig West, Duncker Neighbourhood, City Centre, and Baumwollspinnerei. The city of Leipzig aims to generate environmentally friendly solar thermal heat in the different demo sites and is testing different options. To increase the share of RES in the central district heating system, focussing on the planning, construction, and integration of a solar thermal plant in the central district heating system. Additionally, Power 2 Heat and heat storage is integrated in the existing district heating network, allowing for more efficient control of the district-heating network. The potential of waste heat within the city boundaries for integration in the central district heating system will be assessed, mostly focussing on accessible inner-city sources, such as data centres, sewers and process heat.

On the Baumwollspinnerei site, projects look at optimal energy distribution through a Virtual Power Plant for intelligent energy balancing of different sources (PV's, Combined Heat & Power plant). Energy storage is approached with bulk batteries and bidirectional charging of electric vehicles, putting in place vehicle-to-grid infrastructure. These actions go hand in hand with Human-centric application such as personalized informative billing and smart meters including air quality data.

## Mobility

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Mobility is one of the main contributors to greenhouse gas emissions in Leipzig, with over 20% of the transportation sector's emissions (Stadt Leipzig). In general, Leipzig is a car-dominated city and views the transformation in urban mobility as an important instrument for developing and preparing the city for the future. The replacement of conventional cars with electric vehicles is not enough to fulfil future transportation needs. Leipzig looks to generate mobility concepts which integrate a variety of electric and active transportation, such as e-car sharing, (e-)bikes, e-scooters, electrified public transport and e-boats. The "Leipzig Stadt der intelligenten Mobilität" plan sets out how the traffic system shall be functional, socially equitable, environmentally friendly, and account for pedestrians, bicycles, motorized vehicles, and public transport (Stadt Leipzig, 2020d). Partnering with BMW and Porsche on electrical vehicles and other cooperation partners such as Leipziger Verkehrsbetriebe, the city pushes this transition and additionally sets financial incentives for initiatives increasing the share of e-mobility. The City of Leipzig also supports economic feasibility measures and encourages industrial partners' involvement to increase external financing of e-mobility projects (Stadt Leipzig, 2017).



The Leipziger Verkehrsbetriebe (LVB) is phasing out diesel powered buses, replacing them by electric busses. Most of the other actions focus on E-mobility integration into the energy grid and implementing the necessary charging infrastructure. Through intelligent charge management and energy demand forecasting, electric vehicles can ensure micro-grid stabilisation through bi-directional charging.

## Information and Communication Technologies

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The EU project Triangulum in Leipzig initiated smart city innovations in energy, mobility, and IT infrastructure. In this light the "Digital City Unit" was founded in 2019 to face the digitalization challenges of the city. It deals with the development and implementation of innovation projects and acting as a competence centre for digitalization. Working closely together with other departments, utility companies, research institutions, private enterprises and citizens it initiates projects such as establishing the Urban Data Platform. This platform will combine urban data from different partners: the municipality and its utilities. One of the pillars for this and other projects is the expansion of public WLAN and the 5G network (Stadt Leipzig, 2019a).

Building upon this, the City of Leipzig developed an open data platform to enable experts and developers to develop publicly available applications, based on free, open data ([opendata.leipzig.de](https://opendata.leipzig.de), Stadt Leipzig). In total, the data platform provides 710 data records in seven groups: 'building and living,' 'population and society,' 'citizen service and administration, leisure,' 'culture and tourism,' 'youth, family and social issues,' 'environment and transport' and 'economy and science' (Stadt Leipzig). ICT solutions in SPARCS comprise focus mostly on Energy storage, balancing and demand response. In Leipzig West, SPARCS partners develop human-centric interfaces to control individual energy consumption, so that users receive direct feedback on energy consumption and can evaluate their energy behaviour profile. Besides, Utility companies are looking at how blockchain supported services can be integrate in Peer 2 Peer marketplaces.

## Governance and citizen engagement

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The City of Leipzig strives to implement smart, forward-looking concepts for and with the community. The City of Leipzig deems it crucial to create and facilitate residents' opportunity to be actively involved in shaping their city. Furthermore, the City of Leipzig aims to enable direct service companies to deliver public services at a high quality while maintaining fair and reasonable prices. The city council and local administration must align their actions to strategic goals and current and future requirements (Stadt Leipzig 2018a). Intensification and continuation of residents' participation in Smart City developments and promoting co-creation processes (e.g., workshops and open discussions, citizen science, further development of neighbourhood management) is taking place.

## Leipzig's smart city domains

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Systematisation following the introduced smart city domains of Leipzig's activities in SPARCS, results in the following figure. Similar to Espoo it shows an emphasis on the Smart Environment as well as the Smart Mobility domain. The domains of Smart Economy and Smart Community are underrepresented and offer a first entry point for additional or



complementary services that go beyond the ones envisioned in SPARCS and can enhance impact of the SPARCS actions. The Mobility and Environment dimensions should have a focus on building upon planned activities and offer entry points for additional services that can be linked to future business models whilst encouraging participatory approaches and the inclusion of citizens' perspectives wherever possible.

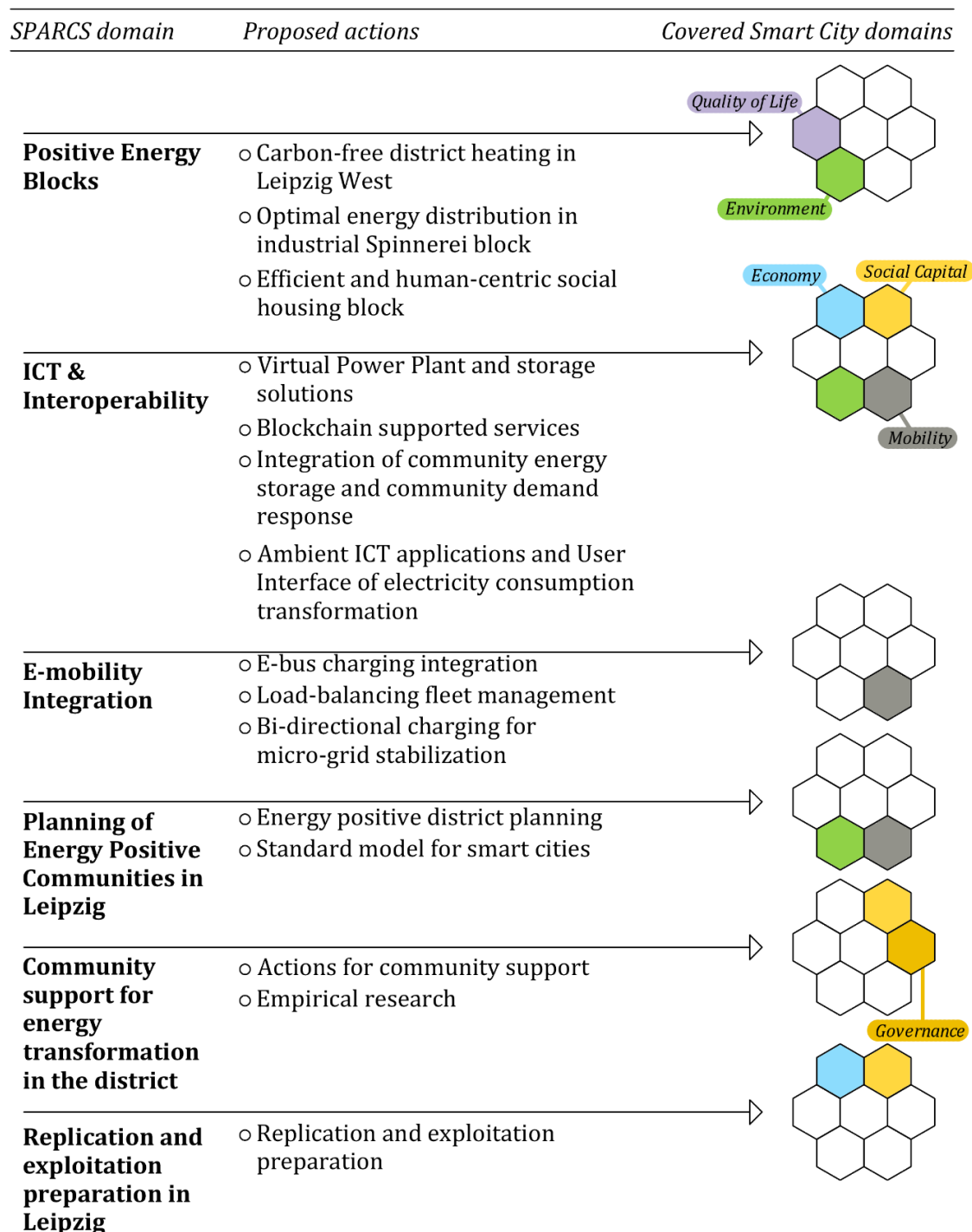


Figure 5: Systematization of Leipzig's lighthouse demonstrations (D4.1) according to the Smart City Metrics



## 5 TOWARDS A HOLISTIC SMART CITY SERVICES ROADMAP FOR IMPACT ENHANCEMENT

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This deliverable is the result of multiple steps of co-creation with local partners from the Lighthouse Cities, synthesis and desk-study within and by the SPARCS consortium. This chapter aims to describe this process step-by-step, giving credit to all partners involved in the task and deliverable. The roadmap has been produced through successive desk research, creative feedback rounds, co-creation workshops, and a concluding synthesis.

### 5.1 Initial conceptualization

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Based upon the D1.1 City Characterization report, D3.1 Espoo Implementation plan, and D4.1 Leipzig Implementation plan, Fraunhofer produced an initial list of potential/possible services, suitable to complement SPARCS actions, as planned in the implementation plans.

Grouped in the topics of Energy, Mobility, Information and Communication Technologies and Governance, these services were drafted in slides, including relevant primary information to understand the services, such as a general description and stakeholders involved. It was also highlighted to what initial SPARCS Actions in the Lighthouse cities;

these additional services were connected or could complement.

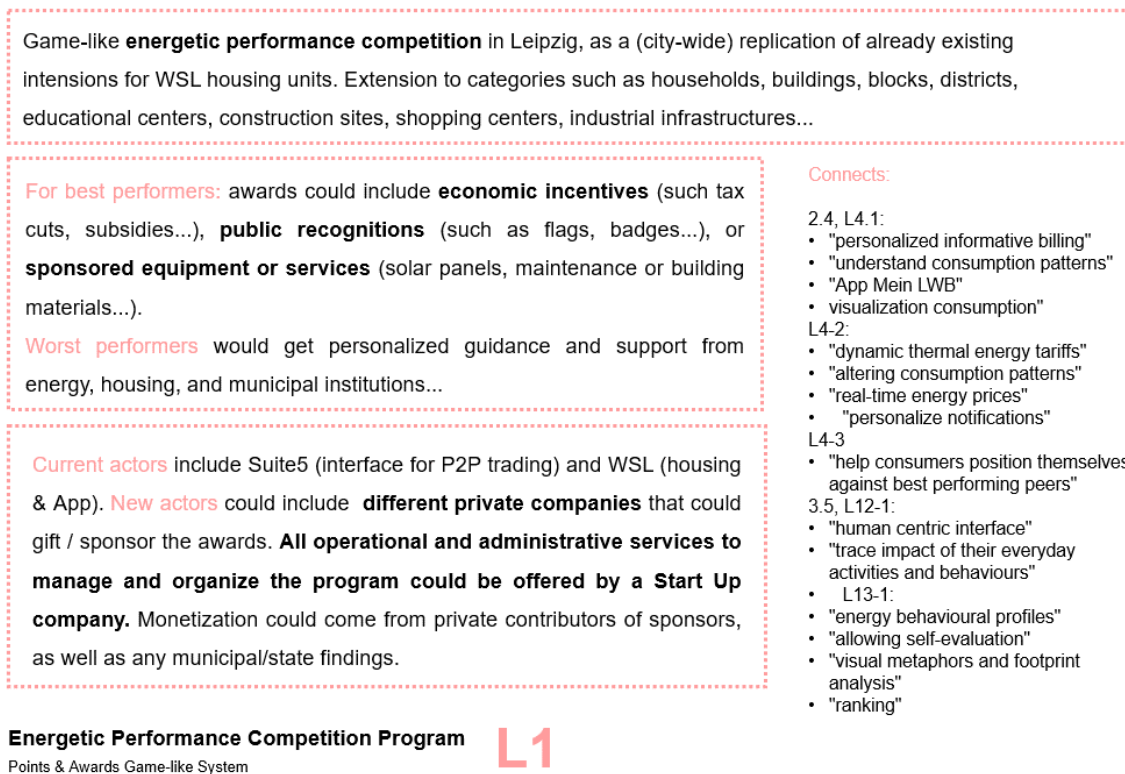


Figure 6: Initial service conceptualization (example)

These first ideas were introduced during a meeting to several technical partners from the SPARCS consortium: CIVIESCO, CVUT, VTT, SUITE5, BABLE and NEW, who provided feedback. Subsequently, they were given two weeks to develop their own additional ideas based on their work within the SPARCS project and experiences in other projects. These were collected and integrated into the slide deck of additional smart city services mentioned above.

## 5.2 Espoo and Leipzig Co-Creation Workshops

Through separate co-creation workshops with the Espoo and Leipzig consortia, the initial ideas were reviewed, improved, and new ideas were developed. The workshop outlines were prepared on the online Whiteboard Tool "MIRO" and Microsoft TEAMS was used for the discussions, and virtual meetings. Sessions in smaller groups were organized through 'breakout rooms'. Fraunhofer IAO moderated the workshops, providing both guidance through the day, keeping notes and reporting discussions relevant for concluding results.

The first workshop organized was with the local consortium in Espoo and held on the 18<sup>th</sup> of January 2021. It was attended by representatives from the City of Espoo, VTT, CityCon, RIL, KONE, and Siemens. The second workshop with the local Leipzig Consortium took place on the 28<sup>th</sup> of January. Attendees were the representatives from the City of Leipzig, Leipziger Stadtwerke, Fraunhofer IMW, Leipzig University, WSL, SEECON, and CENERO.





Both workshops had a length of approximately 4 hours, split up by a 15-minute break. All participants were sent an agenda in advance. In these workshops the central question was: What are additional, complimentary services and necessary surrounding frameworks for the Lighthouse City planned SPARCS-actions to function better?

An initial video shown as ‘brain opener’ (a short explanation of the internet’s possibilities in the 1980’s) invited the participants to be as creative as possible, be open to the idea of additional services when thinking about the implementation of the planned actions within the project. The reviewed set of additional services previously elaborated (3.1 and 3.2) was shortly presented, and participants were given time to comment on the proposed services individually. Feedback referred to duplications with other city’s activities; activities that could be built upon whether or not services had potential in the city and/or to other ideas that could be derived from the initial set.

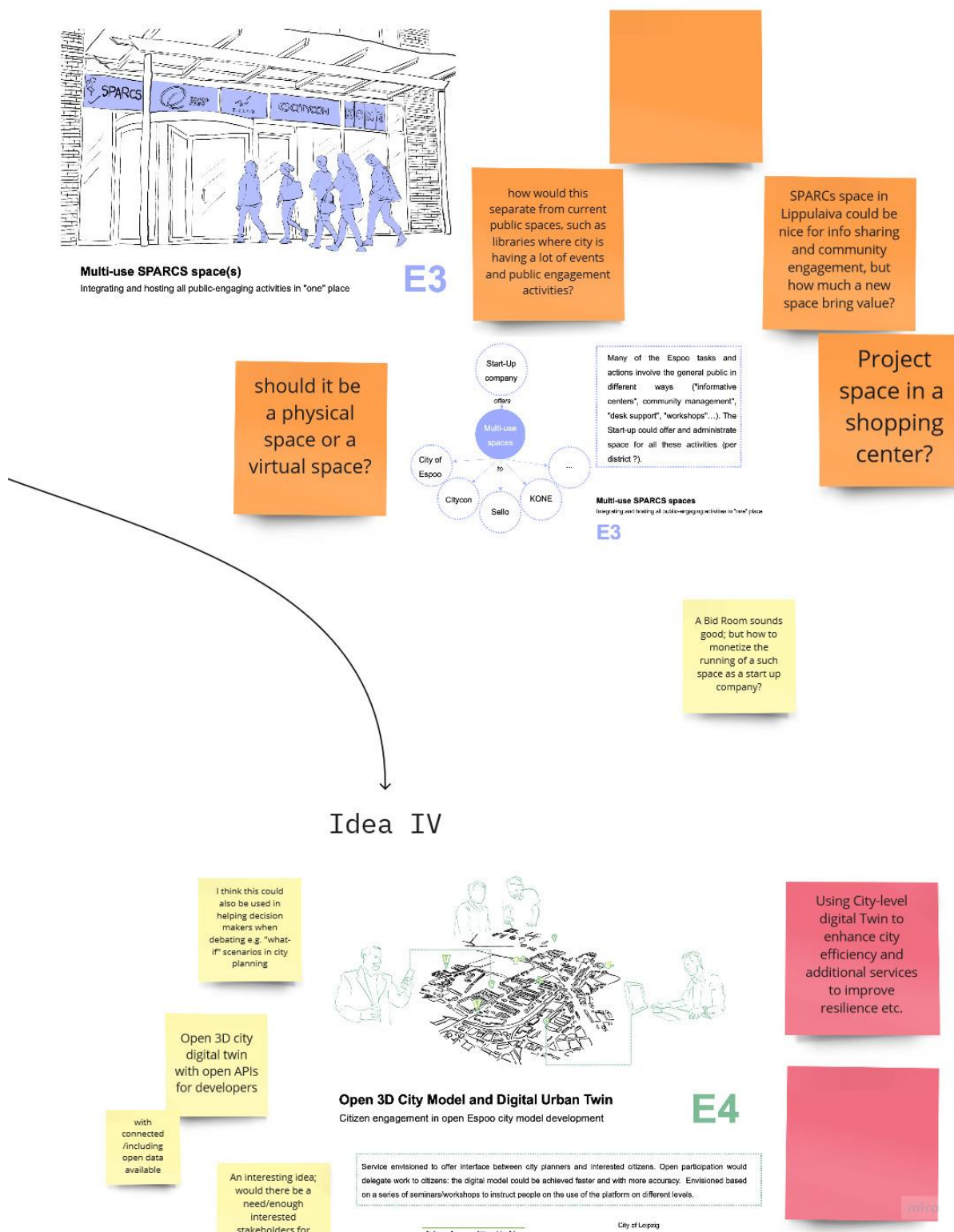


Figure 7: An extract from the Espoo workshop- feedback on initial ideas



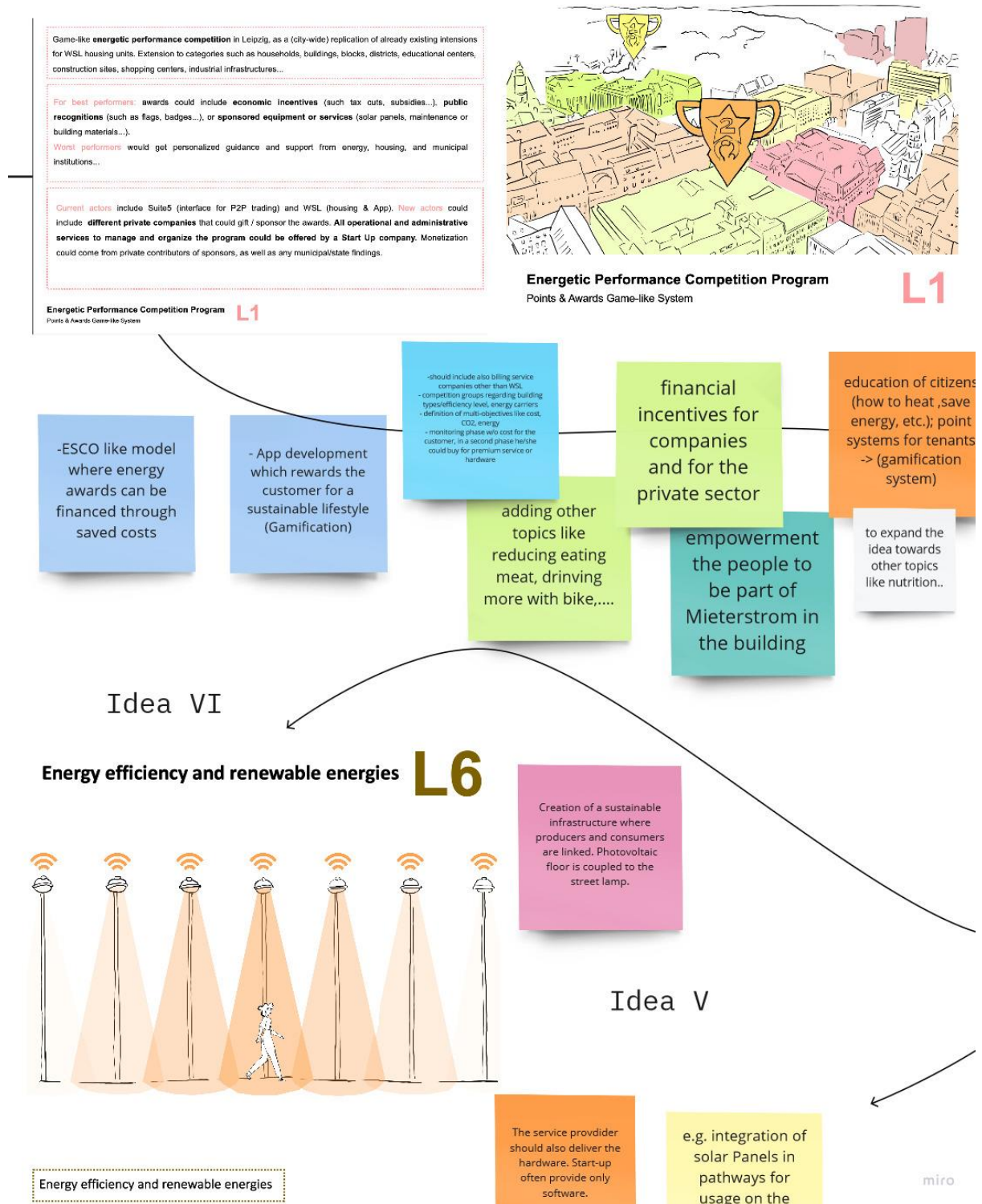
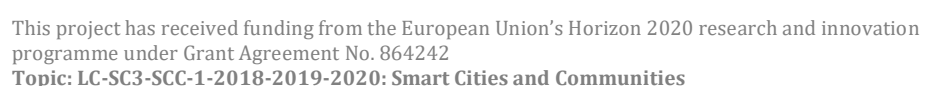


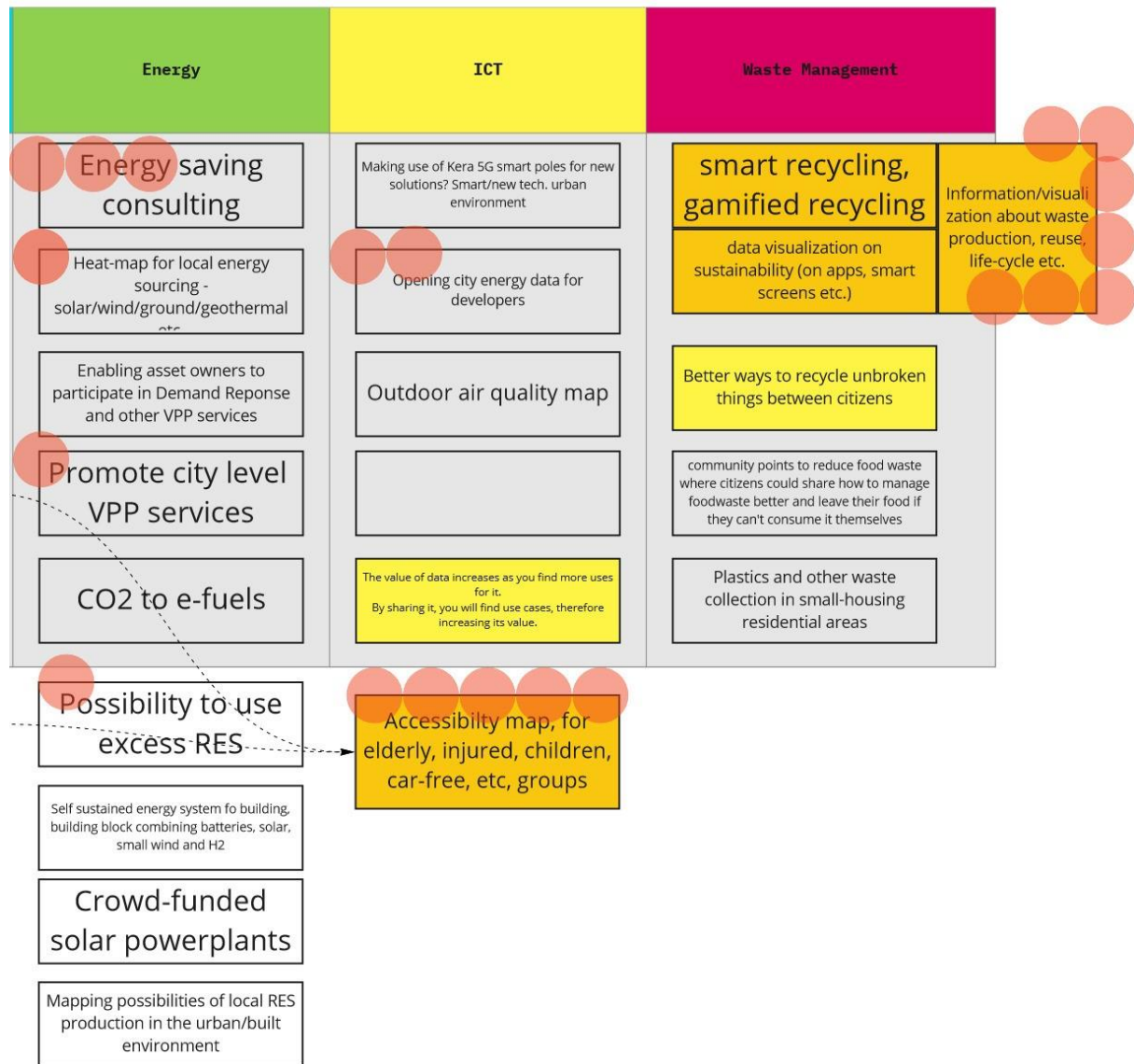
Figure 8: An extract from the Leipzig workshop- feedback on initial ideas



After 20 to 30 minutes, participants were divided into smaller groups to discuss the proposed services and the feedback provided. The MIRO board was prepared for multiple ideas in different sectors (Governance, mobility, Citizen Engagement & Environmental Awareness, Energy, ICT, and Waste Management). This also resulted in additional information, steps and possibilities. After a short break, the participants were given time individually to brainstorm on new ideas. These new services were discussed in small groups, leading to connections between them, new ideas and their revision. A voting process highlighted the most promising new services as shown in the graphics below.







miro

Figure 10: An extract from the Espoo workshop- Voting and Idea initialisation

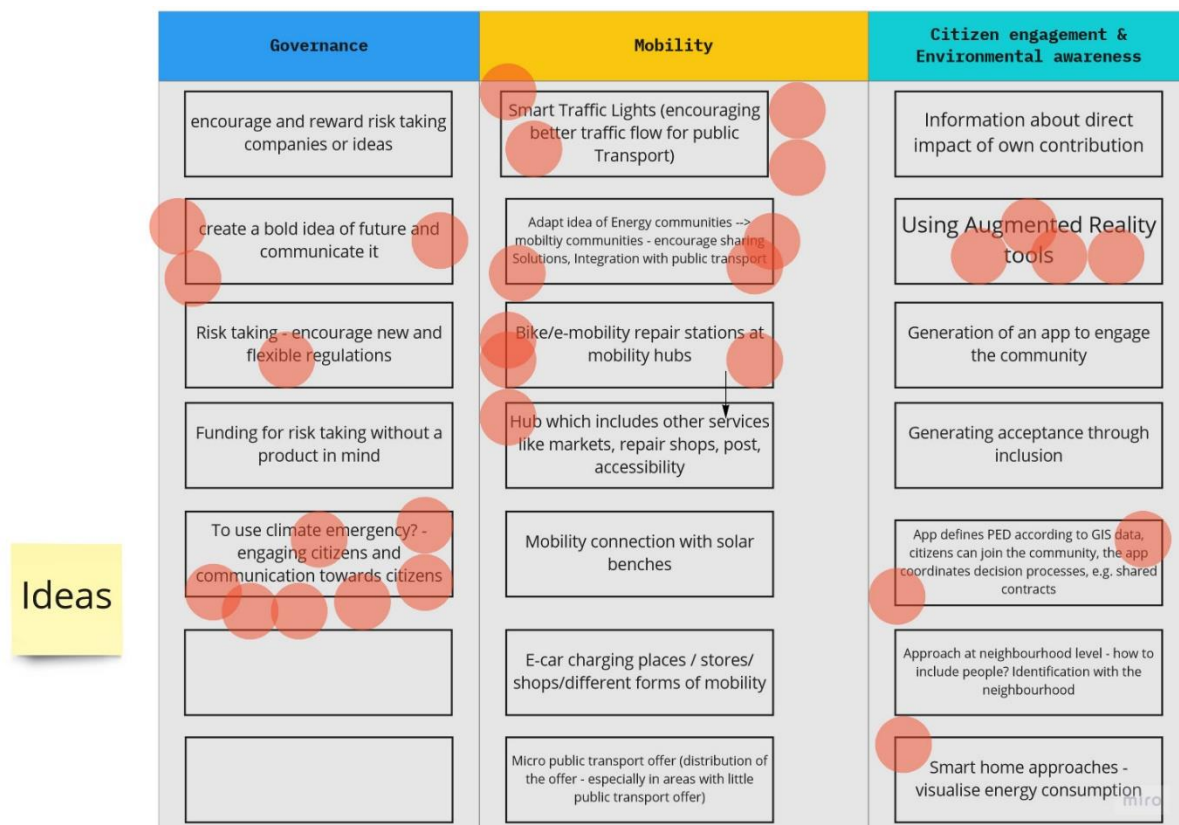


Figure 11: Leipzig workshop- Idea initialisation

In groups of six or seven participants, the ideas highlighted from the voting process were developed further, looking at different aspects: Description, components, Stakeholders and funding/business models. It was noted that when ideas were more concrete, it was easier to work out further factors mentioned before. Notes were made directly on the MIRO board but participants had the opportunity to keep adding their ideas and further details after the workshops.

### 5.3 Synthesis

T7.2. set out by demonstrating the value of additional services within the SPARCS project by firstly outlining possible gaps in the sustainability transformation through a cross-comparison of the SPARCS lighthouse actions with the six dimensions of the smart city (Chapter 2.1). Building up on further analysis of the proposed lighthouse actions, additional measures have been put forward (Chapter 2.2), the need for establishing joint visions between businesses, public administration, and civil society have been outlined (Chapter 2.3) and the case for a diversified business ecosystem, especially with regards to SMEs and start-ups was made. Hailing from the more general classification for successful smart city implementation schemes, chapter 3 provides in-depth insights into the city characterisations of Espoo and Leipzig. The following chapters present the results of the idea conceptualisation rounds & workshops with Lighthouse cities. First a general overview of additional and complementary smart city services is given, followed by a more specified and city tailored overview of services.



## 6 ADDITIONAL AND COMPLEMENTARY SMART CITY SERVICES

This chapter proposes a list of ideas for additional and complementary smart city services in the urban energy context to enhance and increase the impact of SPARCS activities. These services are based on the analysis of the tasks and actions for the city lighthouse demonstrations in contrast with current Smart City discourses, and on the city characterization of the cities of Espoo and Leipzig from D1.1, D3.1. and D4.1. The additional services were developed within the earlier presented framework of Smart City Domains (chapter 3).

The ideas as presented below are structured so that cities see on what initial SPARCS activities they build upon, what general impact they have, what directions these services can be developed in and what financing models or revenue models could be used for sustainable growth. Further details on the specificities that each of these ideas will gain in each setting will need to be defined by the entity offering the service. This general list mainly works to outline overall lines of action and support joint visions between local administrations, businesses, and the civic society around common issues.

One of the goals within WP7 is to address the needs for business diversification, and to enhance the options for small, and medium sized enterprises (SMEs) to establish themselves within the business ecosystem. The services presented in the following and the SPARCS/Smart city network provide a framework in which SMEs can navigate to address urban challenges and cooperate with bigger organisations/utility companies in the urban ecosystem. Connection and support from these companies, such as the Public Transport companies and Distribution System Operators are essential for obtaining a measurable impact.

SPARCS currently engages many frontrunner companies in its composition and deployment structure. T.7.2's mission is to build upon this by setting the foundations for a sustainable and diverse smart city business ecosystem through the incorporation of small and medium-sized companies and creative start-ups. Especially start-ups often lack the networks and cannot benefit from internal knowledge transfer, which is important for local business environments' success.

The structure of the following paragraphs follows a brief description of a problem statement followed by a list of Start-Up competition Ideas that address the respective problem field.

### 6.1. The analysis of user participation willingness in VPP, energy markets, and energy decentralization:

- **This analysis is to be based on the development of bidirectional e-charging system allowing for parked vehicles to be used as additional storage capacity (L1-1, Chap. 4.4, D4.1), and relies on a comprehensive empirical research program on psycho-social factors for participation (L21-4, Chap. 5.2.3, D4.1), and on replication and exploitation preparations in the City of Leipzig.**

- **This analysis is to be based on enabling the use of car batteries as energy reserves (E12-2, Chap. 4.3, D3.1), on developing dynamic pricing models for electric vehicle charging (E7-2, Chap. 5.3, D3.1), on future predictions for expected numbers of electric vehicles (E18-1, Chap. 5.5, D3.1), on defining and validating solutions to encourage peoples' mobility behaviour changes (E3-2, Chap. 7.2, D3.1), and on identifying solutions to engage and encourage energy positive behaviours in Espoo (Chap. 7.3).**

Based on the assumption that Virtual Power Plants, energy markets, and overall energy decentralization processes are likely to require private batteries (e.g., e-cars or photovoltaic battery energy storage systems) to function in an integrated manner, the following concerns emerge:

The population's willingness to participate in such initiatives including EV battery sharing (Vehicle-to-grid, V2G) is not yet clear. Research on socio-psychological factors for citizen engagement has already been conducted in targeted districts by ULEI in Leipzig, and by KONE in Espoo. This study would benefit from a citywide research for replication purposes, for instance through a specific section focused on willingness to participate in energy decentralization.

Popular awareness of the positive (e.g., tax or other economic or ideological incentives) and negative implications (e.g., shorter lifecycle of EV batteries, readiness of the EV batteries for driving at any time) of these initiatives is yet to be investigated. The analysis of user participation is set to a) inform future strategic information campaigns with sensible language, and b) strategic technical solutions necessary to encourage citizen participation.

With regards to the prevalence of a lack of legal/political grounds or support for this kind of incentives it also would be necessary to revise current regulations to allow such energy markets to be possible.

The following ideas for start-up competitions are suggested:

- 1. Start Up Idea 1:** Researching the willingness of citizens to participate and play an active role in energy decentralization.
- 2. Start Up Idea 2:** An Information / sensibilization campaign (based on idea 1) to both instruct citizens about limitations and promote citizen engagement.
- 3. Start Up Idea 3:** based on input from Idea 1, a company that aggregates offers, products, corporate agreements, or sponsoring from promoters, providers, and general commerce into packaged deals for a sustainable city transition would be beneficial, which could entail: incentives for sharing private battery systems or decreased costs in vehicle purchasing if the owner agrees to use V2G charging for microgrid stabilisation, through e.g., "energy credits" or tokens exchangeable for goods or products; differentiation of parking prices, etc...

#### **a) Funding:**

Ideas 1, and 2 are envisioned as funded by private, governmental, or public-private partnerships as it is in the interest of both municipalities and private companies to advance on these topics.





Idea 3 is envisioned as funded with sponsoring and investment from (energy) companies and product providers for the aggregated/package deals.

## 6.2. Integration and hosting of public-engaging activities in a multi-functional “SPARCS space(s)”

- **This proposed service is based on the need for establishing community management and advisors (L21-1, Chap. 3.2.3, D4.1), regularly scheduled workshops (L21-3, Chap. 5.2.2, D4.1), and on the need for desk support for interested citizens (L21-2, Chap 5.2.3, D4.1) in Leipzig.**
- **This proposed service is based on the need to organize public events in Pikkulaiva (E2-2, Chap. 7.2, D3.1), to conduct workshops with diverse stakeholders (E3-2, Chap. 7.2, D3.1) and design sprints (E19-1, Chap. 7.2, D3.1); as well as to engage citizens in co-creation events (E3-1 & E8-1, Chap. 7.3, D3.1) in Espoo.**

Many tasks and actions of the SPARCS project involve the public in different ways (e.g., proposed establishment of “community managements”, D4.1, Chapter 5.2.2, L21-1, “desk support”, D4.1, Chapter 5.2.2, L21-2; “workshops”: D4.1, Chapter 5.2.2, L21-3, D3.1, Chapter 7.2 and D3.1, Chapter 9.3, E23-1), which are likely to benefit from a continuation beyond the project scope through the provision of a multi-functional space(s).

The space(s) offer an added value, when being integrated with other existing or planned hub initiatives with local government offices and managements, as well as with relevant sustainability/climate change activities.

Furthermore, the spaces can be equipped with showrooms or test rooms for citizens to interact with new technologies, products, pop-up labs and inform themselves of new initiatives. In this sense, the potential would go beyond hosting SPARCS related activities, to a multi-functional space(s) for the development of projects in related areas of energy, ICT, mobility, etc.

Therefore, the space(s) could be new constructions or an aggregation of available existing areas, which is to be preferred on ecological grounds. In addition, the space(s) could be envisioned physically as well as online and either as permanent and/or temporary solutions. It would be important to establish links with already existing initiatives in the field of smart cities and sustainable urban development, in order to create a holistic and city-wide vision, whilst engaging the general public. This would also ensure citizen engagement and added value beyond the project duration of SPARCS.

The following ideas for start-up competitions are suggested:

1. **Start Up Idea 1:** A service provider aggregating and managing existing available spaces (e.g. libraries, parks, fairs, municipal buildings, ...) organizes applications, and/ or invitations and schedules from city officials, companies’ promoters (etc.) in the space(s)
2. **Start Up Idea 2:** Providing an online platform for a digital space for all these potential activities.

### a) Funding:

Both Idea 1 and 2's funding is envisioned as sponsored by the consortium stakeholders and municipalities; consisting of either private, public, or partnered investments.

Both the physical and/or the digital spaces, can monetize out of renting space or platforms to interested external parties such as solution providers, for events and workshops.

Moreover, both the physical and/or the digital spaces, could monetize from selling advertisement spaces, if they are able to gather enough use and traffic.

## 6.3. Multi-stakeholder engagement in open urban data platforms and digital urban twins.

- **This proposed service is based on integration of energy and building data into urban data platform (L19-1, Chap 5.1.1, D4.1), and on supporting the creation of holistic intelligence systems (L19-2, Chap 5.1.1, D4.1) in Leipzig.**
- **This proposed service is based on exploring possibilities to utilize a continuously developed 3D city model (E10-1, Chap. 3.4., D3.1), on building a showcase and support replication of urban virtual twins (E17-1, Chap. 4.2, D4.2.), and on the integration of CityGML to the open Espoo 3D city model (E17-2, Chap. 6).**

Current initiatives are developing urban data platforms, digital urban twins, and 3D city model visualizations of city infrastructure by local city architects and planners (D4.1, Chapter 5.1, L19-1, and D3.1, Chapter 4.2, E17-1; Chapter 6, E17-1). This task can be extremely demanding, workforce- and time wise.

Therefore, the potential emerges for these platforms to work as serviceable centres not only for visualization of data, but also for public consulting and to assist in decision-making through the establishment of scenario analysis (e.g., modelling traffic flows, urban heat islands etc.). Such platforms help to enhance city efficiency, resilience, and smart city discourses not only in the public sector, but also in the private sector, and civil society.

A multi-stakeholder engagement in open urban data platforms and digital urban twins disseminates the task of sustainable urban development from city architects and planners to researchers, data providers (energy consumption, climatological, transportation, etc.), and the public, thereby fostering a sense of common ownership of this task. Services regarding this idea are envisioned to offer an interface between municipalities and interested stakeholders. This could imply that the models are developed faster and with more accuracy.

The services are envisioned as a series of seminars, workshops, pop-up labs, or hackathons, to contribute to different formats: as live information contributors with access through apps (delays in transport systems, accidents, historical information about buildings, etc.), 3D modellers/enthusiasts with technical knowledge on digital modelling, and developers/programmers who wish to register to access through open APIs.

The following ideas for start-up competitions are suggested:



1. **Start Up Idea 1:** A training centre with the required equipment and material to host the seminars, workshops, or hackathons, and give support to interested stakeholders in the use of the platform or required programs
2. **Start Up Idea 2:** A service advisory to city planners and architects in the technical knowledge to expand existing urban data platforms and virtual city twins to the full-envisioned potential, integrating diverse data, and integrating the tools for civic engagement.
3. **Start Up Idea 3:** A service for extending the use of open urban data platforms to elaborate accessibility maps for specific social sectors (e.g., people with reduced mobility)

#### **a) Funding:**

Idea 1 can be financed by private investment in the form of memberships: The data created for the platform is open and public data, but the processing and analysis of the data can be analysed by the start-up to the private members with no or little cost. The start-up can also sell the analysis of data, at full price, to companies that are not members. Idea 2 is a service that benefits a municipality therefore it relies on public funding. Idea 3 is mainly versed around groups with special needs and/or social or economic vulnerabilities. This is a service for the public good and therefore also relies on public funding

#### **5.3.1. Energy efficiency and renewable energies through smart street lighting**

The following concept relates to the use of and production of data in smart city initiatives to the previously described idea for open city platforms and virtual city twins. Automatized and responsive lighting systems offer a surplus value to public lighting. It allows for reduction of lighting pollution in urbanized areas, reducing energy consumption, and improving driving experience (Sanseverino et al., 2015; Meier et al, 2015).

The idea of automated and responsive systems of interconnected lighting fixtures implies the use of sensors and smart city platforms to sense presence, movement, and natural light to adjust the luminous flux. Photovoltaic floor tiles offer the potential of being coupled with streetlamps to maximize efficiency.

The following ideas for start-up competitions are suggested:

1. **Start Up Idea 1:** A service provider of sensors and lighting fixtures for innovative and state of the art smart lighting systems.
2. **Start Up Idea 2:** Providing the necessary software synchronization with urban data platforms

#### **a) Funding:**

Being in the realm of public infrastructure, the upgrade of public street lighting would be publicly financed by tax-payer money. These innovative approaches can also be considered for Smart City Projects such as EU-funding.

Since it is also a current area of technological development in lighting engineering and ICT/IoT, a Start-Up service that provides smart street lighting can be financed through research and technological development funds.

#### **6.4. Use of augmented reality tools in visualization and interaction with open city models and virtual city twins**

The use of augmented reality and virtual reality tools in participatory planning processes is gaining momentum and could be envisioned coupled with data visualization, public consultation, and analysis of forecasting scenarios ideas outlined in the additional services 5.3.

Augmented reality and virtual reality tools can encourage citizens to participate in complex topics through interactive maps where city problems are clearly visualized, as well as the impact of planned interventions.

The following idea for start-up competitions is suggested:

- 1. Start Up Idea 1:** A service providing hardware and software for such digital tools, as well as for training or mediation in the use of the tools.

##### **a) Funding:**

Since this Start-Up idea is inscribed within the start-up ideas presented in 5.3., the monetization/funding models work relatively or entirely dependent to the co-development of the open urban data platforms, 3D city models, and digital twins.

Interested investors /sponsors are a main source for initial financing, but this start-up idea can work with the same membership system, providing data visualization tools to member a no/or little price, and at full price to non-members.

Furthermore, the data generated by the user experience development can be sold to other companies developing tools in the realm of data visualization.

#### **6.5. Points and awards game-like system for sustainability performance.**

- **This service idea is based on appealing to residents with apps for personalized informative billings (L4-1, Chap. 2.4, D4.1.), visualizing energy prices in real-time (L4-2, Chap. 2.4, D4.1.), and on the need for comparison mechanisms to help consumers positions themselves against best performing peers (L4-3, Chap. 2.4, D4.1.), on the implementation of human-centric interfaces to monitor and control individual energy consumption (L12-1, Chap. 3.5, D4.1), and on setting individual and community energy savings targets (L14-1, Chap. 3.5, D4.1) in Leipzig.**

An energetic performance competition in Leipzig is already taking form in the WSL housing units. Through visualization of energy consumption and personalized informative billing, homeowners can compare their performance to their neighbours.



The idea of a game-like energy consumption competition program extends this intention in scale, typology, housing companies, and definitions for sustainability. The aim is to scale it up to encompass not only single-family units but also buildings, blocks, neighbourhoods, and districts for the replication of such efforts at a citywide scale. The program extends the typologies to invite not only residential units, but also schools, shopping centres, constructions sites, industries, etc. Therefore, the definition of sustainable behaviour can be extended, not to be restricted only to energy consumption, but to encompass concepts such as a specific preferred mode of transportation, recycling behaviour, or choices of sustainable foods. The program envisions to award best performing peers and offers consulting options for low performers. The awards or prices can include tax cuts, sponsored equipment (solar panels, building materials...) or services (companies providing low carbon footprint services), or credit points exchangeable for purchases. Education campaigns on sustainable behaviours (saving heat, water, etc.) would fit into such consultations.

The following ideas for start-up competitions are suggested:

1. **Start Up Idea 1:** A service provider that manages all operational and administrative services to organize the program, aggregating offers, products and agreements between private companies and the public sector into deals for participants. This shopping planner/aggregator would not only notify users when more sustainable products/services are available, but aggregate similar orders for a communities or neighbourhoods to coincide in schedules and/or providers, in this way lowering transportation costs and the carbon footprint associated.
2. **Idea 2:** A service provider that manages the web platform, apps and user interface.
3. **Idea 3:** Management of a payer platform (that could be or not taken by the start-up idea 2), ideally with an in-built carbon footprint calculator per transaction
4. **Idea 4:** Energy saving consultation to low performer housing units, businesses, or other typologies and scales.
5. **Idea 5:** A service provider that supports the extension to gamified recycling, smart waste management and food sharing by gathering data from private and public entities to visualize recycling performance information and provide common fridges in community food-sharing systems.

#### a) Funding:

As a partnership between public and private entities, the program can be initially financed both by investment from private and state capital. A percentage of the saved costs either in private or public expenses can be redirected to the maintenance of the program.

Service providers that wish to receive public appearance in the program can either sponsor and back financially, or sponsor equipment or services to the award system.

#### 6.6. E-mobility repair shops and do-it-your-self garages.

- **This service idea is based on developing new e-mobility hubs in Leppävaara with first- and last-mile services (E7-1, Chap. 5.3, D3.1), on optimal strategies for commercial electrical vehicle fleets (E7-3, Chap. 5.3, D3.1), and on the need for**

**multi-modal transport solutions for emission-free alternatives (E13-1, Chap. 5.4, D3.1) in Espoo.**

The shift from conventional mobility formats to sustainable alternatives implies changes in mechanical and repair needs. E-mobility repair shops and do-it-yourself garages represent a service to persuade more people to migrate to alternative forms of mobility. E-shops and garages host basic automobile mechanics training centres for electric mobility and offer tools and assistance for clients that desire to learn e-bike repairing themselves.

These additional repair shops are envisioned to happen in either combination with or independent from mobility hubs already foreseen in the SPARCS tasks and actions. E-repair shops can also take the form of mobility pop-ups: bringing the hub to the user and not user to the hub. The additional service presents the possibility to engage and provide some economic support to teenagers entering the work environment

**1. Start Up Idea 1:** Provisioning of the space, services and necessary equipment.

**a) Funding:**

As an initiative that has the possibility to engage young people entering the workforce, the start-up may seek to apply for public funding from youth welfare offices (or similar bureaus). Furthermore, In Germany, there are many funding programmes for sustainable and green start-ups. This could be used to support the e-mobility repair stores. Some ideas for funding option can be found here: <https://expansion.eco/public-funding-programs/>. The repair shops can offer workshops and training in e-mobility repairs, rent equipment or space for the public interested in the do-it-your-self system, and it can offer regular repairing services for conventional costumers with e-mobility modes of transport.



## 7 LIGHTHOUSE CITY SERVICE ROADMAPS

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The roadmap for the integration of additional smart city services outlined below (Fig. 12) describes the proposed steps that are necessary for creating a holistic vision of smart city services that builds upon a thorough analysis of the state of the art, the creation of a common vision of local stakeholders, and the adaptation for the specific local context. Within 7.2, the steps up until Roadmap Action 3 have been undertaken, whilst Roadmap Action 4 needs to be pursued in the following SPARCS tasks. For the implementation of additional smart city services, the sample roadmap proposes a period 12 months, however the length should be adapted to local needs and conditions.

Furthermore, this chapter present the smart city services attuned to the Leipzig and Espoo context, suggesting potential next steps and what actors could be involved. We present one service per smart city domain. Some of these additional services apply to both cities. Others are extended and applied to the existing services that can be used for inspiration regarding the start-up competition (T7.4).



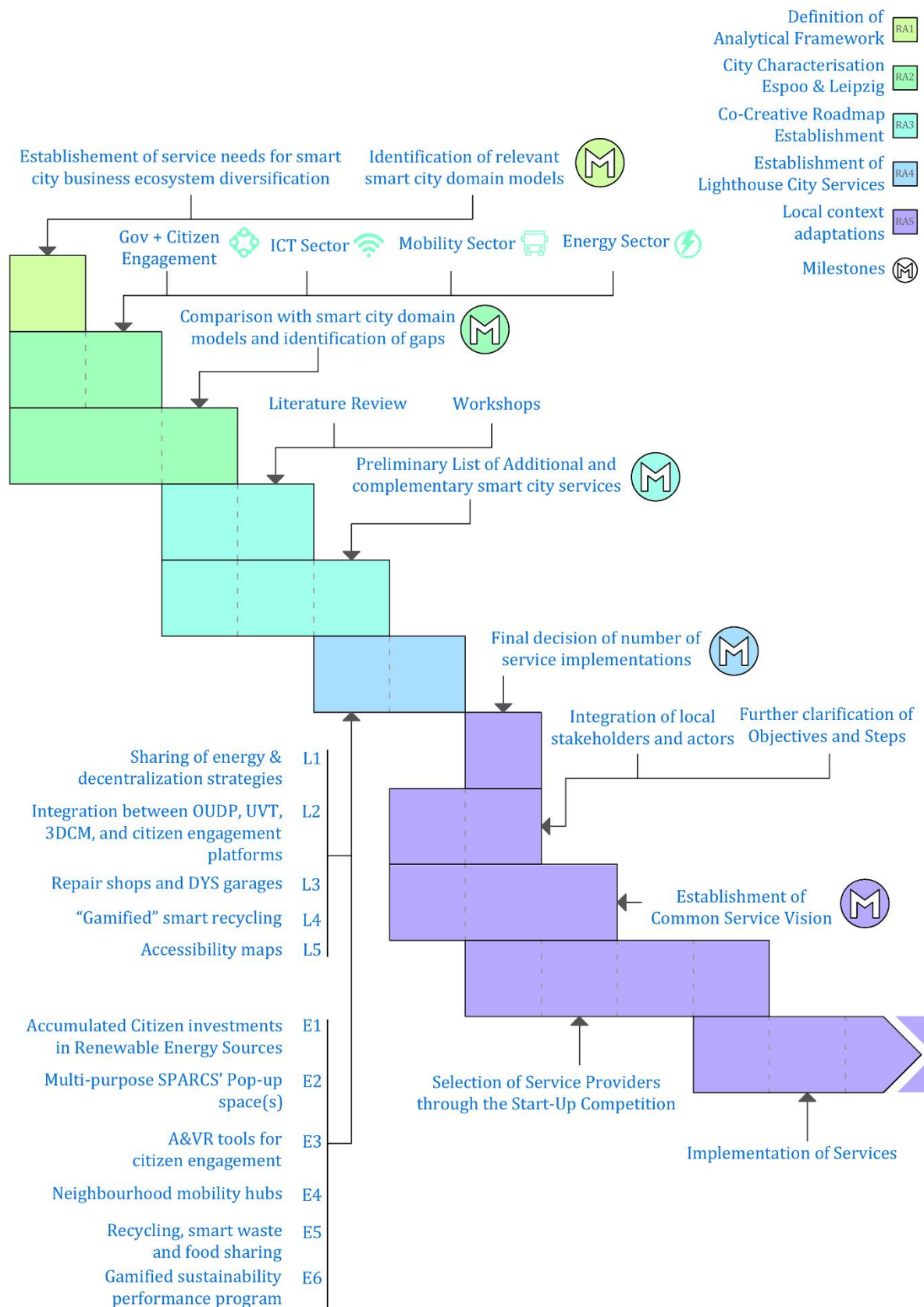


Figure 12: Sample Lighthouse City Service Roadmap





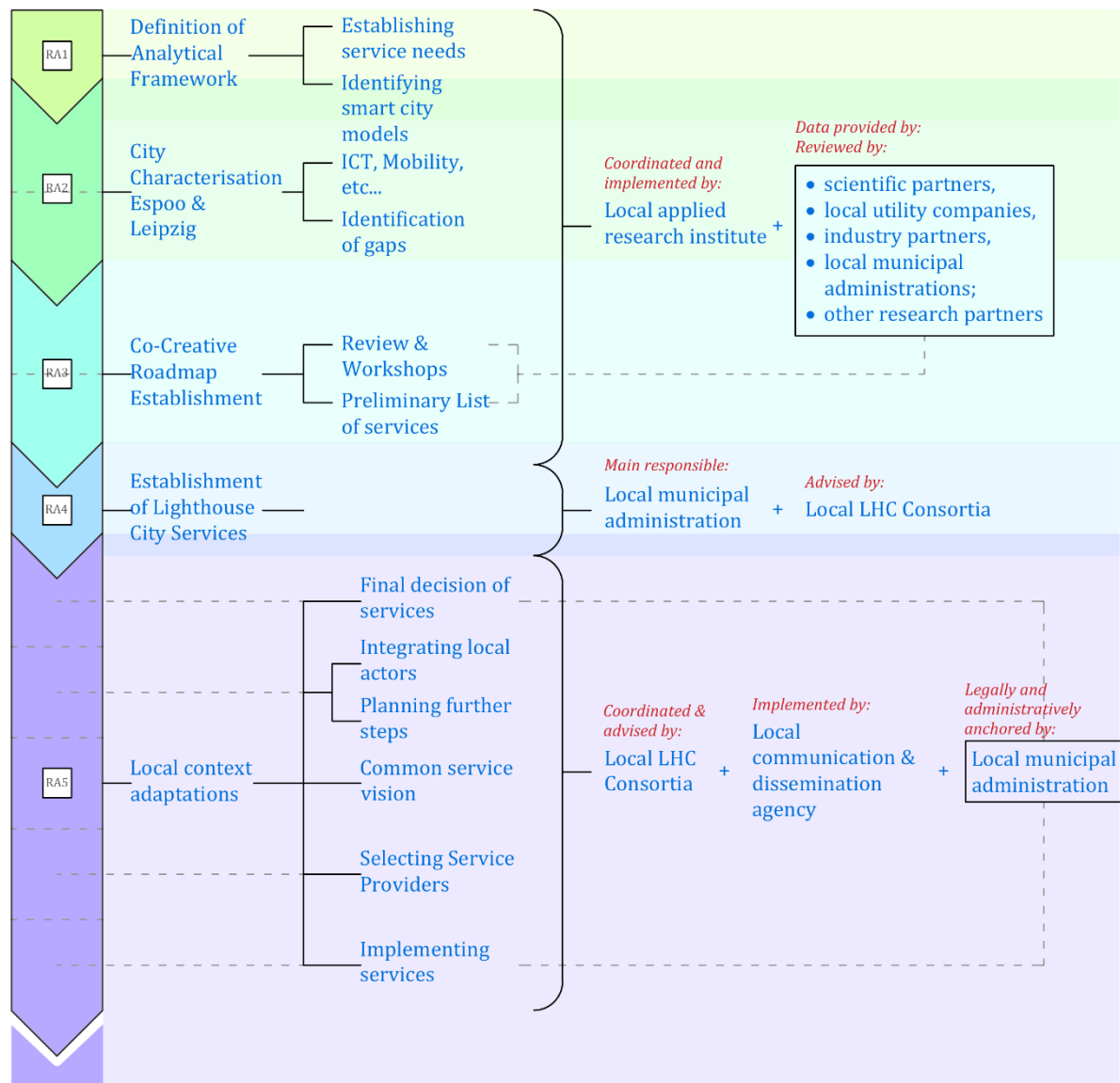


Figure 13: Actors and Functions for the City Service Roadmap

Following the same logic in figure 12, figure 13 characterizes the main activities per roadmap action. The schedule of action 5 still has to be settled in D7.4. The local applied research institute (in this case FHG) coordinates and implements from Action 1 to 3. Action 4, after which the continued development of the additional LHC Services is then delegated to the local municipal administrations with the advisory role of the local consortia. The local consortia takes the lead from Action 5, as the main coordinator, however the local communication and dissemination agency implements the tasks (in this case GOPA). The local municipal administrations are the legal and administrative anchors to the city, who also in many cases have the final decision power on the practical implementation.

## 7.1 Espoo

Table 1: Espoo Additional Service E1

<b>Title</b>	<b>E1_Energy transition incentives aggregation</b>
<b>Based on actions</b>	E12-2, Chap. 4.3, D3.1; E7-2, Chap. 5.3, D3.1; E18-1, Chap. 5.5, D3.1; E3-2, Chap. 7.2, D3.1; Chap.7.3.
<b>Smart City Domain</b>	Smart Economy
<b>Descriptive Title</b>	This service proposes the aggregation of offers, products, corporate agreements, or sponsoring from promoters, providers and general commerce into packaged deals to incentivize citizens to participate in decentralized energy markets (e.g., through PVs).
<b>Description</b>	<p>To provide extra incentives for citizens to participate in energy markets, a service is envisioned to create aggregated package deals from private and public providers. Governments, banks, and organisations on different levels offer ample subsidies and programmes to stimulate citizens and companies to participate in a shift towards electric mobility. Some examples illustrate the intention:</p> <ul style="list-style-type: none"> <li>• Incentives for decreased costs in vehicle purchasing, if the owner agrees to share the vehicle/battery;</li> <li>• Incentives for sharing private battery systems, e.g., “energy credits” exchangeable for goods or products;</li> <li>• Differentiation of parking prices;</li> </ul>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Target specific barriers as identified in E1.</li> <li>• Identify private and public companies that wish to sponsor products, discounts, and agreements;</li> <li>• Engage negotiations between interested stakeholders and seal packaged deals;</li> <li>• Feed E2 (information and sensibilization campaign) with agreed offers and products;</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• City of Espoo</li> <li>• Citycon</li> <li>• Adven</li> <li>• Siemens</li> <li>• KONE</li> <li>• PLUGIT</li> </ul>

Table 2: Espoo Additional Service E2

<b>Title</b>	<b>E2_Sharing of energy &amp; decentralization strategies</b>
<b>Based on actions</b>	E12-2, Chap. 4.3, D3.1; E7-2, Chap. 5.3, D3.1; E18-1, Chap. 5.5, D3.1; E3-2, Chap. 7.2, D3.1.



<b>Smart City Domain</b>	Smart People
<b>Descriptive Title</b>	Service to lead information & participation campaigns (based on research carried out within SPARCS) to both instruct citizens about limitations and promote citizen engagement.
<b>Description</b>	Based on research investigating the willingness of citizens to share energy, e.g., by using an electrical vehicle as an external battery, the proposed service aims to guide and implement information and sensibilization campaigns on a citywide level. Citizens are to be updated about technical, legal, and economic limitations but also potentials of energy decentralizations strategies, for popular participation to be knowledgeable and proactive. These campaigns target the pain points that are the main barriers for integrating citizens in energy sharing as found by previous research.
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Pinpoint barriers for energy sharing</li> <li>• Elaborate plans for sensibilization and information campaigns;</li> <li>• Establish key target groups and social sectors;</li> <li>• Conduct the campaigns and provide the necessary contents and materials;</li> <li>• Monitor citizens' knowledge and willingness before and after campaigns.</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• KONE;</li> <li>• City of Espoo</li> <li>• Citycon (provide spaces)</li> </ul>

Table 3: Espoo Additional Service E3

<b>Title</b>	<b>E3_Integration between OUDP, UVT, 3DCM, and citizen engagement structures (software's &amp; digital platforms).</b>
<b>Based on actions</b>	E10-1, Chap. 3.4., D3.1; E17-1, Chap. 4.2, D4.2; E17-2, Chap. 6
<b>Smart City Domain</b>	Smart Governance
<b>Descriptive Title</b>	Provision of digital platforms and software solutions to extend existing OUDP, 3DCM, and UVT, to integrate them with envisioned structures of citizen participation (workshops, seminars, hackathons, etc.), so that interactions between administrators, trainers, and further contributors is as smooth and effective as possible.
<b>Description</b>	Support to open urban data platforms (OUDP), 3D city models (3DCM) and virtual urban twins (VUT) for the city of Espoo are foreseen within the SPARCS tasks and actions. However, accurate and comprehensive models require a lot of workforce and hourly load. A multi-

	<p>stakeholder engagement platform can make use of universities, data providers, and the public to co-create them. This service aims to secure that the Open urban data platform, urban virtual twins and 3D digital models are integrated and data can easily be exchanged. However, for a system in which different stakeholders can provide input and even be editors, some sort of integration is needed; at least when it comes to the software or platforms the public uses to interact with. This additional service envisions the provision of digital and software integration of citizen engagement in the city's digital infrastructure.</p>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Participate in coordination and negotiations between E6, and city planners and architects for the development of the program;</li> <li>• Providing state-of-the-art available digital and software solutions</li> <li>• Constant administration of the platforms and technical assistance;</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• City of Espoo</li> <li>• Data providers</li> <li>• Digital twin developer /maintenance</li> </ul>

Table 4: Espoo Additional Service E4

<b>Title</b>	<b>E4_ Repair shops and DYS garages</b>
<b>Based on actions</b>	E7-1, Chap. 5.3, D3.1; E7-3, Chap. 5.3, D3.1; E13-1, Chap. 5.4, D3.1
<b>Smart City domain</b>	Smart Mobility
<b>Descriptive Title</b>	Repair shops & Do-It-Yourself garages for sustainable transport modes
<b>Description</b>	<p>Mobility hubs bring together a variety of transport modes, which all need repair and maintenance over time. Mobility hubs with repair shops and Do-It-Yourself facilities provide both alternative transport options and incentives for citizens to switch towards sustainable transportation modes.</p>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Identify mobility hubs &amp; main transportation modes at this hub + space for potential shop</li> <li>• Map existing Repair &amp; maintenance shops</li> <li>• Identify maintenance &amp; repair needs</li> <li>• Set DIY repair guidelines per transport mode</li> <li>• Establish connections with transport mode manufacturers</li> <li>• Explore 'mobile' repair possibilities</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• Shared mobility providers</li> <li>• Existing Bike shops &amp; garages</li> <li>• PLUG-IT</li> <li>• City of Espoo</li> </ul>





Table 5: Espoo Additional Service E5

<b>Title</b>	<b>E5_ “Gamified” smart recycling</b>
<b>Based on actions</b>	E3-1, Chap. 7.3, D3.1, E19-1, Chap. 7.2, D3.1
<b>Smart City domain</b>	Smart Environment
<b>Descriptive Title</b>	Promotion and managing the gamification of a smart recycling competition program, aggregating discounts, points-systems, logistics, sponsors, tax incentives, and consulting for lower performance households or companies.
<b>Description</b>	<p>The concept of competition programs to assess and incentivize sustainable behaviours is introduced here to the domain of waste management, food management, and recycling, as important indicators for sustainable behaviour. This Program could function on different city levels, engaging with different infrastructure typologies (housing, schools, industrial sites, etc.). Participants compete and position themselves with other peers in terms of their recycling, waste, and food management behaviours. It is envisioned as a program that rewards high performers with several forms of economic and social incentives (tax incentives, credit points, public recognitions, etc.), and provides consulting and guidance to lower performers.</p> <p>E9 is an additional service that organizes and manages the platform for the competition and ensures cooperation with city actors to make the recycling and waste minimization infrastructure and prices possible offers, sponsoring, packaged deals, to credit systems, and consulting services.</p>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Set up competition platform</li> <li>• Strategize waste minimization potential</li> <li>• Identify private and public companies that wish to sponsor products, discounts, and agreements;</li> <li>• Establishment of offers and incentives to encourage user participation</li> <li>• Engage negotiations between interested stakeholders and packaged deals;</li> <li>• Administration of exchange between the involved utility companies, city administration and users</li> <li>• Notification of users when more sustainable product options are on the market</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• City of Espoo;</li> <li>• Waste utility company</li> <li>• Organized neighbourhoods and community associations;</li> <li>• Commerce associations;</li> </ul>





Table 6: Espoo Additional Service E6

<b>Title</b>	<b>E6_Accessibility maps based on integrated urban data platforms</b>
<b>Based on actions</b>	E10-1, Chap. 3.4., D3.1; E17-1, Chap. 4.2, D4.2; E17-2, Chap. 6
<b>Smart City Domain</b>	Smart Living
<b>Descriptive Title</b>	Service that focuses on the production and dissemination of “accessibility maps”. These maps support people with reduced mobility, or vision impairments, foreigners with language barriers, kid specific zones, etc. towards their destination or information needs
<b>Description</b>	<p>There is growing concern to meet accessibility needs for different sectors of the society in the city of Espoo. Accessibility is defined here not only as vehicle transportation needs, but also as the overall access to space and information. In this regard, accessibility also addresses people with special physical or mental needs (e.g., reduced mobility, visions impairments, etc.), different age groups (e.g., kids, elderly), and foreigners with language barriers.</p> <p>This is envisioned as a service to the city of Espoo to inform the public about specific accessibility qualities of the city for different sectors of society (e.g., kid's friendly spaces, bike lanes, wheelchair-friendly access, translation of public information to foreign languages, etc...)</p>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Identify societal sectors to cover;</li> <li>• Integrate existing information into maps;</li> <li>• Contribute these maps to integrated platforms;</li> <li>• Identify existing gap of information for additional maps;</li> <li>• Continuous information campaign to address the general public &amp; monitoring / action plans for perceived challenging areas or inaccessibility</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• City of Espoo</li> <li>• Organizations for specific societal sectors</li> <li>• Civil associations (e.g. for hearing impaired)</li> <li>• Data providers;</li> </ul>

## 7.2 Leipzig

Table 7: Leipzig Additional Service L1

Title	L1_Accumulated Citizen investments in Renewable Energy Sources
Smart City Domain	Smart Economy
Descriptive Title	Platform for accumulated citizen investments for Renewable Energy Sources
Description	<p>This service provides a platform where citizens can invest in Renewable Energy Sources when they have no practical or financial possibilities to purchase means for renewable energy sources (e.g. no roof space for PV's). Through the accumulation of investments, large-scale implementation is possible for higher efficiency &amp; impact.</p> <p>The platform will match &amp; accumulate investments with place &amp; RES providers. Return of Investment will be achieved through Energy sales &amp; CO2 balancing.</p>
Objectives & Steps	<ul style="list-style-type: none"> <li>• Explore Legal regulations of investment accumulation for RES provision</li> <li>• Connect place, technology &amp; energy providers</li> <li>• Explore feasibility of integration in Energy network</li> <li>• Set up Platform for investment accumulation &amp; Matchmaking</li> <li>• Monitor energy generation &amp; CO2 savings</li> <li>• communication to investors</li> </ul>
Stakeholders & Actors	<ul style="list-style-type: none"> <li>• LSW</li> <li>• City of Leipzig</li> <li>• Platform provider</li> <li>• Investors</li> </ul>

Table 8: Leipzig Additional Service L2

Title	L2_Multi-purpose SPARCS' Pop-up space(s)
Based on actions	L21-1, Chap. 3.2.3, D4.1; L21-2, Chap. 5.2.3, D4.1; L21-3, Chap. 5.2.2, D4.1
Smart City Domain	Smart People
Descriptive Title	Design & implementation of pop-up activities for public engagement activities related to the SPARCS tasks and actions.
Description	Many of the planned SPARCS tasks and actions are conceived through the implementation of workshops, informative centres, desk advisors, and other forms of physical interactions with the general public. Building upon Seecon & the city of Leipzig activities this service



	proposes the design and implementation of pop-up SPARCS spaces demonstrating, showing and engaging the public with SPARCS related activities. Furthermore, these space(s) can be planned in collaborating with other existing hub initiatives, local government managements, as well as with other relevant sustainability/climate change events and activities.
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Overview of existing smart city exhibitions (Digitalcampus, Stadtbüro, Stadtteilladen LPZ West) &amp; websites (digitales Leipzig)</li> <li>• Overview of smart city initiatives that need presentation or connection to citizens</li> <li>• Explore self-explanatory forms of information provision regarding smart cities</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• SEECON</li> <li>• City's participation office</li> <li>• LSW</li> <li>• Smart City Technology providers</li> </ul>

Table 9: Leipzig Additional Service L3

<b>Title</b>	<b>L3_Augmented &amp; virtual reality tools to engage citizens in planning and decision-making</b>
<b>Based on actions</b>	L19-1, Chap 5.1.1, D4.1; L19-2, Chap 5.1.1, D4.1
<b>Smart City Domain</b>	Smart Governance
<b>Descriptive Title</b>	Building upon the development of urban data platforms and a digital twin, this service looks to extend towards including citizen engagement through, augmented and virtual reality tools.
<b>Description</b>	<p>Through the application of augmented and virtual reality tools in connection to open urban data platforms and urban digital twins, citizens can be further engaged in complex topics of sustainable urban planning and participate along with experts in co-creation workshops for the city of Leipzig.</p> <p>A&amp;VR tools, together with digital twinning tools visualize direct and long-term impact of planning decisions on strategic topics.</p>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Creation of citizen ownership for city development</li> <li>• Environment scanning (city)</li> <li>• Scanning &amp; modelling of set environment</li> <li>• Create different scenarios to be modelled</li> <li>• Integration of augmented and virtual reality tools with urban data platforms &amp; Digital Twin on selected strategic themes</li> </ul>

<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• Leipzig city architect and planners</li> <li>• Citizens</li> <li>• Data Providers</li> <li>• Hardware and software providers</li> </ul>
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Table 10: Leipzig Additional Services L4

<b>Title</b>	<b>L4_ Neighbourhood mobility hubs.</b>
<b>Based on actions</b>	L16-1, Chap. 4.3, D4.1; L16-2, Chap. 4.3, D4.1; L16-3, Chap. 4.3, D4.1; L1-2, Chap. 4.4, D4.1;
<b>Smart city domain</b>	Smart Mobility
<b>Descriptive Title</b>	Community-based additional service that assembles shared-transport platforms and e-mobility repair shops in specific districts/neighbourhood.
<b>Description</b>	<p>A neighbourhood mobility hub is conceived here as a community-based provider of mobility services (focused on e-mobility) for residents of the district/neighbourhood. This additional service assembles organizational infrastructure for scooter, bike and car sharing, and e-mobility repair shops and do-it-yourself garages and workshops. It provides the space, equipment, and staff, and/or mobile pop-ups to bring the services closer to users. This service seeks to facilitate alternative transport options for residents, and incentivize citizens to switch towards sustainable transportation modes.</p> <p>Existing platforms for bike and car sharing in Leipzig have a city-scale approach (Leipzig MOVE), to which this additional service builds upon, providing a district/neighbourhood specific hub for such platforms.</p>
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Map existing repair &amp; maintenance shops</li> <li>• Determine mobility hubs potential locals &amp; main transportation modes at this hub + space for potential shop</li> <li>• Identify maintenance &amp; repair needs in new e-mobility modalities</li> <li>• Set DIY repair guidelines per transport mode</li> <li>• Establish connections with transport mode owners &amp; equipment manufacturers</li> <li>• Establish connection with residents</li> <li>• Establish platform for transport modes demand and offerings: cars, (cargo)-bikes, scooters, etc.</li> <li>• Explore 'mobile' (pop-up) repair possibilities</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• City of Leipzig</li> <li>• Public Transport companies</li> <li>• Shared mobility providers</li> <li>• Equipment providers</li> <li>• Existing Bike shops &amp; garages</li> </ul>



Table 11: Leipzig Additional Service L5

Title	L5_Recycling, smart waste and food sharing.
Based on actions	L4-1, Chap. 2.4, D4.1; L4-2, Chap. 2.4, D4.1; L4-3, Chap. 2.4, D4.1; L12-1, Chap. 3.5, D4.1; L14-1, Chap. 3.5, D4.1
Smart City Domain	Smart Environment
Descriptive Title	Supporting citizens stimulating improved waste handling, recycling and food sharing.
Description	Through the provision of a platform for food sharing, incentivise recycling and making waste handling more transparent, improved user behaviour can yield big effects on local resource consumption. Companies acting in the field can gather public and municipal data on waste amounts and visualize recycling performance on a district or citywide level. Furthermore, showing lifecycles of recycled materials makes the recycling process more transparent and could lead to more recycling due to the visualisation of the 'reward'.
Objectives & Steps	<ul style="list-style-type: none"> <li>• Setting up a platform, preferable adding to existing city apps.</li> <li>• Visualising recycling streams (waste to new product)</li> <li>• Aggregate information on household waste handling improvement</li> <li>• Establish community food-sharing</li> </ul>
Stakeholders & Actors	<ul style="list-style-type: none"> <li>• Municipal Waste Management Company</li> <li>• Sponsors and partner companies;</li> <li>• Organized neighbourhoods and community associations;</li> </ul>

Table 12: Leipzig Additional Service L6

Title	L6_Gamified sustainability performance program
Based on actions	L4-1, Chap. 2.4, D4.1; L4-2, Chap. 2.4, D4.1; L4-3, Chap. 2.4, D4.1; L12-1, Chap. 3.5, D4.1; L14-1, Chap. 3.5, D4.1
Smart City Domain	Smart Living
Descriptive Title	These services organise a sustainability performance gamification program, delivering a platform to aggregate discounts through a points-system and information provision for low performance households or companies.
Description	The concept of competition program is to assess and incentivize sustainable behaviours as introduced here initially to the domain of energy efficiency. The program can engage with citizens on different levels (building block, district level, city wide) to 'compete' with other peers. High performers should be rewarded for instance through tokens that can be used for local discounts on

	local products or city services. The program can also provide information and guidance to lower performers on easy improvements.
<b>Objectives &amp; Steps</b>	<ul style="list-style-type: none"> <li>• Encouragement of more sustainable citizen behaviour and consumption choices</li> <li>• Identification of suitable sustainable performance domains (e.g., Energy and water saving, etc.)</li> <li>• Identify private and public companies that wish to sponsor products, discounts, and agreements;</li> <li>• Establishment of offers and incentives to encourage user participation</li> <li>• Administration of exchange between the involved utility companies, city administration and users</li> <li>• Notification of users when more sustainable product options are on the market</li> </ul>
<b>Stakeholders &amp; Actors</b>	<ul style="list-style-type: none"> <li>• City of Leipzig</li> <li>• Utility Companies</li> <li>• Commerce associations</li> <li>• Organized neighbourhoods and community associations</li> </ul>





## 8 CONCLUSION

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The aim of this deliverable was to co-create additional and complementary smart city services within the urban energy context with Lighthouse Cities and technical partners within SPARCS. This aim has been pursued by an initial idea conceptualization, based upon the work done in D1.1 City Characterization Report, Deliverables 3.1 and D4.1, Action Plans of Espoo and Leipzig respectively, consultation with SPARCS technical experts and workshops with the local consortia of Espoo and Leipzig. First, the report offers a list of potential smart city services to inspire cities and more detailed information on additional activities within the Lighthouse Cities' context. This comes with information on what initial SPARCS action they are based on and financing/revenue models. Based on the initial brainstorming, workshop results and additional city specific feedback, we described how some of these services could be adopted for the Leipzig & Espoo context, what steps should be taken to develop the service and what city stakeholder types could be involved or consulted.

Smart district services offer ample opportunity to enhance or increase the impact of smart city activities as planned in SPARCS. Chapter 2 has shown how different domains, and the integration of these domains can add to the liveability of the city. Besides, it has shown the need for a diversified business ecosystem within smart cities. The presented services (both on a general and a city specific level) show an entrance point into potential for described diversification and these function as an introduction into the start-up competition in both Lighthouse Cities following T7.4. However, for the ideas presented in this deliverable to function as a basis for the Start-up competition, these ideas need to be tailored further to fit into demonstration districts and respond to the local conditions and challenges. Apart from further specification of challenges, the start-up competition should focus on one or two core innovation topics for it to be effective and receive comprehensive business proposals.

Following this deliverable, the Lighthouse Cities, together with Fraunhofer and CIVIESCO will organise workshops to further specify the challenges and look at districts' needs that can be then formulated in detailed innovation challenges to which start-ups can respond. Cooperation will be sought with existing events in Espoo & Leipzig to bundle resources and ensure alignment in methodology and pursued results. Business diversification and new smart city technologies will also remain a central topic in further WP7 task, looking at governance models (T7.3), Exploitation and Business Innovation Planning (T7.5) and the Smart City Market Radar (T7.6).

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