D3.6 Optimizing People Flow and User Experience for Energy Positive Districts

30/09/2022

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Deliverable administration

No & name	**D3.6 Optimizing People Flow and User Experience for Energy Positive Districts**				
Status	Released	**Due**	M36	**Date**	2022-09-30
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Description of the related task and the deliverable. Extract from DoA	**T3.6 Community Engagement M1 – M36 with input from T3.5 Planning of Energy Positive Districts M1-M60 and T3.8 Smart Business Models M1 – M60** Under this task, demonstrated community engagement, people flow, and user experience actions in the lighthouse city Espoo will be presented in detail (D3.6 Optimizing People Flow and User Experience for Energy Positive Districts) to provide understanding of methods, activities, and solutions to motivate more sustainable behaviours and lifestyles among citizens of future PEDs. Also, the added value and replicability potential of demonstrated methodologies and actions are assessed.				
Participants	KONE, City of Espoo, Citycon, VTT, CiviESCo				
Comments					

V	Date	Authors	Description
0.1	20/01/2020	KONE	Basic structure
0.2	30/06/2022	KONE CIT ESP VTT	First version with the complete content on all chapters
0.3	30/08/2022	KONE CIT ESP VTT	Final version with complete content submitted to internal review
0.4	28/09/2022	KONE	Final version with implemented changes and complete content submitted to quality review
0.5	30/09/2022	WP leader	Deliverable checked by WP leader and released to the Coordinator and the Quality Manager for quality check and subsequent submission to the EC.
0.6	30/09/2022	KONE	Quality review comments implemented
1	30/09/2022	VTT	Coordinator submits the deliverable to the EC

Dissemination level

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

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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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EXECUTIVE SUMMARY

SPARCS is an EU Horizon 2020 funded project that focuses on developing solutions and services for future positive energy districts (PED), while reaching the development goals of sustainable Espoo, and achieving the global SDGs by 2025 (Figure 1).

Figure 1: This deliverable focuses especially on 8, 9, 10, 11, 12, 13, and 17 SDGs'. (Source: United Nations)

The deliverable *D3.6 Optimizing people flow and user experience for energy positive districts* is the final report for the task *T3.6 Community engagement*, with input from tasks T3.5 *Planning of Energy Positive Districts,* and *T3.8 Smart Business Models*. The purpose of this final report is to present the demonstrated community engagement, people flow, and user experience actions in Espoo in detail. Another purpose is to evaluate the added value and replicability potential of demonstrated methodologies and actions in Espoo. The goal is to provide SPARCS fellow cities, as well as other cities, ideas, and knowledge for replicating diverse methods and concepts in their local environment and ultimately to support European cities in transforming into Sustainable energy Positive & zero cARbon CommunitieS.

The actions have followed a community engagement approach, which has guided the methodology of the project. In this report first, we present utilized community engagement activities by describing the engagement process and related goals. Second, we present the summarized outcomes of the community engagement activities in Espoo, Finland. These include insights as well as results of the user studies, co-design workshops, and design sprints. First, we present behavioural insights of Espoo citizens' sustainable urban mobility behaviours and related needs and challenges. Second, we present eight sustainable mobility concepts co-designed with citizens based on the presented behavioural insights. Third, we present results from the Sports community mobility pilot that together with the eight concepts feeds into the sustainable business model co-creation results, as two of the concepts were further developed into business model concepts. Finally, we summarize results from diverse citizen engagement events and conclude with a holistic co-creation model for smart city development in multi-stakeholder collaboration. In the end of the report, we discuss selected community engagement methods and activities, and evaluate the replicability potential of them and the community engagement approach in general.

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1. INTRODUCTION

SPARCS focuses on supporting European cities in transforming *into Sustainable energy Positive & zero cARbon CommunitieS* by creating citizen-centric ecosystems that are equipped to bring about meaningful change. This *Deliverable 3.6* (D3.6) reports activities focusing on community engagement, business model co-creation and co-creation for smart city development. The deliverable summarizes key findings on optimizing people flow and user experience for positive energy districts (PEDs) in the context of Espoo, Finland.

The deliverable 3.6 is structured as follows:

- Chapter 2 – *Introduction to co-designing smart and sustainable cities*: Clarifies core focus areas and terminology used in this report. It provides a theoretical baseline for community engagement activities presented in this report. The main topics discussed are: sustainable lifestyle, sustainable urban mobility transition and behaviour change, as well as smart and sustainable business models.
- Chapter 3 – *Community engagement approach*: Presents conducted community engagement activities carried out by several partners in Espoo. Also, communication and dissemination activities are addressed.
- Chapter 4 – *Results*: Addresses results from the community engagement activities by focusing on insights on the behavioural sustainable urban mobility transition in Espoo, eight co-designed sustainable mobility concepts for PEDs, sustainable business model co-creation results, community mobility intervention, and co-creation models for smart city planning.
- Chapter 5 – *Added value and replicability potential*: Reflects on the added value and replicability potential of chosen community engagement activities and related outcomes.
- Chapter 6 – *Conclusions*: Provides conclusions of work conducted under this report and related main outcomes.

In the next sections of this introductory chapter, we describe the objectives of the work conducted under tasks T3.6, T3.8 and T3.5, the purpose and target group of this deliverable, a baseline for community engagement activities in Espoo, contribution of partners, and the relations to other activities in SPARCS.

1.1 Objectives

The main objectives of the work are derived from tasks T3.6 and T3.8. In addition, input has been provided by task T3.5 from the co-creation related subtask T3.5.1 at the end of the chapter.

T3.6 Community engagement consists of three subtasks:

- *T3.6.1 People flow and daily journey*,
- *T3.6.2 Co-creation for energy positive behaviour*, and
- *T3.6.3 Sustainable lifestyle*.

The subtasks and related objectives and actions are presented below in Table 1, Table 2, and Table 3. We refer to the actions described in the following tables in the community engagement activities presented later in the report.

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Table 1: Objectives of *T3.6.1 People flow and daily journey*

T3.6.1	PEOPLE FLOW AND DAILY JOURNEY
Objectives	Defining and validating solutions for encouraging people to change their daily mobility habits optimizing people flow from energy and user experience perspectives, to use positive district solutions for their daily lives, optimizing urban flow from energy and user experience perspectives.
Responsible partners	KONE, VTT, ESP, CIT
Actions	**E3-1** Piloting ways to engage and encourage citizens' energy positive ways of behaviour (CIT, KONE, VTT, ESP) **E3-2** Optimizing people flow (KONE, CIT) **E8-1** Study lead user citizens' energy positive mobility behaviours (KONE) **E8-2** Experiment concepts for encouraging people to use E-mobility solutions (KONE) **E11-1** Citizen mobility (KONE) **E19-1** Optimizing urban people flow (KONE)

Table 2: Objectives of *T3.6.2 Co-creation for energy positive behaviour*

T3.6.2	CO-CREATION FOR ENERGY POSITIVE BEHAVIOUR
Objectives	Piloting ways to engage citizens and improve their awareness of solutions and services for positive district solutions during their daily use of services. Work includes co-creation actions and workshops with citizens and other stakeholders to enhance environmentally friendly mobility, and co-creation of shopping centre.
Responsible partners	KONE, ESP, CIT
Actions	**E4-1** Engaging (lead) users and co-creating (energy positive) business models in Lippulaiva (KONE) **E9-1** Engaging lead users and co-creating energy positive business models in Sello (KONE) **E3-3** Co-creation of shopping centre in collaboration with young consumers (CIT, ESP)

Table 3: Objectives of *T3.6.3 Sustainable lifestyle*

T3.6.3	SUSTAINABLE LIFESTYLE
Objectives	The city is building a sustainable future through mobility, construction, and energy solutions, by offering teaching and education supporting a sustainable lifestyle. SPARCS actors integrate this support in their daily work including support for low-emission solutions, guidance, and energy advisor services.
Responsible partners	ESP
Actions	**E19-2** Sustainable lifestyle (ESP) (M1-M60)

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T3.8 Smart business models consists of three subtasks:

- *T3.8.1 Engaging (lead) users and co-creating (energy positive) business models*,
- *T3.8.2 Smart Otaniemi*, and
- *T3.8.3 Smart business*.

The subtasks and related objectives and actions are presented below, in Table 4, Table 5, and Table 6. We refer to the actions described in the following tables in the smart business model activities presented later in the report.

Table 4: Objectives of *T3.8.1 Engaging users and co-creating business models*

T3.8.1	ENGAGING (LEAD) USERS AND CO-CREATING (ENERGY POSITIVE) BUSINESS MODELS
Objectives	The task is to interact and co-create business models supporting energy positive behaviour and mobility among lead users in the Lippulaiva blocks, Espoonlahti District, and Leppävaara centre, Leppävaara District.
Responsible partners	KONE
Actions	**E4-1** Engaging (lead) users and co-creating (energy positive) business models in Lippulaiva **E9-1** Engaging lead users and co-creating energy positive business models in Sello

Table 5: Objectives of *T3.8.2 Smart Otaniemi*

T3.8.2	SMART OTANIEMI
Objectives	Smart Otaniemi innovation ecosystem as facilitator of developing bankable smart city solutions for worldwide replication. Focus areas: efficient use of energy, intelligent use of data, and creating solutions for real customers.
Responsible partners	VTT
Actions	**E23-1** Smart Otaniemi pilot platform

Table 6: Objectives of *T3.8.3 Smart business*

T3.8.3	SMART BUSINESS
Objectives	New business of Espoo Lighthouse actions is supported by linking to local and national actors.
Responsible partners	ESP, CiviESCo
Actions	**E23-2** Smart business (ESP)

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T3.5 Planning of Energy Positive Districts consists of one subtask:

- *T3.5.1 Energy Positive District Planning*

The subtask and related objectives and actions are presented below, in Table 7. We refer to the actions described in the following table in the co-creation model development activities presented later in the report.

Table 7: Objectives of *T3.5.1 Energy Positive District Planning*

T3.5.1	ENERGY POSITIVE DISTRICT PLANNING
Objectives	The task develops urban planning methodologies for smart city development including: • Co-creation for smart city development. Co-creation models for smart city planning are developed as a collaboration between industry, SMEs, citizens, and other stakeholders.
Responsible partners	ESP
Actions	**E22-1** Co-creation for smart city development

1.2 Purpose and target group

This report presents community engagement activities and related results gained in the SPARCS lighthouse city of Espoo.

This report targets all cities that want to develop Positive Energy Districts. The report is of interest for cities globally and all the public interested in energy positive smart city developments and in the methods and value of a community engagement approach for this very purpose. The report is also of interest to especially citizens and different stakeholders of Leppävaara and Espoonlahti, the EU program office, and different research and industrial partners who are working on similar projects and with similar topics.

1.3 Contributions of partners

The following Table 8 depicts the main contributions of partners in this deliverable and work planned and performed.

Table 8: Contributions of partners

Partner	Contributions
KONE	Task leader of tasks T3.6 Community Engagement and T3.8 Smart Business Models. Concept contributor: Mobility related user studies, co-design workshops and business model work. Planning and conducting user research and co-creation activities with citizens and other relevant stakeholders with a focus on (un)sustainable

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	urban mobility; innovating with users and stakeholders; and developing, testing, and validating solutions. Deliverable contributions: • Main editor of the deliverable. • Content planning, allocation of writing responsibilities. • Leader author of: 1. Introduction, 2. Related work, 3. Approach, 4. Results, 5. Added value and replicability, and 6. Conclusions. On top of the authors listed in the beginning of this report, Reetta Turtiainen has contributed to the previously mentioned activities during project period M1-M24.
Citycon	Concept contributor: Buddy class, youth workshops/work collaboration, tours at Lippulaiva, virtual showroom, webinar. Deliverable contributions: • Leader author of: 3.1.2 Supporting sustainable behaviours. On top of the authors listed in the beginning of this report, Kaisa Kontu has contributed to Citycon's community engagement activities during project period M1-M23.
City of Espoo	Concept contributor: Sustainable lifestyle, Buddy class, test day, e-mobility hubs, Espoo as business environment, co-creation model for smart and sustainable urban areas, webinars together with Smart Otaniemi. Planning and executing citizen engagement activities with partners. Responsible for carrying through activities together with partners and independently. Actively promotes cooperation with stakeholders. Deliverable contributions: • Leader author of: 2.1 Sustainable lifestyle in Espoo, 2.3.1 Review of the City of Espoo's support for business ecosystem development, 3.1.4 Sustainable lifestyle in future Espoo, 4.5 Co-creation model for sustainable and smart urban areas, 5.1.5 Co-creation model. On top of the authors listed in the beginning of this report, Henri Horn has contributed to the PED definition in this report, and Nelli Vasse and Lotta Harsunen have contributed to City of Espoo's community engagement activities and reporting during project period M32-M35.
VTT	Responsible for scientific writing on citizen engagement. Deliverable contributions: - Leader author of: 1.6 Case Espoo: Baseline for community engagement activities in Espoo On top of the authors listed in the beginning of this report, Petr Hajduk has contributed to identifying citizen target groups in Espoo and Eveliina Grönroos has contributed to Smart Otaniemi events work.
CiviESCo	Leads WP7 and supports the local work on smart business (Subtask 3.8.3)

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1.4 Relations to other activities

The following Table 9 depicts the main relationship of this deliverable to other activities or deliverables within the SPARCS project.

Table 9: Relation to other activities in the project

Deliverable / Milestone	Contributions
D2.3 Baseline Establishment for Lighthouse Cities Impact Assessment	Contributes to establishment of baseline Key Performance Indicator values of the SPARCS solutions' impacts.
D2.6 – Holistic Impact Assessment of Demonstration Activities	Contributes to the holistic assessment of the SPARCS solutions' impacts.
D3.1 - Detailed plan of the Espoo smart city lighthouse demonstrations	Provides a description of Espoo smart city lighthouse demonstrations.
D3.2 - Midterm report on the implemented demonstrations of solutions for energy positive blocks in Espoo	Provides a description of Espoo smart city lighthouse demonstrations.
D3.3 – Implemented demonstrations of solutions for energy positive blocks in Espoo	Provides a description of Espoo smart city lighthouse demonstrations.
D3.5 - EV mobility integration and its impacts in Espoo	Presents some of the developed and demonstrated E-mobility integration actions.
D3.7 - Replicating the smart city lighthouse learnings in Espoo: technical, social and economic solutions with validated business plans	Provides a replication and scale-up methodology that is useful for the Lighthouse Cities to share the knowledge achieved in the SPARCS project with other cities.
D7.1 Business Models and Financing Mechanisms for Wide Uptake of Smart City solutions	Contributes to and reports business model work in the SPARCS project.
D7.4 Lighthouse Cities Start-Up Smart City Challenge Report and Lessons Learned	Provides a description of Start-up competition process: Sustainable Mobility Challenge and key learnings in Espoo lighthouse city.
WP01 – Urban Transformation Strategy	The Espoo specific community engagement actions presented in this report provide input for the horizontal community engagement strategy developed as part of WP1.
WP02 - Monitoring and Impact Assessment	Contributes to the baseline of the current situation in the cities, provides straightforward identification of possible solutions to be implemented.
WP05 - Replication	Helps to implement the replication activities, namely the Tasks: T5.3 Fellow City Replication Strategy, T5.4 Project Development in Fellow City and T5.5 Upscaling & Replication in Lighthouse Cities.

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1.5 Case Espoo: Baseline for community engagement activities in Espoo

Here, we describe the current state of citizen engagement in Espoo. In Espoo, resident participation has extensively utilized new methods and tools for a long time. In addition, the municipal democracy has also been continuously revised over the years. The city believes that Espoo residents are much happier than the residents in other parts of Finland (City of Espoo, 2020a). Citizen involvement and engagement are important factors in the city's work and operation. For example, engaging citizens to review new area plans is a requirement in city planning processes.

The city has produced a participation model to which it is committed through its strategy and in everything it does. Espoo´s Participation Model tells us how resident participation is executed in Espoo. It works as a guideline to Espoo's participation work and how the citizens can influence the decision making and city development.

Espoo's Participation Model consists of 4 parts:

- Vision: All Espoo residents can participate in and contribute to developing the city. This section defines what participation is.
- Goals and guidelines tell us why it is important that residents are involved and what the focus points in engagement actions are.
- Systematic participation work is a key to changing work culture from participative administrative culture to modern partnership-based network relationship. In example resident volunteer work and expertise are recognized as a possibility and resource.
- The cornerstones of participation create the guidelines for resident participation and involvement.

The Espoo Participation Model gives participatory work a vision, goals and guidelines, ways of doing interaction work and the cornerstones of participation.

Within the city structure, there are different councils that cater to the need of different age groups such as the youth council (Nuva), which has been active for 20 years and comprises forty 13–18-year-old youngsters to contribute to the decision making and planning. The Espoo youth council is the largest in Finland, and it has representatives in the city council and committees with the right to attend and speak. In 2020, it was also agreed that the youth council representatives have the right to attend and speak at city board meetings. The Espoo Elderly Council serves as an advocate for the elderly in the municipal decision making. In parallel, there is also a council for the disabled. All councils together influence the planning and preparation of the city's activities, as well as monitoring issues relevant to well-being, health, inclusion, work-life, living environment, housing, mobility, day-to-day activities, and services (City of Espoo, 2020b).

More background knowledge on citizen engagement in Espoo and Leipzig can be found from a scientific article published during SPARCS. The article is titled *Citizens and Positive Energy Districts: Are Espoo and Leipzig Ready for PEDs?*[1] and has been published as part of the journal *Buildings.* The article assesses the status quo of citizen engagement in Espoo and Leipzig to evaluate if the cities are prepared to develop PEDs together with citizens.

[1] Fatima, Z., Pollmer, U., Santala, S.-S., Kontu, K., and Ticklen, M. (2021). "Citizens and Positive Energy Districts: Are Espoo and Leipzig Ready for PEDs?" *Buildings* 11, no. 3: 102. https://doi.org/10.3390/buildings11030102

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2. INTRODUCTION TO CO-DESIGNING SMART AND SUSTAINABLE CITIES

To address optimizing people flow and user experience for positive energy districts, it is relevant to first define what is meant by *optimization*, *people flow*, *user experience*, *energy positive districts*, as well as *sustainable business models*. Here, we provide background, context, and theoretical key definitions to form the base of the work. To understand the background, we will later provide an overview of the Espoo lighthouse city which has been the context for the engagement activities.

2.1 Optimization and people flow

In SPARCS, we focus on what an optimal people flow and user experience looks like from a citizen perspective in Espoo. *Optimizing* refers to as changing things for the better from an end user's point-of-view, while considering the four lenses of innovation (described in more detail in *0 Business model co-creation playbook*): desirability, feasibility, viability, and sustainability. Here, sustainability covers ecological, social, as well as economic aspects of sustainability. *People flow* refers to people and material streams in the city as well as the daily experiences of citizens related to mobility, moving from place A to B in and between buildings. People flow has a significant importance in how citizens experience their city and how they go about their daily activities. Inside a building, people flow might specifically mean people moving smoothly, safely, comfortably, and without waiting (see more People flow experiences, KONE). On a city level, people flow is extended to also cover mobility and navigation within the city in a smooth and sustainable way.

User experience (also *UX*) is an important factor to understand when evaluating the overall experience of a person using a product, service or similar, evoking diverse feelings, beliefs, and preferences (Law et al., 2008). From a citizen perspective, an optimal *people flow experience* is unique for each citizen: One appreciates the easiness provided by a private car to transport people and equipment in a fast and convenient way, and another person enjoys the ease of well-functioning public transport with the possibility to change mobility mode in mobility hubs. From a business perspective, good people flow happens when users, solutions, and operations are in perfect harmony – forming ecosystems of people, platforms, and service providers.

2.2 Positive energy districts and energy communities for smart and sustainable cities

Sustainability is an essential dimension when talking about smart cities. When planning smart cities, one of the ways to achieve sustainability and reduce greenhouse gas emissions is through the promotion of sustainable energy. In achieving a profound sustainability impact on a city level or within a specific city district, positive energy districts have gained attention when building sustainable energy systems.

In SPARCS, *positive energy districts (PED)* are defined as geographical locations that produce more energy than they consume while providing ancillary services like flexibility and storage to the grid. However, the exact definition is still evolving, and considerations on spatially distributed generation and increased consumption during curtailment must be elaborated. The European Strategic Energy Technology (SET) Plan aims to establish 100 Positive Energy Neighbourhoods in Europe by 2025. Here, the local actors and

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stakeholders, including the residents, play a crucial part as part of the system and the local communities. Engaging citizens in the PED planning and design, and practical development and utilization of the solutions is thus central for successfully generating such future urban areas.

Energy communities are a social concept focusing on local energy production and distribution, that have gained traction recently due to the move towards more sustainable energy systems. The aim of energy communities is to expand the acceptance of renewable energy by enhancing citizen engagement and social cohesion. In addition, energy communities aim to increase the role that citizens have in the energy transition via expanded funding options. Energy Communities are defined in two EU directives, the Internal Energy Market Directive and the second Renewable Energy Directive. Together these definitions provide a legal framework to support PEDs, where citizens can collaborate in producing and distributing energy.

Energy communities are already established in many European countries, but power sector regulation often restricts the options that normal consumers have. This is often because regulation on energy does not change as fast as the surrounding research and business activities do. Although municipally owned utilities may support Energy Communities through membership or as service providers, utilities often consider such development as a threat to their traditional business model and refuse cooperation.

The Co2mmunity project, funded by the EU Regional Development Fund, has prepared a Finnish manual[i] for implementing energy communities. The publication describes the steppingstones of constructing an energy community, and explains a tool used in the Co2mmunity-project to promote community energy, the renewable energy cooperative partnership (RENCOP). Lessons learnt in the process of Energy Community development include avoiding reliance on external consultants while increasing local ownership and small and medium-sized enterprises' participation, ensuring equitable sharing of benefits, avoiding interventions that extend across municipal borders, coordination with networks like RENCOP, as well as public outreach and facilitation of neighbourhood hearing sessions. (Horn et al., 2022)

While excellent synergies exist between the legislative provisions of Energy Communities and academic efforts to develop Positive Energy Communities, the municipal process of combining these two concepts and pursue the concrete development of citizen-centred, locally administered, and low carbon communities is very complicated.

Next to energy related developments, the future urban sustainable and smart districts also need to incorporate other elements of city development, such as mobility, housing, services, green-and-blue infrastructure, and public space design, in order to create areas that are liveable and attractive for citizens and workplace locations, and which operate as a system of interconnected sustainable and smart city solutions. This holistic PED development requires new approaches towards city planning and design.

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2.3 Demographic characteristics of Espoo

Espoo is located in the capital Helsinki Metropolitan Region in Southern Finland. In the turn of the year 2021/2022, there were around 287.000 residents in Espoo, and over 135.000 jobs. The municipality is divided into seven larger administrative areas, of which the two largest areas Greater Leppävaara (~74.000 residents) and Greater Espoonlahti (~57.000 residents) also house the SPARCS demonstration areas.

Espoo is developed as a network city with five urban centres – Espoo Centre, Leppävaara, Tapiola, Matinkylä and Espoonlahti – located in the central and southern parts of the municipality of 528 km^2 area. The centres are actively developed as mixed-use areas with residency, workplaces, public and commercial services, education facilities, and others located in each centre. The centres are connected via public transportation and rail services, and roads and highways to one another as well as to the neighbouring areas, including the capital Helsinki area. Most trips in Espoo, in total 48 %, are made with private cars, whereas 28 % of the trips are made by foot, 14 % by public transport and 8 % by bike. During 2021, Covid-19 restrictions impacted the mobility habits in Espoo, increasing slightly the use of private driving and walking, and decreasing the use of public transport. (Espoon liikennekatsaus, 2022)

A large number of Espoo inhabitants has a college or university degree, and students comprise a significant number of the city's whole population. The city is growing rapidly: in 2021, the population grew by 1,5%, which equals around 4.300 residents. A significant number (20,1%) of the Espoo citizens speaks another language than Finnish, Swedish or Sami (the official languages of Finland) as their mother tongue, with a significant increase in the share of other languages during the last decade. There were 136.194 households in Espoo in the turn of 2021-2022. 71% of the households were small, one- or two-person households. One-person households were the most typical household type in Espoo. Of the household increase in 2021, 75% were one-person households. (Espoo, n.d. a)

In contrast, there were 78.406 families in Espoo in the turn of 2021-2022. 76% of the Espoo population belongs to family demographics. The average family size is 2,85 persons. The most popular family type is a married couple or a registered couple and at least one child. There are 36.241 families where there are at least one under aged child, meaning 46% of all families. 14% of all families are families with one caregiver and 22% of all families with children are child families with one caregiver. Around 15% of the Espoo inhabitants are over 65 years old, and the number of over 65 years old Espoo citizens is estimated to grow in the next ten years. The population is aging, and the number of one-person households is growing in the future according to predictions. (Espoo, n.d. a)

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2.3.1 Sustainable lifestyle in Espoo

In 2013, Espoo launched a cross-administrative sustainable development programme that has reduced the city's greenhouse gas emissions together with companies in the region for two terms. The programme is now in its third iteration for the 2021-2025 council term. Accelerated by the current council term, Espoo will be made a carbon-neutral pioneer city by 2030. Espoo's key goal is to be the most sustainable city in Europe, as defined in the city's strategy 'Espoo Story' (Espoo, n.d. b). As Finland's fastest growing city, Espoo is a prime example of the fact that sustainable growth is possible.

The Sustainable Espoo cross-administrative development programme implements the city strategy – the Espoo story – and directs development work to achieve set city's goals. Espoo's sustainable development work develops, tests, and introduces new operating models as well as future sustainable urban solutions together with partners and citizens. Achieving the ambitious goals require co-operation and input from many actors: the city, businesses and citizens alike are the main change agents. To achieve carbon neutrality, citizens must also make sustainable and ecological decisions and solutions in their daily lives. Part of this development is the introduction of a sustainable lifestyle into the daily lives of every citizen of Espoo. The city wants to contribute to enabling and supporting a functional and sustainable living environment for its residents and seeks to bring the themes of sustainable living closer to Espoo's everyday life through information, inspiration, and discussion.

Implementing sustainable lifestyle with citizens has centralised around events, activities and so on. The actions that an individual can make can be small but make a great difference regarding the environment and sustainability on a city level. Citizens have been especially interested in sustainable living and learning how to influence sustainability-related issues.

In the SPARCS-project, the aim is to implement sustainable lifestyles and tell and inform about these themes and opportunities to citizens. The goal is to reach residents extensively and from all segments. In the project, we strive to reach a broad variety of citizens and different citizen groups in ways that suit them and address topics of their interest. Various events, buddy class activities, surveys and communication activities actively support these matters throughout the project.

2.4 Sustainable urban mobility transition and behaviour change

One of the main areas of carbon neutral city development is mobility. Mobility represents 'almost a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution in cities' (European Commission, 2016). Mobility consumes a considerable amount of energy and material resources. Approximately 25% of global energy consumption comes from transportation, mostly from unrenewable energy sources (EIA, 2016). While most of the consumption and emissions of mobility derive from the use phase (Sala & Castellani, 2019), it is relevant to consider mobility behaviours as part of creating a sustainable urban mobility transition. Sustainable urban mobility transition here refers to 'transition to forms of mobility that produce fever greenhouse gases and use less fossil fuels' (Temenos et al., 2017).

In T3.6 Community engagement work, one of the objectives is to study Espoo citizens (un)sustainable everyday mobility behaviours and practices. The aim of this work is to

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create a holistic understanding of matters affecting Espoo citizens (un)sustainable mobility choices and identify opportunities for encouraging more sustainable mobility behaviours.

Mobility behaviours are affected by both internal and external factors (Chng, 2021). Examples of external factors are land use and the supply of mobility options. Internal factors are, for example, attitudes, lifestyles, and routines. As the movement of people is a sum of many factors, it is important to address mobility from a holistic perspective. This demands a systemic perspective, where diverse actors (such as the civic society, businesses, and politics), land use and infrastructure, as well as the material perspective (such as new technologies and the changes they demand in legislation, infrastructure, and people's practices, in other words, know-how and routines/habits) are considered.

Sustainable urban mobility requires smart energy consumption in mobility. It can be achieved in two ways: either through adoption of cleaner and more effective technology or by decreasing or optimizing people's mobility practices. Currently, mobility is being electrified, automated, and home deliveries are becoming more common, especially motivated by the COVID-19 pandemic. Businesses are fighting for a leader position in the servitization trend. Home deliveries are decreasing people's need to move to places as necessities may be ordered to home. Simultaneously, a worry towards the decrease of people's active movement and its societal health consequences is increasing. In the system of mobility everything is connected. Also, less focus is given to the often-marginalized people groups when future mobility systems are designed. However, essentially mobility and accessibility should be democratic, just, and socially, ecologically, and economically sustainable.

The community engagement activities in SPARCS have focused on diverse citizens, such as youth and students, elderly people, families, and people with disability, by engaging them in the development and co-design of future mobility and sustainable lifestyles in Espoo. As a result, co-designed interventions have been planned and implemented. By *intervention* we refer to concepts and solutions aiming to create behaviour change towards more sustainable urban mobility and lifestyles in general. These interventions have been validated and tested together with citizens and experts. In this report, we present 30 community engagement activities in more detail and eight concepts that stem from the citizen engagement activities. We also present sustainable mobility transition and behavioural insights related to Espoo citizens' mobility needs, desires, challenges, and practices. These results are also published through several academic articles.

2.5 Co-designing smart and sustainable business models

Community engagement work serves no purpose unless it is combined with wider ecosystem engagement to shape new business models and platforms for *smart city* context. As cities are growing and global challenges are getting more complex, there is a constant need to search for new solutions to maintain a good quality of life for the society and for the planet. Cities improving sustainability with the help of technologies are referred to as *smart sustainable cities* (Ahvenniemi et al., 2017). Connectivity and smart solutions enable cities to become structures where actors on different levels including individuals and companies, are all creating and capturing value.

One objective in SPARCS is to co-design business model concepts supporting the energy transition in cities toward carbon neutral energy supply with the optimal and most cost-

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efficient ways for arranging the cross-sector collaboration. This work has been conducted by piloting ways to co-create business models together with different stakeholders, focusing especially on people and material flow. The business design work has included identifying and developing business models that create and capture ecological, social, and economic value within a complex platform ecosystem of multiple different stakeholders.

In general, business model innovation has gained a great interest in research and business in the past decades (see for example, *Clarifying Business Models: Origins, Present, and Future of the Concept by A. Ostenwalder et al., 2005; Magretta, 2002*). Especially from a design thinking perspective, a *business model* is seen as an overall concept how a company creates, captures, and delivers value. It entails the logic of what the company offers (value proposition), to who (the target customer), how the value proposition is created (value chain), and how does the model generate profit (profit mechanism) (Richardson, 2008). In other words, it entails the elements of 1) customer value proposition, 2) organizations resources and skills to deliver this value proposition, 3) the processes used to convert inputs to finished solutions, as well as 4) the assets and cost structure to cover these activities (Christensen et al., 2016).

Today's *platform businesses* are often described as complex *platform ecosystems*, where multiple stakeholders interact with each other to co-create value (Gawer & Cusumano, 2013). Rapid technological development requires new public-private-people partnerships and the traditional roles in private and public sector are getting blurred. New type of collaboration is happening in larger ecosystems where all sectors are needed to exchange value, including the city and other public sector organizations, service providers, private companies, and citizens.

A sustainable business model refers to 'a model whose rationale for value creation, delivery, and capture allows an organization to contribute to solving sustainability challenges and to promoting sustainable development' (Lüdeke-Freund et al., 2021). These kinds of business model innovations are the key drivers to advance sustainable mobility in smart cities. Business models in the field of smart sustainable cities can be seen as *ICT and data-enabled business models that encourage sustainable behavior*, and preferably consider the whole lifecycle of a service and operations (circularity). They bring value to several different stakeholders in the ecosystem, also from a social and/or ecologic point of view as opposed to one-dimensional profit maximization.

2.5.1 The City of Espoo supporting business ecosystem development

To set the scene for business model co-design, a brief separate report was prepared in 2021 to establish foundations for new business development in Espoo, titled *Espoo: The City as an Environment for New Business Development*.[2] The report covers different key elements of new business development in the city area, and how the city organization supports this development. A bried summary of the report is presented here, the whole report is available in the project bank.

The city strategy - the 'Espoo Story' - provides the backbone for all development work in the city. The previous strategy from the council term 2017-2021 sets a target for Espoo

[2] Bartel, A., Kaurila, M., Mäkinen J., Tartia, J. & Wanne, E. 2021. *Espoo: The City as an Environment for New Business Development.* SPARCS internal report (unpublished), available on the project platform VTT Teams.

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that the city cooperates with different stakeholders and brings them also together, including companies, organizations, different city departments and citizens. Municipal services, for example, are developed together with different stakeholders. The 'city as a service' approach practiced in the city means that new ways of doing things together are actively sought for. *Make With Espoo* is a digital environment that works as a platform for co-creation in education and city services and provides manuals and a databank for co-design processes and methods.

Different externally funded development projects in the Sustainable Espoo development program - that support the carbon neutral Espoo 2030 target and the achievement of the United Nations *Sustainable Development Goals* (SDGs) - also incorporate this co-creation thinking. Different projects have, for example, piloted new innovative urban mobility and circular economy solutions with different companies and organizations to find new low-carbon and shared services that support sustainable lifestyles.

In 2020, there were 14.000 companies in Espoo that provided over 109.000 jobs in total. Around 60 % of these jobs are in the service sector, 20 % in retail and tourism, and 20 % in industry and construction. The experiences of the companies about Espoo as an operational environment are studied yearly through surveys. Currently, the main challenges relate to slow urban planning and zoning processes, limited public transportation connections in some specific areas, lack of suitable premises, and slow permit processes. The main strength, on the other hand, are currently that Espoo is generally a good place for businesses, the city has a positive attitude towards them, and the location is in the capital metropolitan region.[3]

Business Espoo is a service network that helps companies and entrepreneurs in the area. It is made of seven organizations. The general idea behind it is that it serves as a platform where all the different services are located under one roof. The services provide help in all the different phases of a company's lifecycle, from the businesses just starting their operation to more established ones. Business Espoo is located at the Aalto University's campus in Otaniemi, creating a hub of innovation and entrepreneurship.

The city has also formed strategic collaboration with organizations. Research organizations such as VTT and Aalto University accelerate the creation of new businesses and entrepreneurships. Smart Otaniemi innovation ecosystem acts as a facilitator of supporting new business creation.

[3] Espoo yritysten toimintaympäristönä 2020. Espoon kaupunki. Taloustutkimus Oy.

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3. COMMUNITY ENGAGEMENT APPROACH

In this section, we describe the community engagement approach motivated by two main SPARCS objectives: placing citizens at the center of decision-making processes and increasing public awareness of the change towards more sustainable cities (SPARCS, n.d.). We describe community engagement activities and their process on a timeline. The aim of the activity descriptions is to provide insights for replicating these activities in fellow cities and cities globally for developing Positive Energy Districts.

Community engagement (also *citizen engagement*) is defined as public participation, stakeholder involvement, co-creation, civic engagement, participatory democracy, or activism (Carpini et al., 2004). It is also described as individual or collective behavior that focuses on determining the social problems of a community (Ekman & Amnå, 2012; Gil De Zúñiga et al. 2012; Zukin et al. 2006). A clear definition of citizen engagement does not exist, but its true nature is the interaction between citizens and government (Ekman & Amnå, 2012; Fatima et al., 2021). To be able to make a true impact, citizen engagement must be embedded in every stage of the decision-making process and be conducted with deep commitment, proper allocated time, and co-design interest. Merely adopting a tick-box approach or having citizen participation at the end of the process will not have the desired result or be beneficial for stakeholders (SCIS, 2019).

The specific focus on community engagement has strongly guided the methodology of the tasks in question. The community engagement objectives have been approached through *design research* and *collaborative design* (also *co-design*) approaches. Here, *design research* refers to research activities conducted by a researcher/designer for understanding the needs, desires, and challenges of the end users and utilizing this knowledge for design purposes (Cooper, 2019; Margolin, 2016). *Co-design* refers to inviting various people to participate in and contribute to a design process (Sanders & Stappers, 2008). In the co-design approach of this report especially citizens have been placed in the focus of development efforts, while also engaging other relevant stakeholders in the co-design processes. Figure 2 presents the design research and co-design process approach that has been applied in the community engagement activities.

Based on the definitions and different understandings of community engagement, our take of community engagement in SPARCS has been to involve the citizens from the beginning of the project and foster new interactions between different stakeholders: the city, business stakeholders and citizens. Citizens are perceived as co-creators with valuable ideas to meet social needs. In all the activities, we have reached out to citizens and invite them to engage. In this way the community engagement has become a bottom-up approach, despite being led by companies and the city. Traditional citizen-led engagement activities, for example, participatory budgeting has not been included as part of the community engagement approach as it has not been seen as a way to engage a wider community, including public and private partners.

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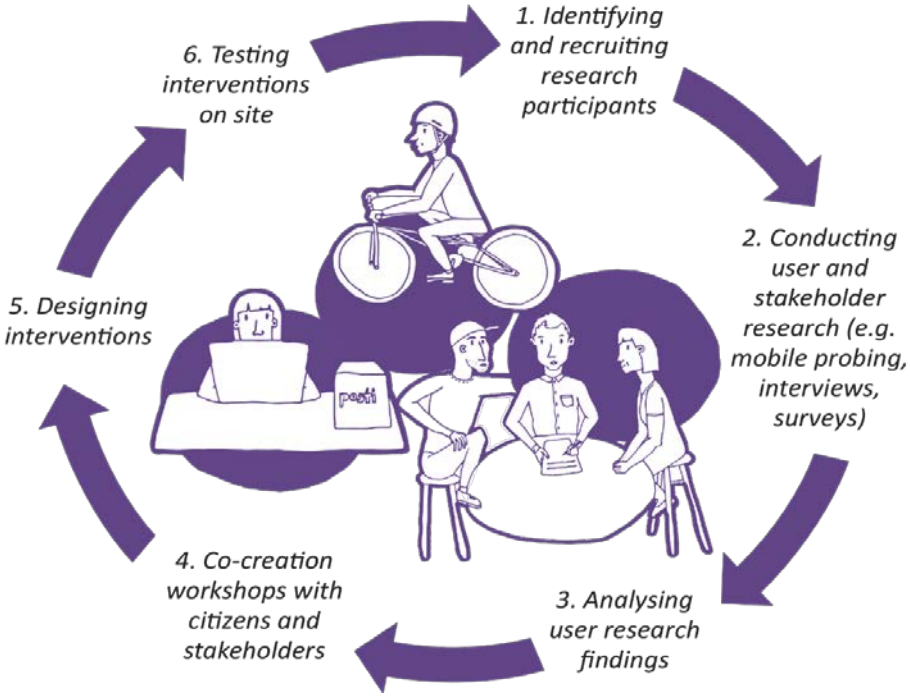

Figure 2: Community engagement research and co-design process visualization. Image: Saga-Sofia Santala and Satu Niemi. (Source: KONE)

The community engagement activities have followed a similar process, where first, (1) research participants have been identified and recruited by the activity organizers. Recruiting has taken place especially through diverse online and offline channels, and in some cases a recruiting company has been utilized. Then, (2) the research activities have been conducted. Various methods (such as mobile probing, surveys, and interviews) were utilized for gaining a proper understanding of citizens' and other stakeholders' needs, desires, and challenges. After this, (3) research and collaboration materials were analysed by activity organizers. Sometimes, also collaborative analysis sessions have been organized among the project partners. Then, (4) co-creation workshops have been conducted with various citizens and/or stakeholders based on the insights generated through the analysis phase. Finally, (5) interventions have been designed based on the research and co-design insights and (6) tested on site.

3.1 Community engagement activities

The community engagement activities presented here have been organized by KONE, VTT, the City of Espoo and Citycon along the project in 2020-2022. In this section, we present these activities in detail (see Figure 3 for an overview of community engagement activities and project timeline). The activities are distributed based on their focus under four chapters, which are:

- *3.1.1 Studying and co-designing for sustainable urban mobility behaviours*,
- *3.1.2 Supporting sustainable behaviours*,
- *3.1.3 Sustainable business model co-creation*, and
- *3.1.4 Sustainable lifestyle in future Espoo*.

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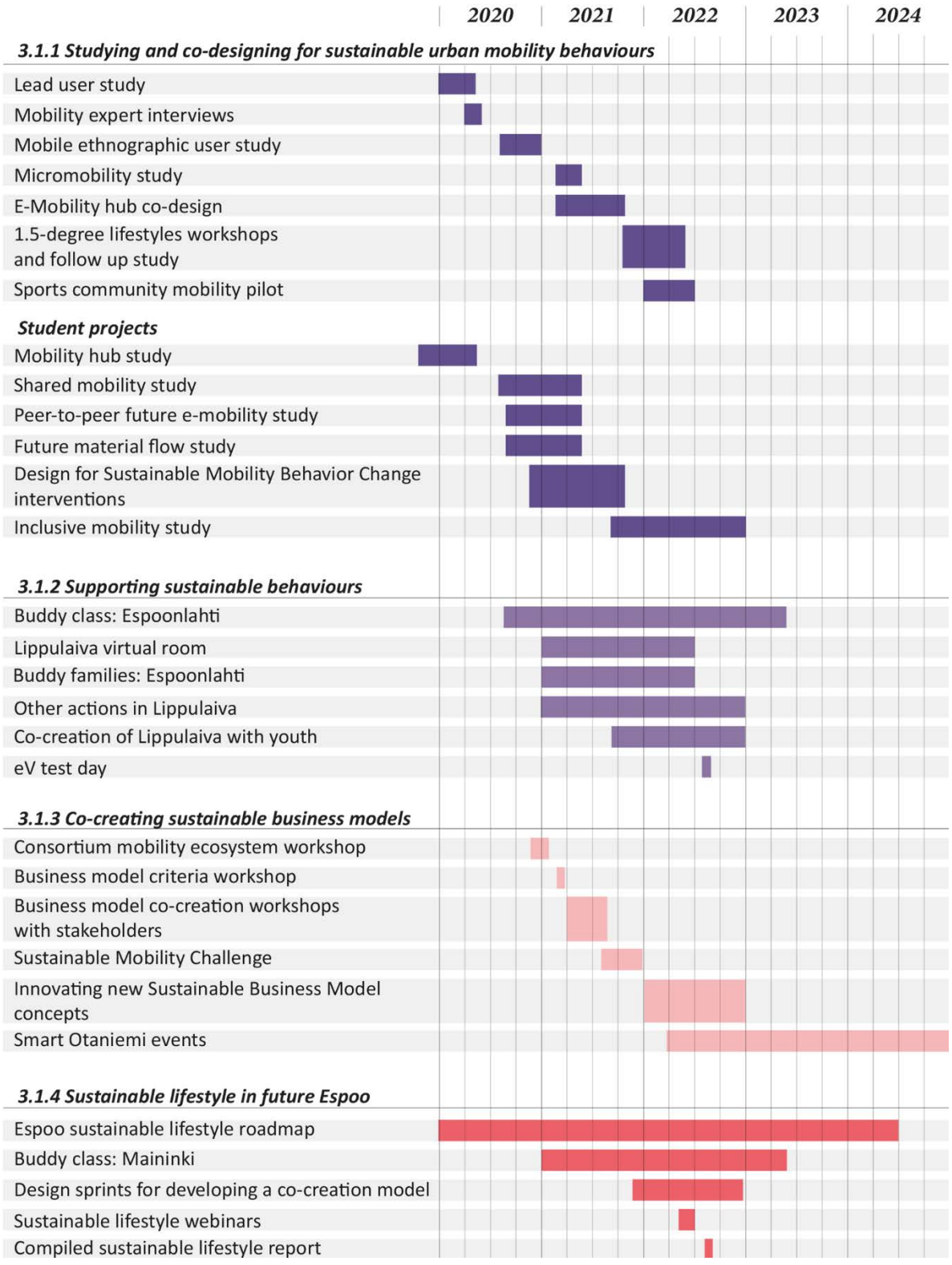

Figure 3: Overview of community engagement activities and timeline. (Source: KONE)

In the beginning of each chapter, there is a table listing the community engagement activities under that section. The table provides information about the duration of the activity, description of the type of engagement, and related subtasks and actions for making it easier to link the activities with related objectives. In addition to the tables, we provide a detailed description of each activity and related research and co-design process.

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3.1.1 Studying and co-designing for sustainable urban mobility behaviours

In this chapter, we present in detail community engagement activities related to studying and co-designing for sustainable urban mobility behaviours (listed in Table 10). The activities aim to define and validate solutions for encouraging people to change their daily mobility habits optimizing people flow from an energy and user experience perspective.

Table 10: Community engagement activities *for Studying and co-designing for sustainable urban mobility behaviours*

Community engagement activity (time)	Description of type of engagement	Demonstration area	Related subtask	Related action
STUDYING AND CO-DESIGNING FOR SUSTAINABLE URBAN MOBILITY BEHAVIOURS				
Lead user study (January - April 2020)	Online and offline interviews with 7 sustainable mobility lead users on a global scale	Global, Espoo	T3.6.1	E8-1 E19-1
Mobility expert interviews (April - May 2020)	Online and offline interviews with 11 mobility experts on a global level	Global, Espoo	T3.6.2	E4-1 E9-1 E19-1
Mobile ethnographic user study (August - December 2020)	An 8-week mobile probing study (preceded with a preliminary survey and interview and followed by a co-design workshop) with 10 diverse Espoo citizens	Espoonlahti, Leppävaara	T3.6.1	E3-1 E3-2 E8-1 E11-1 E19-1
Micromobility study (March - May 2021)	An online survey distributed to Espoonlahti and Leppävaara citizens regarding the use of micro mobility solutions. A design sprint workshop conducted with 7 Espoonlahti citizens to develop new micro mobility solutions.	Espoonlahti, Leppävaara	T3.6.1	E3-1 E8-1
E-Mobility hub co-design (March - October 2021)	An online design game and a series of co-creation workshops with diverse mobility hub stakeholders in Espoo.	Espoo	T3.6.1	E8-1 E8-2 E19-1
1.5-degree lifestyles workshops and follow-up study (November 2021 - May 2022)	Two offline workshops with 26 households (preceded with and followed by a carbon footprint and behaviour change survey). Thematic semi-structured follow-up group interviews with 12 households.	Espoonlahti, Leppävaara	T3.6.1 T3.6.2	E3-1 E3-2 E8-2 E11-1 E19-1

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Sports community mobility pilot (January - June 2022)	An 8-week pilot with a mobility data application used by two sport teams In Espoo. Background and feedback surveys. Data review and group interview workshops.	Espoo	T3.6.1	E19-1
Student projects				
Mobility hub study (September 2019 - May 2020)	A student project (Aalto University IDBM19-20 course).	Global, Espoo	T3.6.1	E19-1
Shared mobility study (June 2020 - May 2021)	A student project (Aalto University Master's Thesis).	Espoonlahti	T3.6.1	E3-1 E3-2
Peer-to-peer future e-mobility study (September 2020 - May 2021)	A student project (Aalto University IDBM20-21 course).	Espoo	T3.6.1 T3.6.2	E8-1, E8-2 E9-1
Future material flow study (September 2020 - May 2021)	A student project (Aalto University PdP20-21 course).	Global, Espoo	T3.6.1	E19-1
Design for Sustainable Mobility Behavior Change interventions (January - October 2021)	A student project (Aalto University Master's Thesis).	Leppävaara, Espoo	T3.6.1	E8-1
Inclusive mobility study (September 2021 - December 2022)	A student project (Tampere University Master's Thesis).	Global, Espoo	T3.6.1	E3-2

Lead user study

In Spring 2020, *a lead user study* was conducted with seven lead users about their novel mobility innovations for understanding current trends, possible future directions, and opportunities of sustainable urban mobility. Lead user research as a method enables exactly this, as lead users are individuals or firms, who experience 'needs that are ahead of the target market(s)' and innovate for solving these needs (Churchill et al., 2009). The seven lead users, representing both private people and companies, were identified through snowball sampling, and interviewed face-to-face or online about their novel

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mobility innovations by two KONE design researchers. These lead users were identified on a global scale, as Espoo represents a small area, and many lead user innovations can be expected to have been born also outside of Espoo. The interviews lasted for 45-75 minutes. The so-called 'user innovations' focused on the field of mobility from specific vehicles to new kinds of services. Many of the innovations focused on different kinds of peer-to-peer sharing services. Seven novel sustainable mobility solutions were identified as a result of the study, providing an understanding of novel sustainable urban mobility intervention opportunities in Espoo.

Mobility expert interviews

In Spring 2020, *expert interviews* with eleven mobility experts from nine different organizations were conducted as the first steps of the project. The aim of these thematic semi-structured interviews was to form a preliminary holistic understanding of the current challenges, opportunities, and trends in the field of sustainable urban mobility. Two KONE design research specialists conducted the interviews, and the transcribed material was analysed by the same researchers through thematic clustering. Eleven insights were formed based on the data analysis. These insights provided a basis for the following user studies in SPARCS, by highlighting interesting and relevant sustainable urban mobility themes to investigate in more detail from a citizen perspective.

Insights from the expert interviews show that businesses struggle to reach the critical masses to meet the supply and demand in profitable business. Even though innovative mobility services and solutions are being introduced to the market with an increasing speed globally, for end-users' new mobility solutions are still relatively unfamiliar. Answering the customers' and users' demands requires risk taking and investments both from public and private sector.

Mobile ethnographic user study

In Fall 2020, an eight-week *mobile ethnographic user study* was conducted by KONE with ten Espoo citizens from Leppävaara and Espoonlahti to understand Espoo citizens' current mobility experiences, needs, and factors affecting their mobility behaviours. Previous expert interview insights served as a basis and input for the user study. Ten diverse citizens of Espoo were identified through a preliminary survey posted on different social media forums. These forums, such as 'Sähköautot - nyt!', 'Espoonlahti', and 'Espoon pyöräilijät' were identified, together with the City of Espoo. We got 41 enrolments, of which ten were selected for the user study. The selected participants varied in their age, mobility behaviours and attitudes towards sustainability, to name some. The goals of the research were twofold. On the one hand, with regards to diversity of the participants, the aim was to gain a wide understanding of the different needs, expectations, and challenges of citizens of Espoo related to mobility in Espoo. On the other hand, the key decision-making moments and factors affecting people's mobility choices on a more general level were studied.

The user study started with a pre-interview for creating preliminary understanding of participants' mobility characteristics, engaging them in the study, and introducing the mobile probing activity. Mobile probing is an ethnographic method which enables capturing insights of citizens' mobility behaviours in the field 'on the move' in their typical

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spatial and temporal context (Muskat, 2020) – see for example Figure 4: Images from the diverse contents self-documented through WhatsApp by selected Espoo citizens. The method allows participants to actively generate information as they document their everyday life, thus revealing their sometimes-hidden feelings and dreams (Sanders & Stappers, 2008). Mobile probing exposes latent knowledge in a way that other methods fail to serve, such as interviews alone, by creating awareness through self-documentation. When the participant becomes aware of their own behaviour and choices, they are also more prepared to communicate these to the researcher-designer.

Figure 4: Images from the diverse contents self-documented through WhatsApp by selected Espoo citizens. (Source: KONE)

The mobile probing activity lasted for two months and was followed by semi-structured 1-on-1 online interviews. In the interviews, the probing material was investigated in more detail together with the participants and more detailed questions were asked. After the final interviews, both mobile probing and interview data was co-analysed by the study organiser and challenges, opportunities, and preliminary concept ideas were addressed based on the analysis. The identified themes included: 1) sustainable mobility and behavioural change, 2) moving with private car, 3) moving with public transportation, 4) hybrid and shared mobility, 5) walking and micro mobility, and 6) material ordering and home delivery. Based on the themes, three user experience (UX) goals were formed: 1) Experience of being appreciated, 2) Experience of meaningfulness, 3) Experience of freedom. Also, 11 initial mobility concepts were designed and presented to the research participants in a final workshop, where the presented insights were validated, and concepts were further developed through a co-design activity.

The mobile probing, supported with interviews and a co-design workshop, provided a wide understanding of the mobility behaviours and mobility needs of Espoo citizens. Insights created through the user study, formed a basis for following mobility-related workshops and Design Sprints presented in this report. The insights are presented in section 4.1.

Micro mobility study

Based on mobile probing study and sustainability goals to increase the use of micro mobility solutions in the future, a study on micro mobility was conducted by KONE and Citycon at Espoonlahti and Leppävaara districts in Spring 2021. In Espoonlahti, the aim was to engage a wider public and to gain understanding of the current state of micro

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mobility solutions locally. The secondary objective was to find new solutions for improving the micro mobility around the newly built Lippulaiva complex. The study was organized as an iterative design process. First, preliminary understanding was gained via online surveys distributed through social media channels at Espoonlahti and Greater Espoonlahti areas, and Leppävaara areas. Second, a design sprint was conducted based on the survey results, including qualitative interviews and an online co-creation workshop with Espoonlahti residents. The results of the co-creation workshop were utilized in the concept creation for new micro mobility solutions as well as to map out possible new shared micro mobility solutions to be located around Lippulaiva (such as cargo bikes, e-scooters, big wheeler kick bikes for elderly and so on).

In total, 79 residents from Espoonlahti and 41 residents from Leppävaara responded to the survey. The survey questions were related to demographic information, daily distances and mobility modes to school/work, and experiences of existing micro mobility vehicles: types of different vehicles, purposes for using, motivations and hindering aspects, experiences and wishes for development. The survey highlighted differences in micro mobility between the two demonstration areas. Espoonlahti was selected as a focus area for the design sprint due to the developing Lippulaiva shopping center and mobility hub. At the time of the study, Lippulaiva was in a construction phase and required considerations on how user-friendly and sustainable micro mobility solutions could be planned and implemented during the construction time.

Four qualitative online interviews were conducted with Espoonlahti residents. To understand the different needs of Espoonlahti residents, the chosen participants had varying life situations and were of different age. Those interviews served as input for the co-creation workshop held online with seven Espoonlahti residents. In the workshop, the participants were presented with innovative micro mobility solutions, then they were distributed in two smaller breakout groups, in which the Google Jamboard tool was used for co-creation on three themes: 1) new ways to park and lock micro mobility vehicles, 2) solutions for moving goods and 3) locations of shared mobility services in the Espoonlahti area (Figure 5).

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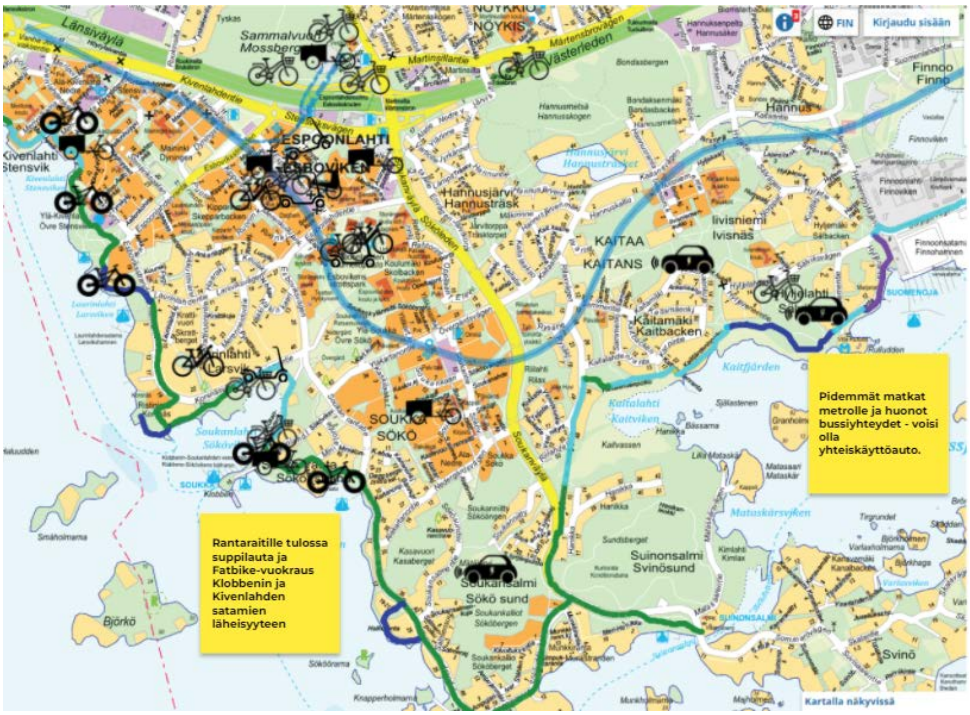

Figure 5: Workshop participants located preferable future shared mobility solutions on the map of Espoonlahti area, including city bikes, cargo bikes, fat bikes, e-scooters, and e-cars. (Source: KONE)

The workshop results were directly utilized in developing the Micro mobility parking and Shared cargo vehicle concepts, as well as highlighted several areal improvement needs for Espoonlahti: better coverage for city bike services, e-scooters and special bikes, for example, cargo bikes, two- and four-wheelers and fat bikes; safer public parking places for micro mobility vehicles; service and charging stations for (e-)bikes and better infrastructure for micro mobility users.

E-mobility hub co-design

The city of Espoo, KONE, Citycon, Plugit, and VTT co-planned and co-organized a series of workshops on an e-mobility hub concept development during 2021. The workshops aimed to develop a working concept for e-mobility hubs of the future considering the hub user and mobility service provider perspectives. Four workshops in total were organized for different stakeholders on how to design, plan and build future user-centric e-mobility hubs. The main question behind the work was: *all mobility modes are becoming electric in a rapid pace - what changes in mobility hubs (or does anything change)?* The workshop process is described here - for the learnings and results of the workshop series, please see SPARCS Deliverable D3.5.

KONE co-developed an online e-mobility hub design board which contained diverse citizen profiles (see Figure 6 for example) and visual templates to map out mobility hub users' travel chains and to identify needs for future electric mobility hubs.

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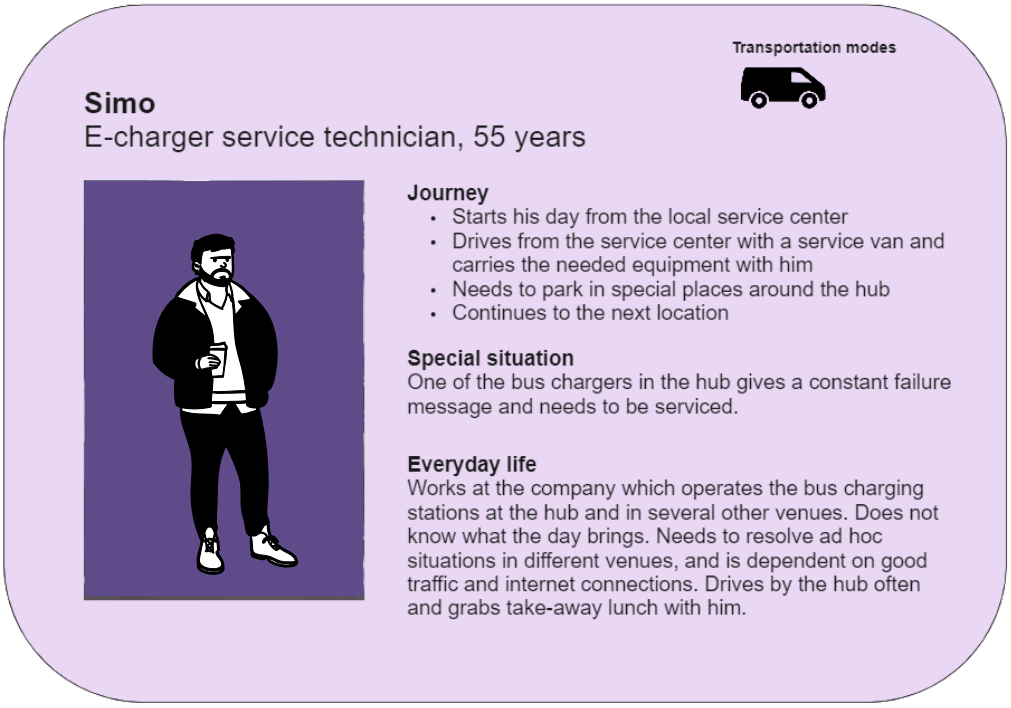

Figure 6: An example of a user profile that was used to think about the service path before / during / after utilizing the hub on a travel. (Source: KONE & City of Espoo)

The eHub workshop series contained online co-design boards on the MIRO platform that were designed separately for each workshop. MS Teams was used to host the sessions. In terms of the focus and contents, the workshop process was organized in different rounds, iteratively. Results from the first workshop were utilized as an input for the second workshop, the second fed in to the third one, and so on. Figure 7 presents the MIRO board created for the first workshops on user profiles and travel journeys through the hub.

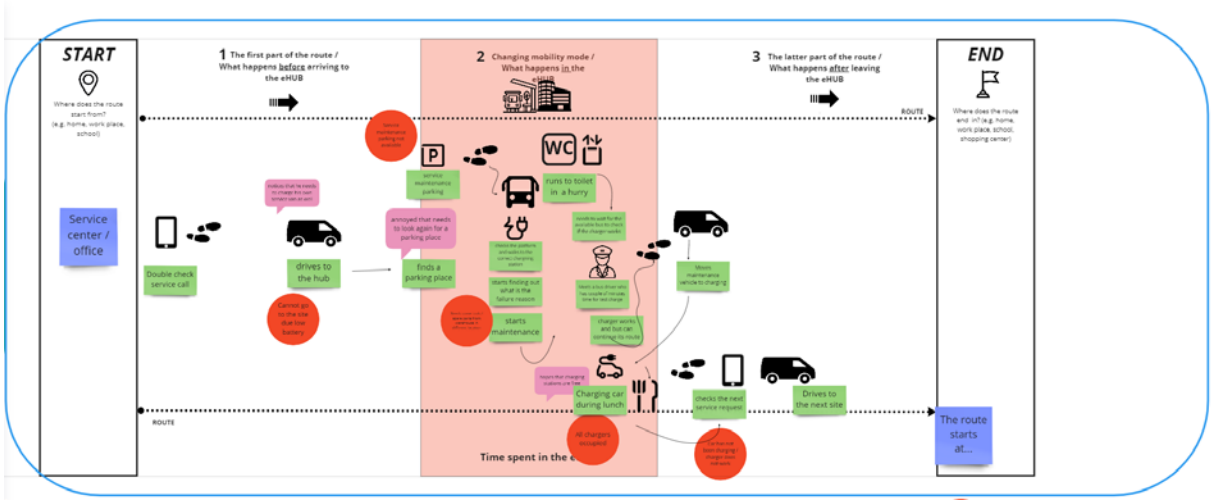

Figure 7: E-mobility hub design board with diverse citizen profiles and visual templates to map out user mobility journeys via e-mobility hub. (Source: KONE & City of Espoo)

The workshop series contained five workshops, each directed at different stakeholders. The workflow process and main focus areas of each workshop varied between the

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different iterations as the series' theme of future e-mobility hubs was approached from multiple angles.

1. *Workshop: Pilot, SPARCS consortium, May 2021*
   In the first workshop with SPARCS partner organizations, the participants created travel chains for diverse end-user profiles reflecting different characteristics of citizens in Espoo. User profiles were created for various kind of end-users: passengers, commuters, professional drivers, service technicians etc. The first workshop was held as a pilot to test the working method with the mobility experts from the WP3 partners. Here, the invitation was extended to personnel of the partner organizations beyond the ones actively working in SPARCS.

2. *Workshop: Lead users, Jun 2021*
   The second workshop was targeted to the end-users of electric vehicles and shared mobility services in large mobility hubs, such as Sello and Lippulaiva. Eight participants were recruited, which all had first-hand experience of owning or driving EVs: e-cars, e-taxi, e-bicycles, e-cargo bikes and public transport. The workshop aimed to identify the user needs in relation to e-vehicles, shared mobility services, and mobility hub use (including services, information and orientation, and accessibility).

3. *Workshop: Expert panel and mobility service providers, Sep 2021*
   The third workshop was organized as part of EU mobility week. In the workshop, three expert panelists from the Finnish Environment Institute SYKE, VTT and the city of Espoo discussed the future of mobility hubs and diverse stakeholder needs for future e-mobility hub development. After the inspirational panel discussion, the latter part of the workshops included a co-working session on the discussed themes. The workshop was targeted to service providers, mobility actors, hub operators and other stakeholders working with the theme. The main question here was: what are the requirements and needs of mobility service providers in terms of future e-mobility and shared mobility service production?

4. *Workshop: E-mobility hub concept workshop for SPARCS cities, Dec 2022*
   The final workshop was targeted to the other SPARCS cities. Brief presentation of workshop process and results were given to the SPARCS cities stakeholders followed by a co-working session in small groups to develop the e-mobility hub concept further by reflecting the previously reached results and learning with the experiences of these cities. The event had participants from five of the six SPARCS partner cities (in addition to Espoo).

The main insights and learnings from the e-mobility hub co-design process are presented in the Deliverable 3.5 'EV mobility integration and its impacts in Espoo'. Additionally, the work on the e-mobility hub futures was also taken into a mobility hub-themed workshop in April 2022, co-organized by the Finnish Lighthouse Cities with the lead from Tampere and the Stardust project. The results from the workshop series were presented in this event, and the challenge of e-mobility hub development was given for one of the small groups in the co-working part of the event to solve. The results and learnings - and the process - have also been disseminated in Finnish Urban Studies Days in April 2022 as part of a session on SPARCS co-creation and co-development work by the city of Espoo.

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1.5-Degree Lifestyles workshops and follow-up study

In Fall 2021, two 1.5-Degree Lifestyles workshops were organized with 26 households from the demo areas of Leppävaara and Espoonlahti (see Figure 8). The mobile ethnographic user study showed that citizens lack knowledge about the climate impacts of their lifestyle choices, motivating an activity built around the Climate Puzzle, a design and educational game, developed by D-mat ltd. (later D-mat). Design game refers to design activities with gamified elements (Vaajakallio, 2012). The Climate Puzzle concretizes the impact of a diversity of climate actions related to citizens lifestyles and provides citizens' a tool for planning informed carbon footprint reduction actions.

Figure 8: On the left, participants have marked their carbon footprint on the board and started to select 'puzzle pieces'. Image: Salla Lahtinen. On the right, a view of the Espoonlahti workshop. Image: Satu Niemi (Source: D-Mat & KONE)

In the workshop, participants selected carbon reduction actions for decreasing the carbon footprint of their current lifestyle to a level compatible with the 1.5-degree climate target of the Paris Agreement. Then, participants situated their selected actions on a roadmap for achieving 1.5-degree lifestyles (2.5-tons CO_2e per person in a year) by 2030. After the workshop, selected participants were shortly interviewed about their choices, reasons for selecting actions, and the positioning of the carbon reduction actions on the roadmap, as a pre-interview for a follow-up study conducted in Spring 2022. See Table 11 for a description of the workshop phases.

Table 11: 1.5-Degree Lifestyles Workshop phases.

Phase	Description of the execution of the phase
1. Carbon footprint calculation	Before the workshop, each participating household answered a carbon footprint survey by D-mat. Results were sent to the participants before the workshop.
2. Introduction of the project	Welcoming words and project presentation by SPARCS.
3. Introduction to climate change and low-carbon lifestyles	Presentation of climate change and how lifestyles affect global warming. Presentation also included a summary of participant's carbon footprints.

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4. Planning a low-carbon lifestyle with Climate Puzzle	D-mat facilitated the workshop, where participating households made carbon footprint mitigation plans with Climate Puzzle. Each household made their own plan. D-mat offered the participant individual guidance. Workshop documentation by SPARCS included recording, interviewing, and taking photos of the different phases of the puzzle.
5. Identifying systemic barriers and enablers	Participants made wishes for the public and private sector with the guidance of D-mat's facilitation, and the Climate Puzzle Wish cards. Participants also discussed the wishes among their own household. Wishes were written on post-it notes. D-mat documented and collected participant's plans and wishes.
6. Low-carbon lifestyle roadmap calculation	D-mat created a roadmap calculator for each household. The calculation presents the starting point and the carbon footprint mitigation until 2030. The documentation also includes a list of actions the households selected.
7. Discussion	In Espoonlahti, the workshop ended with a common discussion. The topic of the discussion was low-carbon lifestyles in Espoonlahti. Discussion was documented by D-mat.

Half a year after the workshop, a follow-up study was conducted with twelve selected households to study the implementation process of planned actions and the role of participants' social community in achieving planned lifestyle changes. The follow-up study utilized data from the workshops as a starting point. Semi-structured online interviews with twelve households, supported with comparing carbon footprint calculations from the workshop and after the six-month follow-up period, were conducted. Based on the follow-up study findings, twelve narratives were created, describing the characteristics and effects of close social community on Espoo citizen's behaviour (change) towards more sustainable mobility practices. The narratives will be reported in a journal article, currently under review during the writing of this deliverable.

More detailed description of the 1.5-Degree Lifestyle Workshop, Climate Puzzle, and concepts and related use cases co-created with citizens and other stakeholders and calculated by D-mat from a carbon impact perspective can be read from the report titled *1.5-degree mobility – concepts and choices*[4].

Sports community mobility pilot

As a following action from Sustainable Mobility Challenge organized by KONE, a sustainable mobility pilot was initiated in collaboration with KONE, the City of Espoo, Moprim Ltd., and the Tapiolan Honka basketball club. During the spring 2022, two basketball teams from the Tapiolan Honka club participated in the pilot. In the study, KONE introduced the Sustainable Mobility challenge winner *Moprim Move Together* community-based mobile phone application as a research intervention to Tapiolan Honka

[4]Lettenmeier, M., Kolehmainen, J., Lahtinen, S., Rinta-Jouppi, U., Ryöppy, M., Santala, S.-S., & Niemi, S. (2021). *1.5-degree mobility – concepts and choices: Concepts and potentials for carbon footprint reduction in mobility in Espoo and inhabitants' choices towards 1.5-degree lifestyles*. [Project report for SPARCS]

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basketball club. The aim was to improve the understanding related to mobility CO_2e footprint of the sports teams by using location-based mobility data collected with the app and understand the effect of community on individuals' mobility behaviors by studying whether the community and the exposure to the community's mobility data impacts individuals' mobility choices and behaviors.

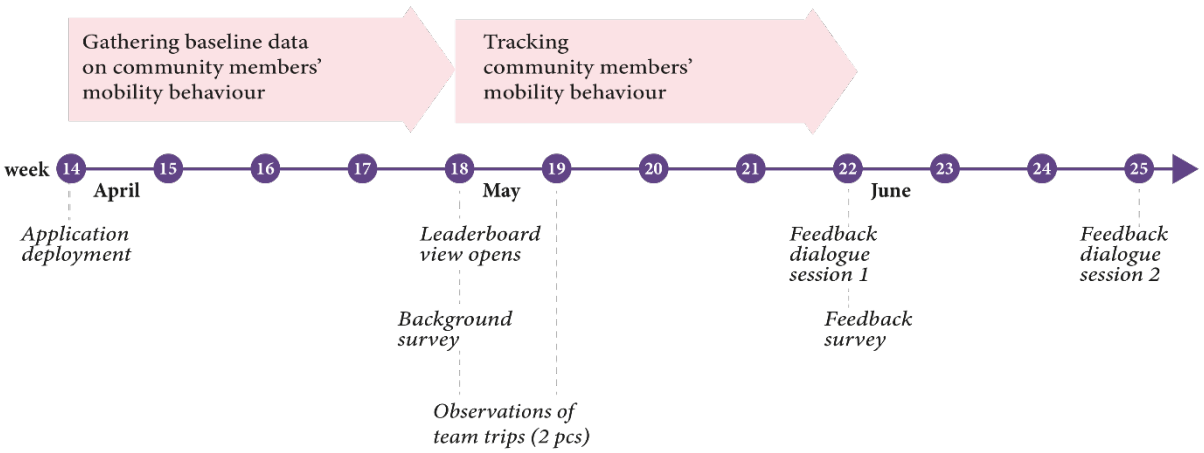

Figure 9: Sports community mobility study process. Image: Satu Niemi (Source: KONE)

Figure 9 presents the eight-week pilot process in two main phases: 1) gathering baseline data on community members' mobility behaviour (3-4 weeks) and 2) tracking community members' mobility behaviour (4 weeks). During the first week of the pilot *Application deployment* and introductions to the use of the app was given to the sport team members, including visits to the rehearsals and written instructions on the installation and remote troubleshooting. After the baseline period, *Leaderboard view* opened in the application enabling the team members to see each other's ranking based on travel kilometers and CO_2e emissions related to Honka trips. At the end of the pilot one-hour focus group interviews were held as a *Feedback dialogue session* with both teams separately.

All together 25 members from two basketball adult teams participated in the study and installed Move Together application in the beginning. The app enabled the team members to register data on their daily journeys and mobility choices. For a period of two months, the team members registered data about trips that that were related to their own team rehearsals and games as well as other trips related to Honka sport club activities. The application tracked the used mobility mode, the travel time and distance of each trip and the related CO_2e emissions. The collected data made visible the amount of travelling and the related CO_2e emissions from sports activities on a weekly basis (see Figure 10). The collected data was used to better understand the mobility behavior of the sport team members and to support transition towards sustainable mobility modes and wider community impact.

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Figure 10: Screenshots from Moprim Move Together weekly summary of collected individual mobility data presented based on distance (km), travel time (h, min) and CO_2e emissions (kg). (Source: Moprim)

Alongside with quantitative mobility data collection, qualitative field data was collected to better understand the individual and social traits of the community related mobility behaviour. The study included a field observation and qualitative interviews at the rehearsals and games of the sport teams and online surveys to the team members to collect background information in the beginning and feedback at the end of the pilot (see Figure 11). In the analysis, both quantitative weekly mobility data and qualitative data was combined to draw insights on the behavioural traits of the community members and the change potential of community mobility intervention.

Figure 11: Two teams discussing their weekly mobility data around data visualization sheets at the sports club. Image: Satu Niemi (Source: KONE)

Based on the mobility insights, the research team from KONE and Honka explored further the high impact of communities to individual's mobility behaviour. The detailed outcomes and results are presented in the chapter *4.3 Sport community mobility pilot: results*.

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Mobility hub study

In Fall 2019 and Spring 2020, four Aalto IDBM students conducted a course project on the topic of mobility hubs to research, analyse and define how KONE could contribute to smooth, decarbonized, and sustainable urban mobility in 2030. The aim was to gain a broad understanding of how the future of cities and mobility is changing as well as research and explore trends and drivers emerging from urbanization and digitalization of global mobility. The objective was to discover new opportunities and possible touch points between buildings.

Desk research on current and future urban mobility showed that transport systems are focused on creating new engineering solutions and are full of individual operators, making them complicated, confusing, and less attractive to users. They lack personalized user focus, flexible interconnectivity, and centralization, which were identified as essential for creating faster change in adopting sustainable mobility solutions.

To discover what aspects truly matter to people globally, in terms of mobility needs, user research was conducted in three locations. On field research trips, two extreme mobility examples were benchmarked. In Barcelona, a mobile probe study, interviews, and observation by exploring the city's outstanding public transport system and their Superblock initiative were conducted. In Havana, the aim was to find out how things work with limited resources and connectivity. Journaling and interviews were used as field research methods. In Espoo, a survey, and a workshop for Leppävaara residents were conducted. See images from the engagement actions and field trip notes in Figure 12.

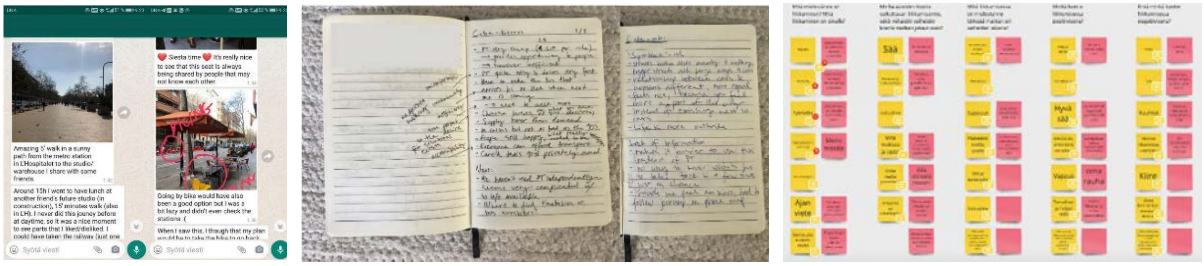

Figure 12: Images from the engagement actions. First on left, the Barcelona mobile probe highlighted aspects of urban mobility the user found pleasant or unpleasant. Image: Keny Muesa. In the middle, journaling from Havana enabled to reflect on the transportation system and the experience of a different road hierarchy. Image: Erika Sipilä. On the right, the first task of our citizens' workshop explored the subject of mobility as well as its phases and aspects. Image: Erika Sipilä. (Source: KONE)

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Figure 13: Images of the two research sites. On the left, Barcelona's Superblock area around the Sant Antoni market provides an example of a pedestrian friendly area that used to be car road and parking spaces. Image: Kirill Lazarev. On the right, the lively streets of Havana gave the experience of road space being naturally and intuitively shared by pedestrians, bicycles, and cars. Image: Erika Sipilä. (Source: KONE)

Mobile journeys 2030: Mobility hub ecosystem

By analyzing field research and on-site observations, a user-centered vision of what sustainable mobility should look like in 2030 was formed. It was discovered that knowledge of what sustainable mobility is and what kind of innovative services are already available is lacking. However, people are interested in sharing economy and choosing more sustainable modes of mobility, but suitable options are limited. The study shows that convenience, the opportunity to exercise and enjoying outdoors space are highly important. Flexibility and the ability to personalize services are seen as key factors in creating smooth and attractive mobility.

Based on the findings, a concept that would answer citizens' mobility needs by 2030 was created. In ten years, sustainable mobility could be supported by a comprehensive infrastructure making micro mobility options and public transportation more accessible and an attractive choice for users. The concept focuses on uniting transportation providers and services, thus creating intuitive sustainable mobility. It would answer users' needs and the research findings, by consistently providing citizens with the most convenient option to make sustainable journeys.

A modular mobility hub system that connects private and public transport systems and other daily services was designed by the students. The service offering of the hubs would be customized based on the demand and needs of each surrounding area. Eventually building it up to a comprehensive city-wide service network that serves users seamlessly and as intuitively as possible. Four different business model concepts to operate the network, ranging from a low governance leasing option to a Mobility as a Service (MaaS) provider option, were developed.

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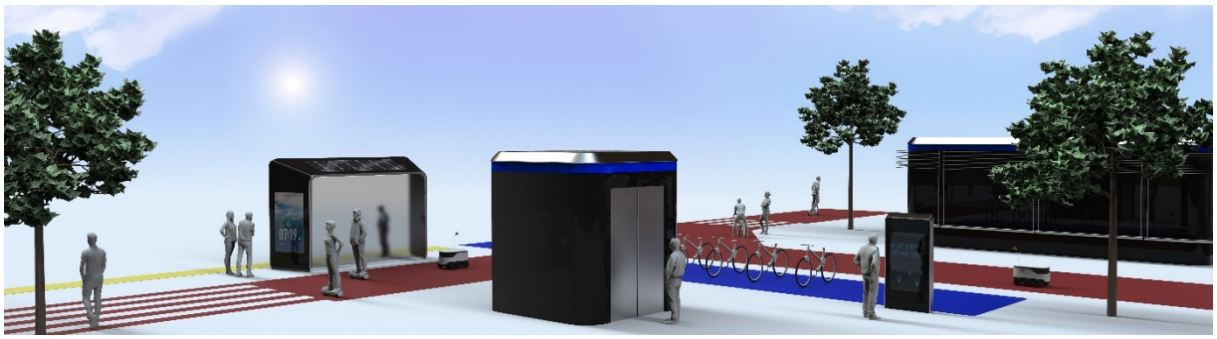

Figure 14: A rendering we used to illustrate what the mobility hub could look like and how it would bring services together. Image: Keny Muesa. (Source: KONE)

To achieve this, the structure of the ecosystem should be optimized from the outset, so that it considers the needs of both the end-users and the stakeholders, simultaneously balancing the service network density and matching supply with demand. Therefore, to manage the operation of this multi-actor context, and avoid conflicts of interest between different stakeholders, KONE should pursue a mission driven governance model. This way, it could engage the various stakeholders to operate in unison, breaking down traditional industry boundaries.

Shared mobility study

This study was initiated by KONE in 2020 to explore how carsharing services could succeed, how potential users' mobility habits affect service adoption and how carsharing is perceived in Espoo. A thesis work was conducted with Aalto University International Design Business Management programme. The focus was on the SPARCS demo area of Greater Espoonlahti and its residents. To research the existing attitude and knowledge of Espoonlahti residents regarding carsharing and car ownership, the Grounded Theory strategy (Charmaz, 2006) was chosen. The participants were found through Facebook groups: Asukkaiden Espoo (991 members), Espoonlahti (1400 members) and Suur-Espoonlahti (1800 members). All together 21 responses were received, out of which seven residents of the Greater Espoonlahti area were selected and participated in individual theme interviews. The interviews were analysed with the Grounded Theory analysis method to gain insight into what habits, preconceptions and attitudes the residents have relating to mobility, especially regarding cars and carsharing.

The objective of the study was three-folded: 1) to illuminate why carsharing, a service with great potential, has remained a rather unsuccessful mobility system in Finland, 2) to understand carsharing, shared mobility and how the current services have been built around sharing economy, and 3) to improve carsharing services to make them appeal to users of Espoonlahti. The thesis process and the results are published in the master thesis by Sipilä, 2021.

Peer-to-peer future electric mobility study

A group of Aalto students took part in the SPARCS initiative through a six months' course project with KONE. The project was part of Aalto University's International Design Business Management (IDBM) Industry Project, where KONE set a task for three Aalto University master's students to research and design for more sustainable shared electric

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transportation solutions according to the objective of SPARCS. The project also supports KONE's Sustainable success with customers strategy period and the city of Espoo's 2030 carbon neutrality target. As a result, a final concept designed for the Leppävaara area in Espoo was created. It includes primarily electric and shared vehicles, which should be attractive to diverse set of citizens and supporting more sustainable mobility behavior of the citizens. The brief for the project was to design and understand '*What could be all the shared electric mobility solutions that support citizens' sustainable behavior?'* The research question was explored through secondary (literature review) and primary (field trip, expert interviews, survey) research, as well as user research and co-design activities.

The student team designed a final community e-mobility concept that was aided through user research and co-design activities. These included surveys for mostly university students, and two different sets of deep interviews and virtual co-design workshops with two groups of participants: people living in Leppävaara, Espoo and people who have used either shared or electric transportation vehicles.

To be able to design the final concept and understand the problem, the team conducted secondary research in the form of a literature review regarding sustainability in mobility, electric vehicles, and the sharing economy and shared vehicles. Also, the team conducted primary research in the form of a field trip and multiple expert interviews with experts from both academia and different industries. The main findings of these research initiatives were:

- Sustainable mobility stems from the need of reducing emissions to tackle climate change and shared mobility can partly support the sustainable transportation
- Three main challenges for turning electric cars into commodity are: 1) shorter range of electric vehicles, 2) time consuming charging, 3) higher selling price compared to traditional cars
- Trust plays a big factor in sharing economy services
- There is a need for infrastructure changes, and transition plans to greatly aid more sustainable mobility behaviors. Also, private and public partnership is needed to create a wider impact.
- People tend to hesitate to switch their modes of transport

Based on co-innovation workshops, surveys and interviews, the team identified three distinct user problems related to shared electric transportation that the final concept specifically solves:

1. People still feel like they need to have access to a car in Finland, and the final concept allows residents of Espoo to still use cars in the future without owning them or needing to make an investment to buy a private electric car.
2. They need a way to know and to trust other people using the same vehicles. The concept creates a sense of trust and knowing by accessing only people within the same residential building or neighborhood to access the shared vehicles.
3. Convenience and flexibility play a major role in the longevity of a shared system. Therefore, residents need a way to ensure the availability of any shared electric vehicles in their communities. By including all types of electric vehicles in the final concept and giving an easily available access to them, residents have minimal barriers to adapting into the idea of shared transportation.

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The final concept of the project is an electric vehicle management system (a platform, physically accessible via shared dashboard and a mobile app), which allows the housing cooperatives to manage their fleet of electric vehicles (cars, bikes, scooters and so on) and residents to view, book, and share electric vehicles within their community or building of residence. It plays a role in changing the view of owning a vehicle to sharing one, having a positive impact on the environment by possibly limiting the amount of private mainly petrol cars on the road. To change the mindset from owning a vehicle to sharing a vehicle creates a positive sustainable change in the form of reducing CO_2 emissions in the urban environment and reducing the need for resources each new private vehicle requires. The creation of the final concept took a user-centric approach, but the final concept still needs to be validated with possible customers and end-users.

Future material flow study

In 2020-2021, KONE collaborated with the Aalto University to study last mile delivery services. This international student group belonged to a product development course. The study lasted for six months and focused on developing drone-based Drop Shop last mile delivery services. The theme for the study was identified previously in a SPARCS ethnographic user study. It combined the need for transporting goods and home ordering as well as autonomous mobility as a future mega trend. During the project, a user survey for an international group of respondents was conducted to obtain quantitative understanding of the practice, experience, attitudes, and expectations of diverse users on delivery services and related service providers. The survey was sent to over 2000 people in China, 150 people in South Korea and about 1000 people living in European countries through friends and family networks and received 217 responses. Based on the findings, the research continued with an interview with a delivery service provider and field visits to delivery pick-up stations and a delivery robot. This included development of a high-fidelity prototype and a user scenario. The solution was a last-mile delivery concept 'Drop Shop' that includes drones and an automated pick-up container with a sorting robot for ultraquick last-mile deliveries in urban areas.

Two co-creation workshops were conducted to evaluate the feasibility of the prototype and to collect feedback in Espoo. The workshops were advertised online via social media groups for designers and UX professionals, Aalto Design Factory channels and personal networks. In total 21 people joined the workshops. As Aalto University is a collaboration partner of South Korea, the second co-creation workshop was conducted online with South Korean students (ten students altogether). The workshop helped to gain an international perspective to SPARCS solutions, validate one mobility concept developed in SPARCS and narrow down the focus for the piloting phase.

Design for sustainable mobility behavior change interventions

In 2021 KONE initiated an experimental study for designing a sustainable behaviour change intervention in the context of urban mobility. The study was conducted with Aalto University programme in International Design Business Management. A thesis work was made to explore the design of behaviour change intervention for sustainable urban mobility in the city of Espoo, Finland. The study focused on investigating design interventions that can contribute to nudging a behavioural change towards more

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sustainable mobility. As the main outcome of the study, a behaviour change intervention concept called 'Bicycle bonus' was developed and its impact on behaviour change was studied with four residents of Espoo.

Participants for the user study were recruited from Facebook groups that were related to the Espoo area in Finland. The final selection of participants included four people, who were all citizens of Espoo, 30-60 years old and living with family members. Also, the participants needed to have a possibility to use a bicycle during the user study.

The design process unfolded as follows: Firstly, two co-design workshops were conducted with six participants to ideate design concepts together with citizens, which could encourage them to commute in more eco-friendly ways in their daily lives. Secondly, a user study was conducted to test the 'Bicycle bonus' concept with four participants, in which they were provided rewards if they cycled to the grocery shop over a period of two to four weeks. Lastly, semi-structured interviews were conducted with the participants to find out their experience of the behaviour change design intervention. In addition, two semi-structured interviews were conducted with grocery store and shopping centre representatives to explore their point of view about the design concept idea and its potential business interest. The thesis reporting the process and the results can be accessed online (Hyvärinen, 2021): Towards sustainable urban mobility: How to design behaviour change interventions (aalto.fi)

Inclusive mobility study

Social sustainability, inclusive and accessible multimodal mobility was identified as relevant topics to understand special user needs beyond the masses. A thesis project with Tampere University was initiated by KONE, which focuses on sensory overload in public transportation in Finland and evaluates how different technological solutions may support traveling with sensory overload. The project started in September 2021 and will continue the whole two-year master programme until May 2023. An important part of this approach is to include people who experience sensory overload from the beginning to the end. Altogether ten users suffering from varying level of sensory overload conditions were selected for thematic interviews and go-along method, where the student joined the participants for one journey in the city to observe what kind of situations trigger the sensory overload symptoms and in which ways.

Part of the project is to design application features that could help manage sensory overload in public transportation. The main goal is not to build an actual mobile application, but rather to test out ideas that can be embedded later into already existing platforms. Many different applications used at the same time might not be accessible, which is one of the themes. Furthermore, the goal is also to create and evaluate a sustainable design process, which takes into consideration sensory overload as well as other social sustainability aspects. Designing for special needs usually increases the quality for other people as well, which makes inclusive design a fruitful approach.

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3.1.2 Supporting sustainable behaviours

In this chapter, we present in detail community engagement activities related to supporting sustainable behaviours (listed in Table 12) The activities aim to improve the awareness of sustainability solutions during the construction time and the daily use of the Lippulaiva services and encourage citizen's sustainable behaviours.

Table 12: Community engagement activities for *Supporting sustainable behaviours*

Community engagement activity (time)	Description of type of engagement	Demonstration area	Related subtask	Related action
SUPPORTING SUSTAINABLE BEHAVIOURS				
Buddy class: Espoonlahti (September 2020 – May 2023)	Thematic workshops, site visits	Espoonlahti	T3.6.2 T3.6.3	E3-3
Lippulaiva virtual room (January 2021 – May 2022)	An online virtual room where people can go around and look inside Lippulaiva and see its sustainability solutions	Espoonlahti	T3.6.1	E3-1
Buddy families: Espoonlahti (January 2021 – June 2022)	Thematic events, surveys, site visit	Espoonlahti	T 3.6.2	E3-1
Other actions in Lippulaiva (2021-2022)	Online event 'Lippulaiva LIVE', a playground area for kids with the sustainability theme, info screens with the sustainability theme	Espoonlahti	T3.6.1	E3-1
Co-creation of Lippulaiva with youth (September 2021 – December 2022)	Thematic events, surveys, site visit	Espoonlahti	T3.6.2	E3-3
eV test day (August 2022)	An e-mobility event providing possibilities for local people to test e-bikes and e-scooters and promoting sustainability themes in general	Espoonlahti	T3.6.1	E3-1, E3-2, E19-2

Buddy class: Espoonlahti

There are two buddy classes in the SPARCS project: one with City of Espoo and another with Citycon. Citycon's buddy class is a class from Espoonlahti upper comprehensive school. Lippulaiva Buddy Class action planning started in March 2020 (see Figure 15) and a buddy class was chosen in August 2020. Before starting actual Buddy Class actions,

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permissions from students' parents were asked for. The relationship with the buddy class lasts three years until the students graduate. Students are from age 13 (7th grade class) to 15 (9th grade class).

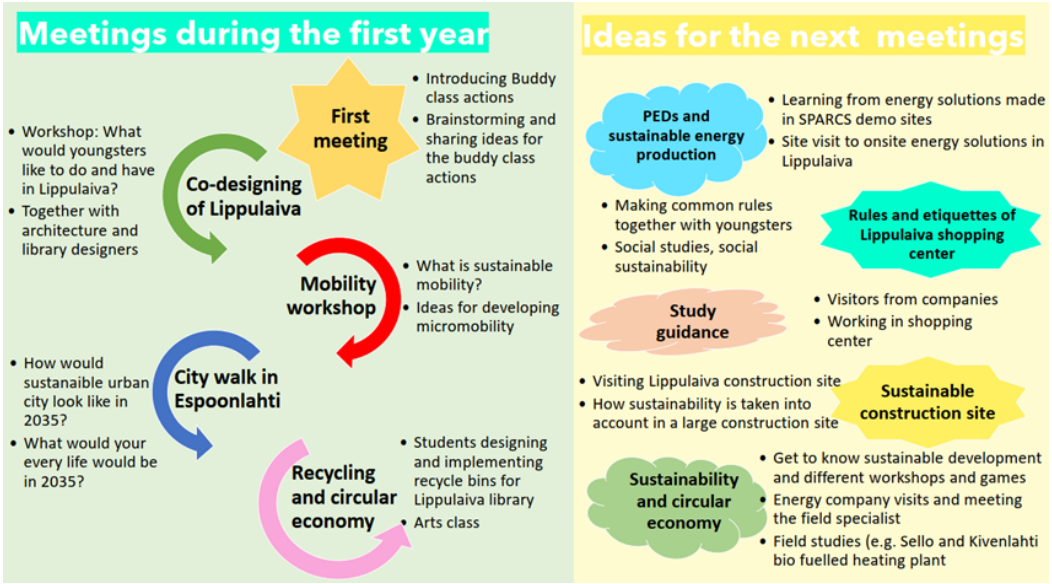

Figure 15: Buddy Class plan. (Source: Citycon)

The aim of the buddy class action is to jointly design the shopping centre in collaboration with young consumers and thus improve convenience and usability for young people. There have been meetings approximately three to four times a year with the buddy class. Students have been working on specific sustainability themes, for example energy and mobility. All implemented Buddy Class engagement activities are presented in the following table (Table 13).

Table 13: Implemented Espoonlahti Buddy Class engagement activities.

Time	Description of implemented Buddy Class action
September 2020	Introducing Lippulaiva development project. Workshop with Citycon, architect and personnel from the library
December 2020	Workshop regarding mobility. Organized together with KONE and city of Espoo. Ideas to develop micromobility solutions in Espoonlahti.
April 2021	City orienteering in Espoonlahti region with the theme 'How do we live in 2035?'.
May 2021	Art lesson for designing labels to waste bins. Waste bins are in the Lippulaiva's library.
October and November 2021	Sustainable construction site visits. Lippulaiva's sustainability solutions (for example PV panels, geo-energy) were introduced to youngsters.
January 2022	Energy lesson. Topics including renewable and non-renewable energy sources and how to save energy at home.
May 2022	Visit to Lippulaiva. Completed Lippulaiva was introduced to youngsters.

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On Figure 16, the students are participating an online mobility workshop and visiting Lippulaiva construction site to learn about sustainable solutions. Figure 17 shows the results from art lessons, where the students designed labels for waste bins located at Lippulaiva library.

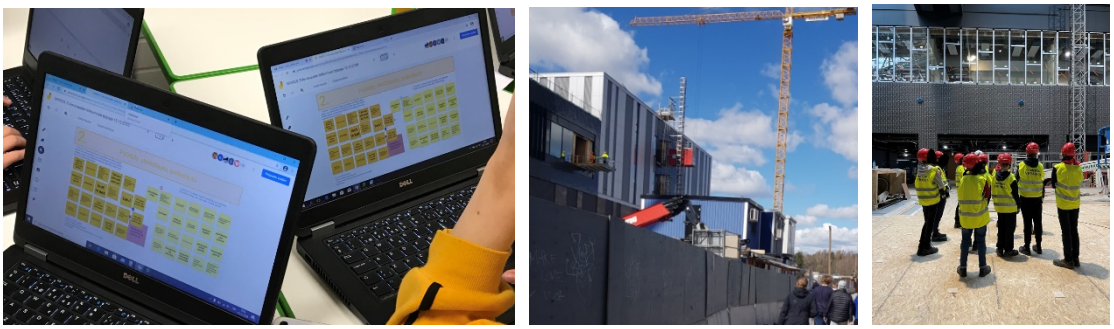

Figure 16: Buddy class activities. (Source: Citycon)

Figure 17: Recycle bins (plans on left and implemented on right). (Source: Citycon)

Lippulaiva virtual room

Lippulaiva virtual room was an online virtual showroom (virtual visit video: https://vimeo.com/512500786?embedded=true&source=vimeo_logo&owner=53554456), where you could walk around and look inside and around Lippulaiva (Figure 18 and 19). The virtual showroom was powered by WebAR. The aim was to bring the still-in-construction shopping center closer to future visitors. The virtual room opened in January 2021 and closed in May 2022. There were over 28,300 viewers and more than 36,100 views.

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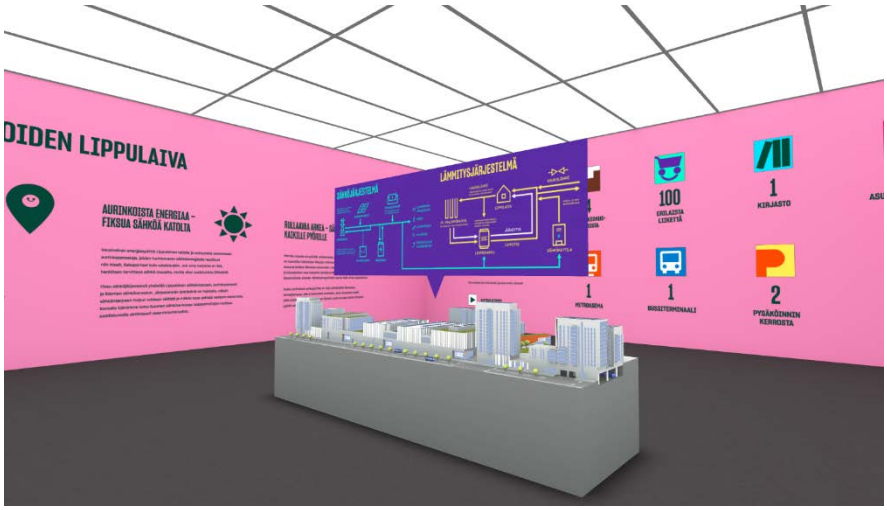

Figure 18: Lippulaiva virtual room: Energy solution. (Source: Citycon)

The virtual showroom displayed the features of Lippulaiva: 100 stores, eight apartment buildings, a metro station, and a bus station. The showroom also featured a 3D model of the completed center and its surroundings. The visitors could walk around the model and even see the buses and metros arriving and leaving.

Figure 19: Lippulaiva virtual room: Lippulaiva entrance. (Source: Citycon)

In addition to visualizing the future shopping center, Lippulaiva wanted to show its sustainability values and actions. The 3D model showed the electric and heating systems, and their operations were further explained on one wall of the virtual space (Figure 18).

Buddy families: Espoonlahti

Citycon and Espoo City Library engaged local citizens in the design of the new Espoonlahti regional library. The aim of buddy family actions was to encourage active citizenship and sustainable development. In addition, the target was to establish a long-term cooperation with that given group. Another goal was to co-design with the residents and to gain deep engagement, not only design based on an assignment.

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The planning of buddy family actions started in autumn 2020. Local families were asked to become a buddy family for example by using local Facebook groups. About 30 families were included in the buddy family actions. Citycon and Espoo City Library planned events and workshops for buddy families in late 2020 (see Figure 20).

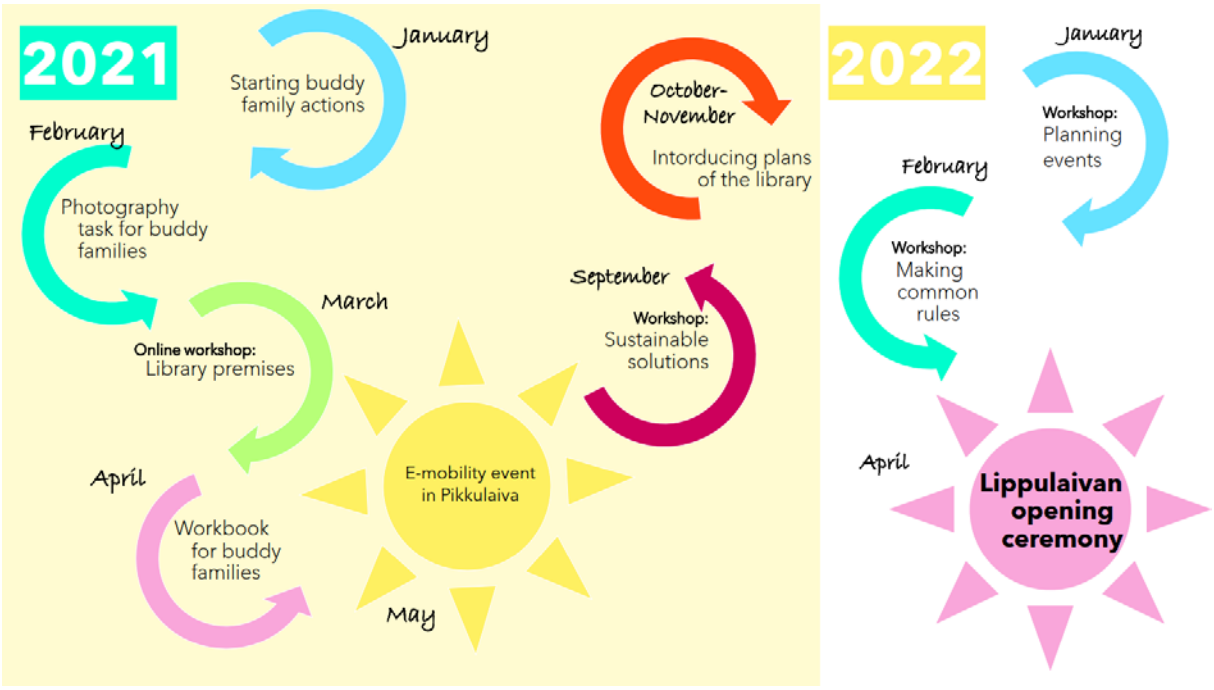

Figure 20: Buddy family plan. (Source: Citycon)

In January 2021, a Facebook group for buddy families was created. Buddy family actions started in March 2021. Table 14 shows a list of implemented buddy family actions, and Figure 21 presents highlights from interviews with buddy families.

Table 14: Implemented Buddy Family actions.

Time	Description of implemented Buddy Family action
February 2021	Photography task for buddy families: Buddy families took inspiring photographs of their shopping actions. The target was to collect ideas to be used in the planning of new Lippulaiva.
March 2021	Online workshop with the theme 'What would you like to do in the library?'
March 2021	Interviews with buddy families
April 2021	Micromobility survey (see Micromobility study)
April 2021	Micromobility workshop (see Micromobility study)
October 2021	Construction site visits
November 2021	Music room survey for youngsters
January 2022	Workshop: Library staff introduced plans of the library and collected feedback from buddy families.
March 2022	Commenting Lippulaiva's new website
June 2022	Closing meeting with buddy families in Lippulaiva library

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Figure 21: Highlights from interviews with buddy families. (Source: Espoo City Library)

Other actions in Lippulaiva

In addition to buddy family actions and a virtual room, there have also been other actions to inform and encourage local citizens of sustainable positive ways of behaviour.

In April 2021, Citycon held a Lippulaiva LIVE info-webinar for Espoonlahti residents where sustainability solutions were promoted. The recording of the webinar is online, 1600 viewers (until 1.8.2022).

There is a playground area for kids promoting sustainable energy solutions and waste management in Lippulaiva (see Figure 22). Kids under the age of seven can practice waste recycling and learn about sustainable energy solutions.

Figure 22: Images from the playground area for kids. (Source: Citycon)

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Visitors are informed about sustainable solutions in Lippulaiva. There are info-screens for visitors around Lippulaiva (Figure 23). For instance, the importance of green roofs, carbon neutral energy solutions and waste recycling rates are presented on the screens. Apart from info screens, there is also an educational stand that summarizes the highlights of sustainability practices in Lippulaiva (Figure 24).

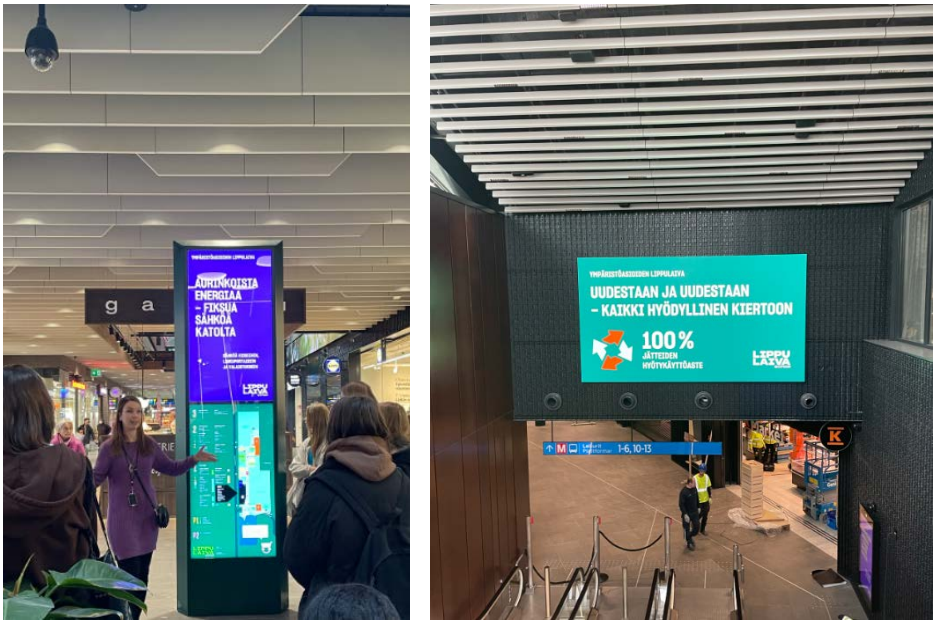

Figure 23: Examples of Lippulaiva info screens. (Source: Citycon)

Figure 24: Lippulaiva educational stands. (Source: Citycon)

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Co-creation of Lippulaiva with youth

As part of the Lippulaiva development project, Citycon has cooperated with Nuorten Palvelu ry which is a nationwide, politically independent discovering youth work organization in Finland. The organization promotes the daily wellbeing of youth, where everyone has someone who listens and cares. Nuorten Palvelu ry was founded in 1969.

In the two-year project, possibilities for young people to influence and take responsibility have been developed in the planning and construction as well as operation phases of Lippulaiva. The project started in March 2021 and will end by the end of 2022.

The project is aimed at young people between the ages of ten and 18 who spend a lot of time in shopping centers. The project is implemented by getting in touch with young people and mapping their wishes, organizing workshops and other meetings based on young people's ideas. All implemented engagement activities with Nuorten Palvelu are presented in the following table (Table 15).

Table 15: Implemented engagement activities with Nuorten Palvelu.

Time	Description of implemented actions with youth service organisation
September 2021	Workshop with the theme 'What would you like to do in Lippulaiva?'
September 2021	Construction site visit
September 2021	Workshop in cooperation with Espoo City Library. Making 'a mood map' (Figure 25) and voting on the interior solutions.
October 2021	Workshop with the theme 'What would you like to do in Lippulaiva?'
November 2021	Construction site visit
February 2022	Workshop with the theme 'What would you like to do in the opening ceremony of Lippulaiva?'. In addition, a representative of KFC restaurant introduced their plans.
May 2022	Two workshops related to the shopping centers rules. Youngsters developed rules & regulations for Lippulaiva together with youth-focused security guards.

Figure 25: Workshop in September 2021. (Source: Citycon)

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Electric vehicle (eV) test day

Citycon and City of Espoo were responsible for arranging electric vehicle test event for locals where sustainable mobility habits are presented. The idea of the event was to provide possibilities for users to test different e-bikes and e-scooters. Due to the Covid-19 situation, the event was postponed until August 2022 (M35).

Planning for the event continued in the summer of 2022 and was held in the end of August of the same year. The event was a part of Espoo's 50th anniversary as a city, which also brought the event more attention in the media. The aim of this event was to activate residents to adopt e-mobility habits as part of their daily lives and thus reduce motoring in the city.

For the test day Citycon and City of Espoo collaborated with many different partners (TIER, Helkama Velox, Yeply, Schneider Electrics, Plugit Finland and HSL). These partners came to the event to concretely show their products and also to guide residents to use them (see Figure 26). Residents had an opportunity to test e-bicycles and e-scooters in action. It was also encouraged that residents would come to the event with their own bikes since there was an option to take your bike to the mobile bike repair shop on wheels. People had also an opportunity to get to know more about sustainable lifestyle and public transportation.

Figure 26: Images from the eV test day. (Source: City of Espoo)

It is important to inspire and motivate residents to use more sustainable forms of mobility in the future, and concrete testing of these vehicles brings the theme closer to the resident's everyday life. A safe and supportive test environment strengthens the resident's experience and view of their own ability to use the vehicles and thus strengthens the will to use them independently.

3.1.3 Co-creating sustainable business models

In this chapter, we present in detail community engagement activities related to sustainable business model co-creation (as listed in

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Table 16) This chapter presents especially work conducted under *T3.8 Smart Business Models*. The work builds on and complements the work conducted under *T3.6 Community engagement*.

As part of the *subtask 3.8.1 Engaging (lead) users and co-creating (energy positive) business models* KONE piloted ways to co-create business models together with different stakeholders, focusing especially on both people and material flow.

In Spring 2021, KONE conducted a series of co-creation workshops both with business stakeholders and citizens to research and develop business models for sustainable mobility (see Figure 27). The aim of the workshops was to identify relevant stakeholders and ecosystems as well as the value of the concepts for different actors involved. Due to Covid-19 pandemic, all activities were organized as online workshops and utilized different engagement methods and interactive online tools for co-creation.

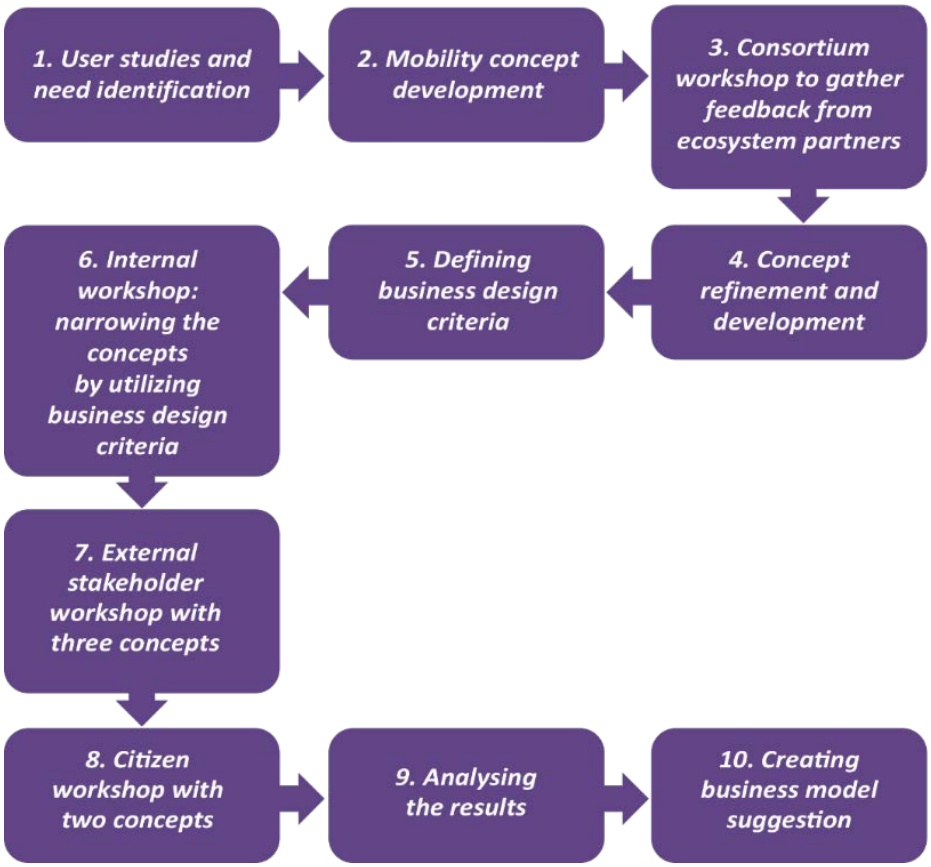

Figure 27: Process of co-creating business models. (Source: KONE)

The content of these workshops (including the workshops for consortium feedback, business model criteria, and business model co-creation) is presented in the following chapters. Additional activities related to the Sustainable Mobility Challenge, Sustainable Business Model Innovation work, as well as the Smart Otaniemi events are also discussed.

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Table 16: Engagement activities for *Co-creating energy positive business models*

Community engagement activity (time)	Description of type of engagement	Demonstration area	Related subtask	Related action
CO-CREATING ENERGY POSITIVE BUSINESS MODELS				
Consortium mobility ecosystem workshop (December 2020 - January 2021)	Gathering feedback from Espoo SPARCS consortium partners on the sustainable mobility ecosystem and concepts	Espoo	T3.6.2 T3.8.1	E4-1 E9-1
Business model criteria workshop (March 2021)	Defining business design criteria to guide decision-making and evaluation of the mobility concepts from business perspective	Espoo	T3.6.2 T3.8.1	E4-1 E9-1
Business model co-creation workshops with stakeholders (April – August 2021)	Internal workshop External stakeholder workshop Citizen workshop	Espoo	T3.6.2 T3.8.1	E4-1 E9-1
Sustainable Mobility Challenge (August – December 2021)	A co-innovation challenge process consisting of online pitching, mentoring and selection of one mobility related solutions for piloting. The process reached 100 mobility and data start-ups and companies. 8 companies were selected to the pitching round.	Espoo	T3.8.1 (T7.4.)	E4-1 E9-1
Innovating new Sustainable Business Model concepts (January – December 2022)	A student project (Thesis), co-creating business models with mobility data provider	Espoo	T3.6.2 T3.8.1	E4-1 E9-1
Smart Otaniemi events (April - September 2022)	SPARCS and Smart Otaniemi ecosystem webinar series launched in spring 2022. Different topics focusing on EV charging and energy etc.	Espoo	T3.8.3	E23-1

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Consortium mobility ecosystem workshop

First, a consortium workshop was organized for addressing the initial co-designed mobility concepts from a service provider perspective. The kinds of ecosystems that could enable these concepts to succeed as well as the possible roles of different actors in these ecosystems were investigated in more detail.

The three-hour workshop was held online and utilized InVision online platform as a tool in common exercises. The nine participants represented six Espoo SPARCS consortium partners namely KONE, VTT, City of Espoo, Siemens, Citycon, and Plugit. During the workshop, the participants were asked to provide their thoughts and ideas to the mobility concepts by focusing on four questions / themes:

1) What kind of knowhow and actors are needed and what could be their role and business models?
2) What kind of risks and worries there are?
3) How social and ecological sustainability should be taken into account?
4) What kind of role your organization could have in an ecosystem around in this solution? What kind of touch points there are to your current (or future) business?

The workshop had two objectives. Firstly, the aim was to present the results from the mobile probing user study and the identified challenges and opportunities as well as ideated mobility concepts. In addition, the workshop aimed to open up the discussion with the consortium partners about what kind of an ecosystem and knowhow would be needed in order to produce the solutions (in Espoo) and what kind of roles and actors are needed for sustainable future mobility. Figure 28 shows the evaluated mobility concepts placed on an evaluation matrix.

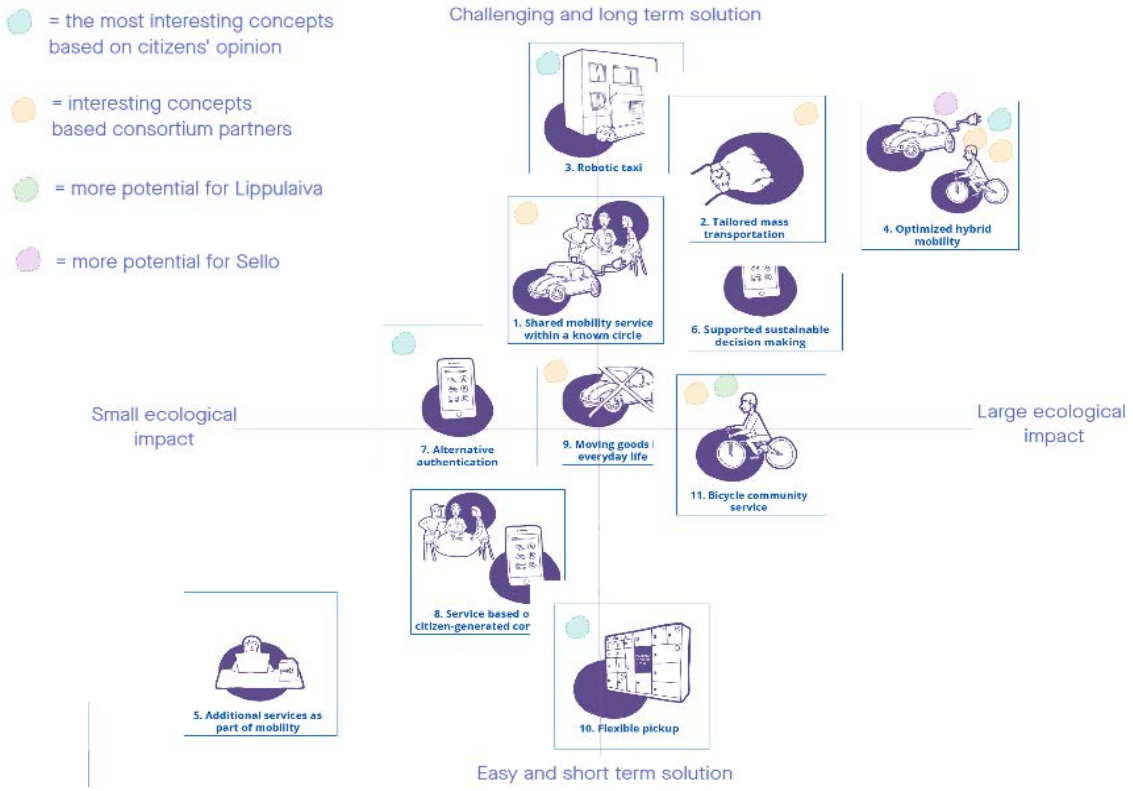

Figure 28: Evaluation exercise result about the co-ideated mobility concepts placed in the matrix highlighting the timeframe of the solution and the ecological impact. (Source: KONE)

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Business model criteria workshop

In the second workshop (M17), business design criteria were defined to guide the decision-making and evaluation of the mobility concepts from the business perspective. The business design criteria serve as a set of strategic perspectives through which mobility concepts can be evaluated, making it possible for the design team to prioritize and choose concepts that are taken further in the process. It should be noted that these criteria are based on KONE's position as a global industrial company. The initial business design criteria were built during the KONE internal business design workshop and was then further defined during the internal stakeholder workshop (May 2021).

As a result, five evaluation criteria were defined: 1) Sustainability, 2) Scalability, 3) Customer value, 4) Differentiation, and 5) Inclusiveness (Figure 29). *Sustainability* perspective entailed questions related to climate targets, energy efficiency, circularity, social consciousness and the sustainability of material supply and sustainable life-cycle operations. From the *scalability* perspective, the mobility concepts were evaluated through questions related to, for instance, serving different business lines and customer segments, global attraction and impact, as well as local customizations. *Inclusiveness* as a criterion included questions about accessibility, safety, inclusive values, and solution applicability for different types of customers, cultures and geographies. In terms of *customer value*, the mobility concept was assessed by its customer centricity, customer life-cycle reach, and potential brand value. Finally, from the *differentiation* perspective, the market differentiation, thought leadership possibilities, and potential for new partnership models related to the concept were evaluated.

Figure 29: Defined business design criteria. (Source: KONE)

Business model co-creation workshops

To refine the developed mobility concepts and as continuation for the business design criteria workshop, KONE hosted three workshops with different stakeholder groups. Co-creation workshops were conducted in collaboration with a business design agency Embassy of Design. Embassy of Design was chosen as a partner based on business design

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expertise and previous references within the field of mobility. The aim of the workshops was to create a process where eight mobility concepts were evaluated and developed further by ending up with two to three more detailed and concrete concepts with business model suggestions. The approach was based on co-creation methodology in which different participant groups would evaluate previously created mobility concepts and ideate with how these mobility concepts could find the potential product/market -fit from their perspective.

All three workshops were targeted for different stakeholder groups (see Figure 30). In the first workshop, participants were KONE's representatives from the fields of business and design. The second workshop gathered 15 experts together. The participants represented central mobility players, including companies that operate on shared mobility, micro mobility, sustainability, real-estate, navigation and more as well as public actors. In the workshop, the participants identified success factors and obstacles for mobility concepts through interactive exercises and discussion. To complement the service providers' viewpoint, the third workshop was organized with Espoo citizens.

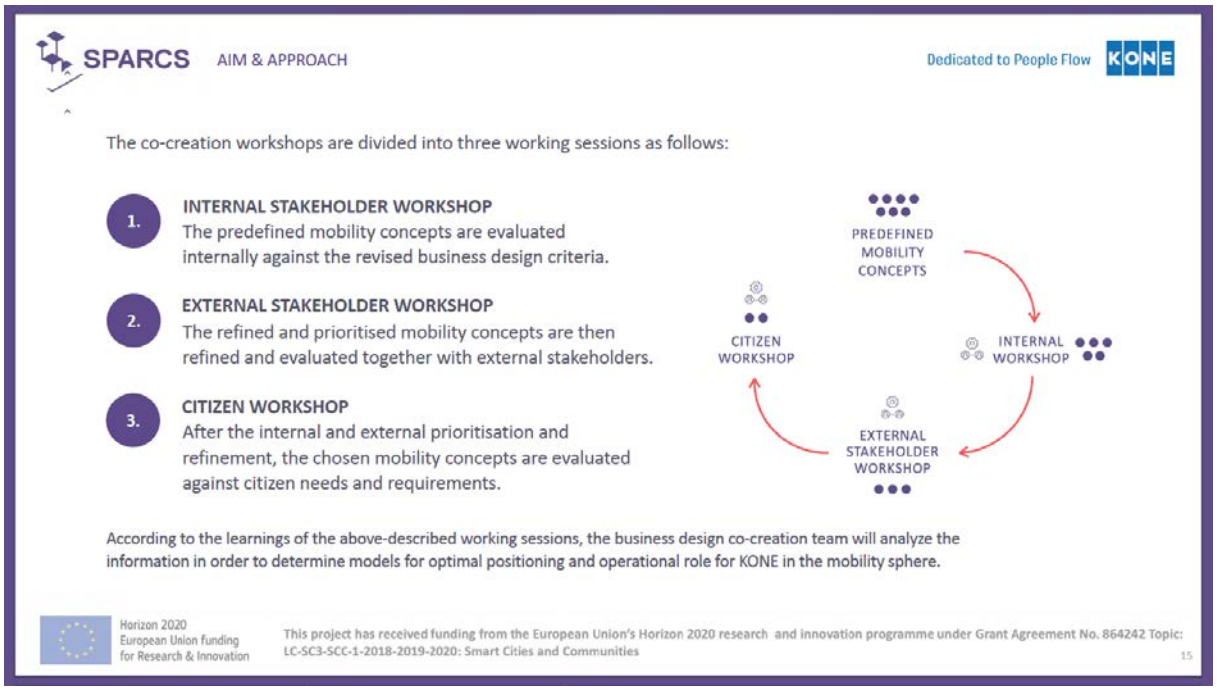

Figure 30: Process of series of co-creation workshops. (Source: KONE)

Internal workshop

The first collaborative working session of the business design co-creation workshop series was held with KONE's internal stakeholders. The research question for the internal stakeholder workshop was: 'What mobility themes/concepts are relevant and have the most business potential to develop KONE's ecosystem and partnerships between buildings?' A total of seven participants from the fields of service design, smart and sustainable cities, ecosystem business research, and people flow solutions, attended the online session.

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External stakeholder workshop

During the external stakeholder workshop, the aim of the business design team was to further evaluate and elaborate the predefined mobility concepts together with a myriad of mobility entities. The research questions for the external validation workshop were: 'How can we find new angles and ideas for the pre-chosen mobility concepts?' and 'How can we build an ecosystem of business partners that can improve our thinking or further extend and/or expand the business opportunities?'. In addition to three experts from KONE, twelve experts from eleven different organizations participated in the workshop.

Citizen workshop

The citizen validation phase included a remote co-creation workshop ('Future of mobility workshop'), aimed at activating the local citizens both in Leppävaara and Espoonlahti demonstration areas. The citizen involvement brought the final validation round to the predefined and prioritized mobility concepts according to the first two phases (internal + external validation).

The citizen participants of the workshop were divided into two smaller working groups where they had the chance to evaluate and discuss the mobility concepts. The research question was 'How could each of the shortlisted mobility concepts fit into the everyday life of local citizen?'. In addition, the citizen participants also evaluated their willingness to pay for the presented mobility concepts and comparing the costs to other similar services. The recruiting of participants was conducted through social media, primarily through the local citizen discussion groups and secondarily with paid local targeted advertising. A total of twelve citizen representatives took part in the workshop.

Sustainable Mobility Challenge

In August 2021, KONE launched a co-innovation challenge to find innovative solutions, services, and business models on sustainable mobility to be piloted in the SPARCS Espoo lighthouse. The co-innovation process is connected to the SPARCS T7.4. Start-up competition and reported in detail in deliverable *D7.4 Lighthouse Cities Start-Up Smart City Challenge Report and Lessons Learned*. Together with other SPARCS partners, lighthouse city Leipzig, Fraunhofer, GopaCom and Civiesco and KONE aligned the challenge process and shared learnings between the partners.

In the co-innovation process, KONE together with its partner, launched an open challenge for other companies inviting them to suggest their mobility solution ideas and co-create those further in the process. KONE chose Gaia Consulting Oy as a partner to support the facilitation of the process. The company was chosen from two candidates based on the value and quality of the proposal, expertise in sustainability and mobility as well as previous references from similar challenge processes.

The purpose of the process was to:

- Find and pilot innovative mobility solutions or business models to transform the way people move sustainably in an urban setting
- Develop ecosystem partnerships with key players in sustainable mobility
- Engage business stakeholders in SPARCS

In the KONE SPARCS Sustainable Mobility Challenge, the end-user needs and sustainability impacts – from all the three angles of social, ecological, and economical –

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were placed at the center of the design process from the beginning. Based on the previously studied themes in mobility, the challenge brief was formed around three mobility trends: shared mobility, micro mobility, and multimodal navigation. In these themes, several different user paint points were defined in different user studies by KONE and thus, selected as a starting point for the brief. To allow participating companies to suggest their innovative solutions, yet guiding them in the right direction, a list of identified user needs was provided as part of the challenge (see Figure 31). The brief was published on the SPARCS website.

Figure 31: Material from the challenge brief. (Source: KONE)

The secondary objective of Sustainable Mobility Challenge was to develop ecosystem partnerships with sustainable mobility partners and engage business stakeholders in SPARCS project. Therefore, the challenge was targeted to companies in the field of mobility and ICT, reaching over 100 small and middle-sized companies. The co-creation process was organized in two rounds. On the first round, eight sustainable mobility solutions were selected to be pitched to the jury consisting of experts from KONE and the city of Espoo. The selected mobility solutions were related to four major trends: micro mobility, autonomous vehicles, shared mobility, and multimodal sustainable travel chains. On the second round, four teams proceeded to the mentoring and, in the end, pitched their iterated solutions and pilot proposals to the jury. The timeline of the process is presented in Figure 32.

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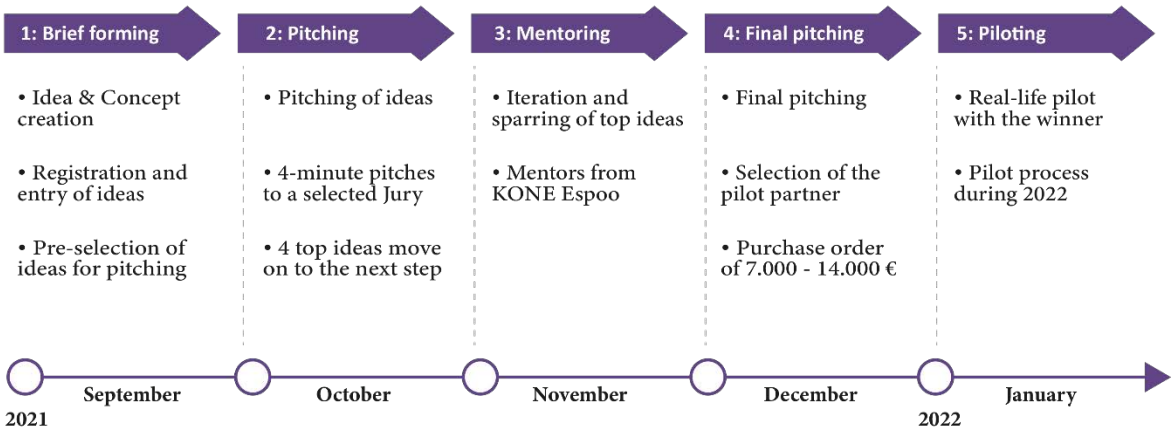

Figure 32: Process and timeline of the co-innovation challenge in five steps. (Source: KONE)

The Sustainable Mobility Challenge jury selected a winning solution to be piloted within SPARCS demo areas during Spring 2022. The selected solution was a mobile community application *Move together by Moprim* to measure and visualize personal mobility behavior and help local communities to make sustainable mobility choices together to reach common targets. Ultimately, this pilot evolved into a more comprehensive study and intervention on community mobility behavior, presented in chapter 3.1.1.

Innovating new Sustainable Business Model concepts

In addition to the mobility study mentioned above, KONE initiated a joint project with Moprim to innovate and co-design new business models promoting sustainable mobility behavior. This process was documented as part of a master's thesis work by a student from International Design Business Management (IDBM) at Aalto University. The purpose of the project was to explore possible sustainable business models, especially in the field of mobility data utilization and people flow. The project (and thesis) objectives included:

1) constructing a process and toolkit that support two organizations (KONE and Moprim) to co-design sustainable business model concepts in urban mobility,
2) documenting the process of applying the constructed tool in real-life scenarios, and
3) validating the outcomes based on pre-defined criteria (incl. different aspects of sustainability).

During the project, theories related to Sustainable Business Models (SBM) and platform design methods were studied, and the benefits and limitations of research-based toolkits were explored. In addition, ten Business Designer interviews were conducted to understand how they as practitioners design sustainable business models.

A series of *four platform design workshops* were facilitated among KONE and Moprim to map relevant stakeholders and roles in the urban mobility data ecosystem, and to identify the key assets, skills, relationships, and motivators to create and capture value within this ecosystem. The methodology utilized in this process was an adapted version of the open-source Platform Design framework and canvases originally developed by Simon Cicero/Boundaryless and revised by Aalto University. This platform design approach was chosen due to its focus on multi-stakeholder collaboration and the shared use of data. The

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results of this work are presented in the section 4.4.3. To further examine the role of KONE within an urban mobility data ecosystem, internal interviews were conducted along with a workshop to evaluate the relevance and potential of the ideated ecosystem model from KONE perspective.

Smart Otaniemi events

The Smart Otaniemi ecosystem has been working in close collaboration with the City of Espoo in finding different ways of collaboration within the SPARCS project. As a result of several planning and brainstorming sessions, SPARCS and Smart Otaniemi launched a webinar series in the spring of 2022. The first webinar was organized on 7th April 2022 with a focus to EV charging infrastructure. The webinar, containing presentations from VTT and Plugit Finland OY, gathered numerous representatives from cities, municipalities, and companies. In VTT's presentation the focus was on the cities and municipalities' role in the electrification of the transport sector, and Plugit presented the bus charging system in Leppävaara, Espoo. The next webinar will be in autumn-fall 2022, focusing on energy solutions within the Lippulaiva blocks.

3.1.4 Sustainable lifestyle in future Espoo

In this chapter, we present in detail community engagement activities related to sustainable lifestyle in future Espoo (listed in Table 17). The activities aim at educating Espoo citizens about a sustainable lifestyle and creating a co-creation model for smart city planning.

Table 17: Community engagement activities for *Sustainable lifestyle*

Community engagement activity (time)	Description of type of engagement	Demonstration area	Related subtask	Related action
SUSTAINABLE LIFESTYLE				
Espoo sustainable lifestyle roadmap (January 2020 – June 2024)	Roadmap of the engagement actions to be done in the project	Espoo	T3.5.1 T3.6.3	E22-1 E19-2
Buddy class: Maininki (January 2021 – May 2023)	Different thematic workshops, surveys, and field studies	Espoonlahti	T3.6.2 T3.6.3	E3-3 E19-2
Design sprints for developing a co-creation model (December 2021 – December 2022)	Design Sprints for developing a co-creation model	Espoo	T3.5.1 T3.6.3	E22-1 E19-2

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Sustainable lifestyle webinars (May – June 2022)	Hybrid events for citizens to learn more about sustainable lifestyle and how to embrace it	Espoo (Espoonlahti, Leppävaara, Tapiola) + online	T3.6.3	E19-2
Compiled sustainable lifestyle report (August 2022)	Qualitative content analysis of different survey and online and offline event materials from diverse Espoo engagement projects	Espoo	T 3.6.3	E19-2

Espoo sustainable lifestyle roadmap

Citizen engagement is one of the leading themes in the SPARCS-project and in the City of Espoo's tasks include the implementation of sustainable lifestyle. The goal is to have more sustainable everyday life in Espoo and educate, engage, and raise knowledge of the citizens through actions, communication, and activities. Citizens are seen as an active player in the development and decision-making of the city.

Specific plan, a roadmap, for these actions is important tool to gather the information and have a list of activities, goals, timelines, and themes. continuous updating and monitoring of the plan provides a good basis for monitoring activities. In such a large entity, it is important to maintain an accurate plan and follow-up.

When planning citizen engagement activities, special attention must be paid to the continuous development of activities and changing opportunities. Linking in to municipal and projects own communications, timelines and activities, there must be room for change and flexibility. This needs to be taken into consideration when updating the list of activities planned.

Different modes of engaging:

- **Informing people about sustainable development themes** (especially those related to project activities: energy, mobility, smart cities, engagement) and new emerging issues (for example, related to changing policies and regulations on EU, national and city levels); including events and webinars (Low level of engagement)
- **Gaining peoples' insights on the themes and future expectations**, especially related to sustainable lifestyles; as background & research material for future development; questionnaires, workshops (Moderate level of engagement)
- **Co-working in workshops on the relevant themes and PEDs** – developing together how PEDs will look like in the future (High level of engagement)

Buddy class: Maininki

Buddy class concept is experimented in the SPARCS project. Project has one buddy class in two secondary schools in Espoolahti area, in Espoonlahti school, that has Citycons shopping centre emphasis, and Maininki school, which actions are led by the City of Espoo. The activities of the two actors differ in some respects.

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Before the Buddy Class activities started (both Espoonlahti and Maininki) a research permit was applied from the City of Espoo's Growth and Learning Sector. A research permit is required when conducting research work with young, under-aged citizens as part of education activities. The application was drafted between ESP and CIT with help from VTT on the ethical guidelines and GDPR issues (including guidelines to ensure anonymity in the production of visual material from the events). In the beginning of the Buddy Class activities, the students' parents were informed about the future activities and permits for the students' participation were gained.

The focus with both classes is on sustainable lifestyle, specifically implementing these themes in the everyday life of a young citizens through discussions and surveys. It is important to make sure that students can discuss, ask, and get answers to questions that they might have in the subject of sustainability.

In a more practical level, the goal is to meet the students approximately 4 times a year and engage them in the different action points, such as workshops and field studies and simultaneously collect their ideas and evaluate attitudes. Engagement activities with Maininki school have been presented in Table 18 and Figure 33.

Table 18: Implemented Maininki Buddy Class activities

Time	Description of implemented Buddy Class activities
Spring 2021: Future orientation	• Students orientated from school to the shopping centre Lippulaiva's contraction site and answered questions about their views about the future of the Espoonlahti district. Fence of the site included QR-codes about the new shopping centre, students got to see how it will look. • Discussions and collection of the answers after the orientation.
Spring 2021: Mobility workshop	• The goal was to study the students' view of forms of mobility, opportunities, and challenges that one might face. There was also a discussion about the urban environment, its comfortability and future urban planning. • Discussion and ideas collected via online Miro board.
Fall 2021: My2050 game, climate theme	• My2050 is an interactive online adventure game played outside in a group in the Centre of Espoo. The game deals with climate change and how it affects everyday life in the future. • Discussion and collection of answers after the game.
Fall 2021: Energy lesson	• The goal was to increase young people's knowledge of energy production, its forms and how its consumption affects the climate. After the energy themed groupwork, City of Espoo's energy specialists held an online lecture for the group. • Discussion and questions after the lecture.

The work with the schools began at the fall of the year 2020 by applying permission for the study from the municipal educational administration of Espoo. After the permission was granted a kick-off with the buddy classes were held and the work was able to start. Buddy class actions will continue until Spring 2023 when the students graduate.

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Figure 33: Buddy class activities; students at orientation, playing My2050 adventure game, writing down ideas and questions. (Source: Citycon)

Design sprints for developing a co-creation model

As part of developing a co-creation model for the city of Espoo, a series of design sprints were facilitated among city stakeholders during Spring 2022. The set of design sprints finally evolved into a co-creation model, which is presented as a result in Chapter 4.7.

Sustainable lifestyle webinars

To concretely promote the adoption of a sustainable lifestyle among the citizens, the city of Espoo has organized sustainable lifestyle webinars during the spring and summer of 2022. Following the carbon footprint - towards a sustainable lifestyle! - named event series consisted of three hybrid webinars and face-to-face workshops. The series of events that began in May 2022 has, in an interesting way, brought inspiration to residents for a more sustainable lifestyle.

The evening events focused on everyday life in Espoo and delve into actions and habits that reduce citizens carbon footprint, introduced by top speakers. The events' themes come directly from residents based on a survey carried out in autumn 2021. The workshops take a more detailed look into themes of residents' everyday life.

The events and workshops took place in three libraries all around Espoo which was important for citizens to participate and make accessibility better for citizens (Figure 34). Citizens were able to attend the events in person at the libraries or follow the events vial live stream at home. Recordings of the events were available for viewing for two weeks.

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Figure 34: Pictures from Following the carbon footprint - towards a sustainable lifestyle! -events that were held in Sello, Lippulaiva and Tapiola libraries. The topics of the event series were chosen by the citizens via survey. (Source: City of Espoo)

The themes of the event series have been collected directly from the citizens. The main point was to focus on sustainable lifestyle but themes around energy were also discussed from the wishes of the citizens. It is important that the theme meets the real need and interest of the resident. The survey was published on the espoo.fi website in the autumn of 2021. About 110 people responded to the survey. The themes and speeches of the series are based on these responses to match citizens wishes.

The hybrid webinars and face-to-face workshops are a concrete example of the ways that citizens can participate and bring their opinions out and straight to the city. Streaming the events also makes it much easier for citizens to take part and learn more about sustainability during or after the event since the webinars have been available for two weeks after the actual events. In the events there has been many good and concrete questions about sustainable lifestyle and how to make everyday life more sustainable. It would seem that citizens have benefited from the hybrid event and workshop series. After the webinars the recordings of the events are available to watch in the City of Espoo's public YouTube channel.

Compiled sustainable lifestyle report

The city of Espoo has held several occasions where the citizens have had a chance to bring up their opinions on the city development and good everyday life in the city. During the SPARCS-project the collected data has been analysed from the sustainable lifestyle- point of view. The analysed data consists mostly of Our Espoo 20X0- event series. The series was held during 2022 and at the events citizens got to talk about their hopes future Espoo. Also, other citizen surveys and event materials were analysed during the process. This data was:

- Sustainable development survey. 2021.
- MyEspoo survey. 2020.
- Survey from the citizens organized by SPARCS, co-creation model. 2022.
- Promotion of renewable energy- Report of citizen survey organized by FCG. 2022.

The data was analysed by using qualitative content analysis. The goal for the analysis was to figure out how the citizens of Espoo define sustainable development and what

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sustainable lifestyle means for them. The goal was also to figure out, what kind of participation citizens of Espoo want and what they think about the participatory actions in general.

3.2 Communication and dissemination activities

Several dissemination and communication activities have been conducted as a part of the community engagement activities in Espoo to share insights and engage citizens and experts in knowledge sharing. Table 19 presents the different dissemination and communication activities.

Table 19: Dissemination and communication activities in Espoo.

DISSEMINATION AND COMMUNICATION	
Multiple news in different medias	SPARCS Business models webinar Co-creation with citizens and stakeholders Buddy class activities in Espoo Co-innovation process launched Future e-mobility hub development Webinar results on community engagement in EU Regions week Summary and recordings from SPARCS Citizen engagement webinar Announcing Sustainable Mobility Challenge pilot winner KONE Tech&Inn news on 1.5-degree workshops and Moprim pilot Results from 1.5-degree workshops and work in Espoo (Finnish) Results from 1.5-degree workshops
Webinars	**Related to T3.6** Citizen engagement webinar (October 2021) EU week of regions and cities (October 2021) **Related to T3.8** Smart business models webinar (April 2021) Start-up challenge webinar (April 2022) SPARCS & Smart Otaniemi webinar on eV-charging infrastructure (April 2022)
Academic publications	Fatima, Z., Pollmer, U., Santala, S.-S., Kontu, K., & Ticklen, M. (2021). Citizens and Positive Energy Districts: Are Espoo and Leipzig Ready for PEDs? *Buildings 11*, 102. https://doi.org/10.3390/ buildings11030102 Fatima, Z., Vacha, T., Swamygowda, K., & Qubailat, R. (2022). Getting Started with Positive Energy Districts: Experience until Now from Maia, Reykjavik, Kifissia, Kladno and Lviv. *Sustainability 14*(10). https://doi.org/10.3390/su14105799 Ryöppy, M., Santala, S.-S., & Jacobson, S. (2022). Citizen-led approach to designing inclusive digital shared mobility services. *In ISPIM Copenhagen 2022 Conference Proceedings*. The International Society for Professional Innovation Management (ISPIM). Ryöppy, M., Siltanen, S., Santala, S.-S., Ranne, J., Mölsä, A., Jacobson, S., & Hyvärinen, J. (2021). On agile approaches in mid-and long-term research and innovation. In *ISPIM Valnecia 2021 Conference Proceedings* (pp. 1-13). The International Society for Professional Innovation Management (ISPIM).

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	Santala, S.-S., Ryöppy, M., Lettenmeier, M., Kolehmainen, J., & Lahtinen, S. (Submitted). Design game intervention and follow-up study for sustainable mobility behaviour change in households in Espoo, Finland. *Sustainability*. Santala, S.-S., Tartia, J., & Ryöppy, M. (Submitted). Community-driven mobility practices: A socio-behavioural perspective to designing effective sustainable urban mobility interventions. *Mobilities.*

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4. RESULTS

This section describes the summarized outcomes of the community engagement activities in Espoo, Finland. These include insights as well as results of the user studies, co-design workshops, and design sprints. First, we present behavioural insights of Espoo citizens' sustainable urban mobility behaviours and related needs and challenges. Second, we present eight sustainable mobility concepts co-designed with citizens based on the presented behavioural insights. Third, we present results from the Sports community mobility pilot and sustainable business model co-creation. Finally, we summarize results from diverse citizen engagement events and conclude with a holistic co-creation model for smart city development in multi-stakeholder collaboration.

4.1 Insights on sustainable mobility transition in Espoo

Figure 35: Illustration of diverse Espoo citizens. Image: Saga-Sofia Santala and Satu Niemi. (Source: KONE)

Here, we present concluding insights of Espoo citizens' mobility behaviours and practices as well as insights for matters hindering, driving, and enabling behaviour change towards more sustainable mobility in Espoo. A significant amount of the community engagement activities focused on studying Espoo citizens' (un)sustainable urban mobility behaviours. Matters that were studied included urban mobility related needs, challenges, enablers, drivers, barriers, and experiences. The studies varied from observation, interviews, and workshops to longer ethnographic and follow-up user studies. The insights are categorized under 6 main themes focusing on diverse aspects of sustainable urban mobility.

4.1.1 Private motoring as a norm

Based on the user studies, it can be concluded that mobility habits in Espoo are highly car-based. The infrastructure in Espoo supports and even favors private motoring. Thus, also the current mobility practices are strongly tied to private driving. Also, many Espoo citizens own a summer cottage and visit the cottage regularly. This was mentioned as one of the most common reasons for not giving up private motoring, as communicated by one participant:

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Even [the car] is not so ecological, but for our lifestyle, we could not get to the summer cottages [without the car]. So, we kind of must have it.

(1.5-degree lifestyles follow up study participant)

Also, trips to leisure time activities are often done by car in Espoo. Here, also for example, the lack of city bike stations was communicated as a matter supporting car travel to sports activities. In addition, the decision of using a car is also motivated by a desire, for example, comfort rather than the ecological aspects, saving citizens time in a busy everyday life. On value level, environmentally friendly mobility choice is easy to argue for, but the implementation and execution can be challenging on an individual level. As a conclusion, environment and emissions are rarely the most important criteria for citizens when choosing mobility options, and there is a big barrier for giving up a car, and it requires effort and taking initiative. More insights on the challenges of giving up private car in Espoo can be found from Sipilä's (2021) master's thesis.

In addition, citizens have challenges in understanding and comparing mobility emissions. Comparing one's own mobility options and choices is easier when the comparison is reliable and linked to the real life. Simultaneously, societal guidance for mobility is often perceived as unpleasant and unfair. Then again, personal as well as friends' experiences affect mobility choices and preferences.

The article reporting more insights about the ways in which (un)sustainable mobility behaviours and related change unfold in social interaction inside citizens' close social communities from Espoo citizens' perspective has been submitted to Sustainability journal titled *Design game intervention and follow-up study for sustainable mobility behaviour change in households in Espoo, Finland*[5].

4.1.2 Electrifying existing stock of vehicles

As the long distances in Espoo make private driving a necessity in some parts of Espoo, a sustainable mobility transition involves electrifying the existing stock of vehicles. For this change to be successful, citizens need to be able to afford it.

In a sense, the easiness and environmental friendliness of the electric car. No need to feel bad conscience on polluting and also the expense of individual trips is so small that you don't have to take it into account.

(Mobile ethnographic user study participant)

But I admit that with electric car, I might sometimes drive for an hour after a remote workday, freshening up my mind without going anywhere. Somehow, I feel that it's nicer with an electric car because there aren't emissions or expenses. With gasoline car bad conscience is burdening if you are driving unnecessarily.

(Mobile ethnographic user study participant)

[5]Santala, S.-S., Ryöppy, M., Lettenmeier, M., Kolehmainen, J., & Lahtinen, S. (Submitted). Design game intervention and follow-up study for sustainable mobility behaviour change in households in Espoo, Finland. *Sustainability*.

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There is a growing interest towards electric mobility but still lack of knowledge and skills. The ones who have adopted the electric mobility practices communicated that electric car enables driving with clear conscience. It might even increase driving and emissions, such as described by the mobile ethnography participant who goes on rides for pleasure without understanding that also driving an electric car produces CO_2 emissions.

In principle, the emissions of electric cars are experienced smaller, but the emissions of the used energy are rarely known. The expenses are also experienced as lower than with gasoline cars, which is based on sensation rather calculations. Many participants could not estimate the yearly expenses of their car. Also, obtaining clear and reliable information about electric cars is challenging.

In addition, electric bikes are seen as interesting, but the cost compared to benefit is still challenging. The high price of an e-bike and maintenance costs were not seen as bringing added value compared to ordinary bikes. The participants were also worried about bike thieves and how to lock and park an expensive e-bike safely, especially in public spaces.

4.1.3 Encouraging shared mobility for longer distances

Another opportunity to achieve more sustainable mobility behaviours is to increase the use of public transportation and shared mobility services (Machado, 2018). A transition to shared mobility requires still plenty of changes both on an attitudinal as well as service provider level in Espoo. To make citizens feel confident in sharing their own vehicles with others, common rules for sharing should be established and facilitated (Ryöppy et al., 2022). Citizens communicated a desire for an external party taking care of the responsibility aspect, as stated by one user study participant:

> *In my own family, other people can of course drive my car, but even if I should give a car to a friend… I don't think I would do that because if something were to happen to the car it could be tricky. It might even ruin the friendship, so perhaps this is not a good idea. The same rules should apply to both friends and strangers, and it would need an agency and an insurance and so on, in advance.*
>
> *(Man, 58, electric car owner)*

In addition to changes in behavioural norms and practices, the findings highlight that a shared mobility transition requires the development of platform and sharing economy for providing the needed infrastructure and vehicle fleet for citizens to use. Ways to increase the adoption of shared mobility services includes motivating a transition from ownership to usership through enhancing communality and meaningful encounters (Ryöppy et al., 2022).

Also, inclusion and accessibility require efforts for creating shared mobility services that are truly available for all citizens, both from a digital and physical perspective. Many challenges and opportunities were identified from the viewpoint of inclusive shared mobility. Our research shows that 1) transition from ownership to usership takes time, 2) reliability and safety poses concerns, 3) sharing within communities calls for facilitation, and 4) physical and digital accessibility requires smooth integration. (Ryöppy et al., 2022)

The article reporting more insights about the digital shared mobility transition and related challenges and drivers from Espoo citizens' perspective has been published in the

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form of a conference paper, titled *Citizen-led approach to designing inclusive digital shared mobility services*[6].

4.1.4 Increasing the uptake of micro mobility for shorter distances

Increasing micro mobility is challenging due to long distances and a scattered city bike network that covers only parts of Espoo. Micro mobility includes walking, biking and all sorts of light mobility devices that people might use for last-mile mobility, including but not limited to, ordinary and electric bicycles, city bikes, kick bikes, e-scooters, one- and two-wheelers and so on. Most of the Espoo citizens have bicycled or own a bike. The participants expressed that they move with a bicycle to some extent, however, mostly for sports purposes rather than moving from A to B. While many have tried city bikes and find them useful, some have not had the opportunity to test this option, although interest for this exists, as communicated by one user study participant:

> *I've not tried a city bike. Sure, I could try them if the city bike stations were closer to where I live. However, they're still not available in many places.*
>
> *(Man, 37, combustion engine car owner)*

Also, the infrastructure is seen as a barrier for increasing bicycling. Citizens wish for better winter maintenance of bicycling infrastructure, and some citizens communicated there being challenging hills and roadblocks due to street works along the bicycling roads. Electricity in bicycles was seen as an enabler for bicycling on these kinds of roads. Also, the accessibility of bicycling for elderly people was highlighted as a concern. New kinds of bicycles, such as electricity-assisted tricycles, were seen as potential for increasing the inclusiveness of bicycling services. Also, the infrastructure could consider different kinds of bicyclers by providing separate lanes for bicyclers of varying speeds.

4.1.5 Enhancing navigation and hybrid travel chains

Increasing hybrid travel chains and last mile options were identified as drivers for a sustainable mobility transition. Many Espoo citizens travel long distances to work, for example, to neighbor cities, and thus private driving is the business-as-usual choice for many. Many families own two cars due to daily commuting, including taking children to kindergarten or school and hobbies. Enabling hybrid travel chains, such as taking a bike to the train or driving to a mobility hub and continuing the trip by light rail, poses an opportunity to decrease dependency on private cars and motivating the use of more sustainable mobility means. The lack of existing parking infrastructure in Espoo as well as in other cities supports this mobility transition.

The planning of trips often starts from Espoo citizens' home. Often citizens plan their trips beforehand and use their calendar, navigation, and public transportation apps for planning their trips and related schedules, especially when traveling with children.

[6]Ryöppy, M., Santala, S.-S., & Jacobson, S. (2022). Citizen-led approach to designing inclusive digital shared mobility services. In *ISPIM Conference Proceedings*. The International Society for Professional Innovation Management (ISPIM).

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4.1.6 Interest towards autonomous mobility

Autonomous mobility was viewed as an interesting opportunity by many user study participants. In the SPARCS context, autonomous mobility was defined as self-driving vehicles or transport systems that move without a human driver and that can be used for transporting people and goods. It was seen as a solution enabling accessibility also at an older age, when typical mobility modes might not anymore serve their purpose, as put by one participant:

> *Ageing and having an autonomous electric car in front of your house that could be ordered to drive where you want, that would be quite optimal. The car would be parked in front of the house, always ready for use but you wouldn't need to drive it, rather it would perform autonomously.*
>
> *(Mobile ethnographic user study participant)*

In addition, autonomous mobility would autonomize labour-intensive functions and free human resources. Many trips in Espoo are about giving lift for other people to different places: Parents driving their children to leisure time activities or partners driving family members somewhere due to a lack of a driver's license or car. These interdependencies lock Espoo citizens into unsustainable patterns of mobility when an autonomous mobility service could enable less dependency on being driven by others and better accessibility, also for people who do not own a private car. However, rebound effects pose a potential down-fall for these kinds of services, risking the sustainable behaviours of some citizens due to the availability and attractiveness of a more unsustainable mode of mobility, compared to for example, the use of public transport.

The behavioral insights and challenges summarized in the previous chapters, provided a base for the development of eight *sustainable mobility concepts* for research purposes, presented in the following section.

4.2 Co-designed sustainable mobility concepts

As a result of the user studies and following workshops and design sprints, **eight sustainable mobility concepts** were formed and developed to answer to the identified end-user challenges. The concepts from left to right in Figure 36: 1) Micro mobility parking, 2) Bicycle bonus, 3) Community vehicles, 4) Shared mini cargo vehicles, 5) Door-to-door travel chain, 6) Smooth mobility hub navigation, 7) Drop shop last mile delivery, and 8) Robotic taxi. These concepts were co-designed with diverse stakeholders for research purposes to show potential directions for the future smart and sustainable cities.

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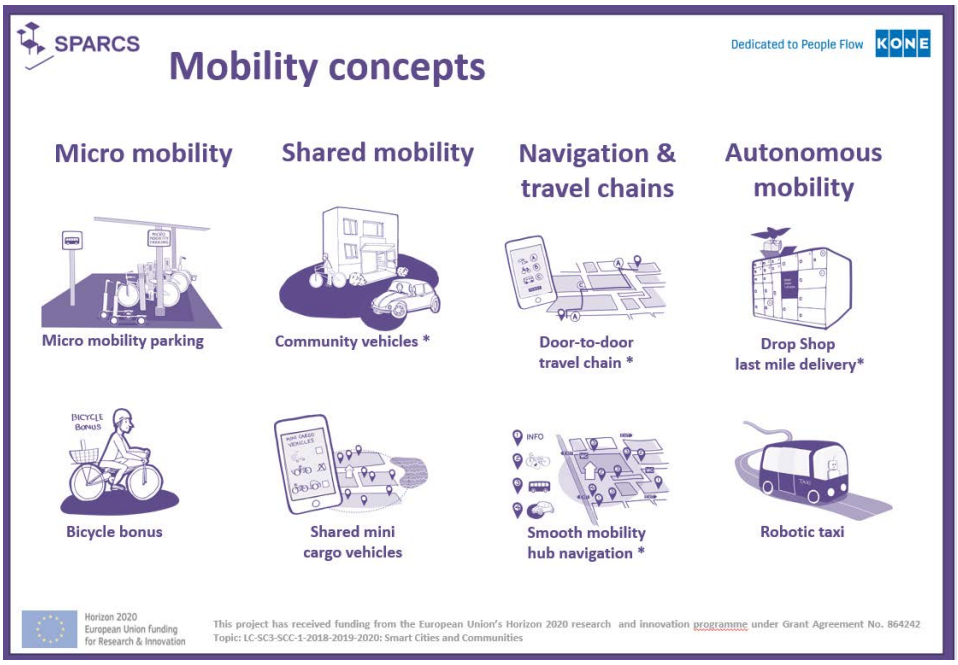

Figure 36: Co-designed eight final sustainable mobility concepts. (Source: KONE)
(*these concepts were later chosen to business model development)

This concept development work is future-oriented and exploratory in nature. KONE has identified trends and directions for future mobility solutions that might have business potential, and for some of them, initial business model development work was done. However, it is important to note that these concepts are not directly chosen as potential new business offering or future solutions for KONE. The concepts serve primarily as inspiration for sustainable mobility solutions that can be implemented in ecosystem partnerships in smart city context.

In this section, we describe each developed mobility concept, the potential value of the concept for the end-user and service providers, as well as the possible use context. In addition, two use cases and their related CO_2e calculations are presented for each concept.

4.2.1 Background for the CO_2 Impact assessment

The CO_2e reduction calculations of future mobility concepts developed within SPARCS were conducted in collaboration with D-mat ltd. The calculations were conducted to evaluate the carbon footprint reduction potentials of the eight future mobility concepts presented in Figure 14. More detailed description of the concepts, their related use cases and the carbon footprint calculations by D-mat can be found from the *1.5-degree mobility – concepts and choices'* report by Lettenmeier et al., 2021.

Carbon reduction calculations can be conducted by using different approaches. In the SPARCS context, the objective was to evaluate concepts that produce or promote sustainable ways of transport (for citizens/daily end-users). The requirements for calculation were, therefore, to:

- Assess the magnitude of carbon impact of use cases developed for each mobility concept

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- Provide a reasonable scenario in which different households in Espoo apply a given use case in their daily lives, and calculate its yearly carbon impact (kg CO2e / person / year)
- Provide a reasonable scenario for the carbon impact achievable in whole Espoo by a given use case, considering population characteristics and other area-specific variables
- Assess the change of the carbon impact of a given use case over time, extending to 2030.

To fulfil the requirements, the calculation of the concept was based on the idea of carbon footprint (Akenji et al., 2021). In the centre of this approach is an individual, whose resource consumption is assessed, and multiplied by the consumption's respective carbon intensity. The result is a number describing the climate burden of the given activity. The climate burden is expressed in CO_2-equivalents, meaning how much carbon dioxide would have to be emitted to the atmosphere to produce a matching net warming effect to the given activity. The scope includes both direct and indirect emissions, some of which could be formed beyond national borders. In this context, the method is applied to the single use cases, resulting in their household-level carbon impacts.

Carbon footprint reductions were calculated for two different use cases per concept and for four different household types based on the most common characteristics of households and residents in Espoonlahti and Leppävaara. The four household profiles are presented in

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Table 20, including household number, size, location in Espoo, car engine type and a short description of the household members and their lifestyle characteristics.

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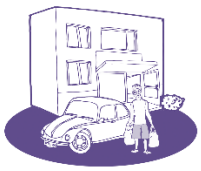
Table 20: Description of the households used for the use case calculations

Household	Size	Location	Car	Description
H1 	1	Leppävaara	Gasoline	Anton is single and lives alone in a social apartment in Leppävaara, Espoo. He is 35 years and works part-time at a grocery store.
H2 	2	Leppävaara	Gasoline	Sara is a 63-year-old pensionist, who lives in a detached house in Leppävaara, Espoo, with her partner and a dog. Sara's partner works as a teacher one hour car drive away from Espoo.
H3 	3	Espoonlahti	No car	Tom is a single parent living in a row house in Espoonlahti, Finland. He is 42 years and lives with two young children, with active hobbies.
H4 	4	Espoonlahti	Electric	Maria is living in a detached house in Espoonlahti, Finland. She is 42 years and lives with her husband and two young children, with active hobbies.

The calculations for each household covered the present situation as well as the projection of a 2030 scenario with changes in the provisioning system (energy production and car fleet characteristics). Calculations were made for 2030, as this is the year when Espoo, accompanied by many other European cities, aim to be carbon neutral. In addition, the carbon footprint reduction potential for each use case was calculated for the whole SPARCS lighthouse city of Espoo.

For every household and for every use case, an estimated amount of mobility in both business-as-usual and use case scenarios is needed to assess the carbon footprint. Most of them are unique to the households, but some, such as driving to work for lunch (use case 3a), does not depend on household characteristics, in which cases only one, unified scenario is presented. Furthermore, a given use case's carbon footprint reduction potential in the whole Espoo will be assessed as well, requiring mobility amount estimations for a typical Espoo citizen. The travel distances for each use case and household are presented in Table 21.

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Table 21: The travel distances used in the use cases and per household.

Name	Use case IDs	Driving distance, km (one way, if not stated otherwise)				
		HH 1	HH 2	HH 3	HH 4	Whole Espoo
Distance to a shopping mall / supermarket (by bike) / mobility hub (by bike) / check-in station (by bike) / park & ride station (by driving)	1a, 1b, 2a, 2b, 4a, 6a, 6b	0.8	3	0.8 (when included)	3	1
Distance to destination (by car / by train)	1b	14 / 15	14 / 17	19 / 21	19 / 24	14 / 15
Driving distance to the supermarket	2a, 2b, 4a	1	3.5	[excluded]	3.5	1
Driving distance to the destination	3a	15 (unified scenario)				15
Trip length (only one-way trip applicable)	3b	30 (unified scenario)				30
Driving distance to the port	4b	2	2	2	2	2
Distance from airport to home (public transport, railway part / public transport, bus part / driving)	5a	26 / 0 / 18	26 / 0 / 22	35 / 9 / 33	35 / 9 / 36	27 / 0 / 27
Distance to work (public transport, railway part / public transport, bus part / driving)	5b	5 / 5 / 8	60 / 10 / 70	[excluded]	8 / 8 / 15	6 / 6 / 12
Distance to destination (railway / driving)	6a	10 / 10	10 / 12	16 / 14	16 / 14	12 / 12

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Distance to city center (railway / driving)	6b	10 / 12	10 / 12	16 / 14	16 / 14	12 / 10
Last-mile delivery distance (drone / driving)	7a	4 / 10 (unified scenario)				4 / 10
Last-mile delivery distance (drone / driving)	7b	4 / 15 (unified scenario)				4 / 5
Distance to the hobby (bus / driving)	8a	[excluded]	10 / 8	[excluded]	10 / 8	10 / 8
Distance to the destination (e-taxi, alone part / e-taxi, occupied part / driving)	8b	2 / 10 / 8	2 / 10 / 8	[excluded]	2 / 10 / 8	2 / 10 / 8

The second part, along with the consumption amount, is the carbon intensity of the respective activity. The simplified overview of intensities used in this project are presented in

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Table *22*. There are distinct values for 2030, which are projected from 2021 data, estimating:

- The regional transportation entity, Helsinki Regional Transport Authority (HSL) has a target of 90 % reduction in direct emissions by 2025 (road infrastructure impact assumed unchanged) (HSL, 2021)
- Among private cars, fuel efficiency improvement of 37,5 % between 2021 and 2030, as per an EU-target (according to the Ministry of Transport and Communications report, Andersson et. al., 2020)
- Railway traffic is already low carbon with direct emissions of 0.0 g / pkm and indirect ones, including the non-fossil electricity production lifetime emissions, 12.9 g / pkm. In the future, this expected to change by the indirect electricity part 2.2 g / pkm, resulting 10.7 g / pkm (Ecoinvent 3.7.1, 2020; IPCC, 2014)
- The carbon intensity of electricity is expected to change from current 150 g / kWh to that of waterpower's, 24 g / kWh by 2030. Water-produced electricity has a larger carbon footprint than wind power (11 g / kWh) but smaller than solar (45 g) or biofuels (230 g) (IPCC, 2014).

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Table 22: A simplified overview of the used intensities. The final numbers may vary depending on for example the car size. (Sources: Bieker, 2021; Ecoinvent 3.7.1 database, 2020; Finnish Climate Change Panel, 2021; HSL, 2019; HSL, 2021; IPCC, 2014; Liikennefakta, 2021; Ministry of Transport and Communications report by Andersson et al., 2020; Pusenius et al., 2005; van Vliet et al., 2011; VTT, 2016; Zhang et al., 2021)

Name	Intensity 2021	Intensity 2030
Biking	0.01138 kg CO_2e / pkm	0.01138 kg CO_2e / pkm
Fossil-fuel powered car	0.1848 kg CO_2e / km	0.121 kg CO_2e / km
Electric car[7]	0.077 kg CO_2e / km	0.045 kg CO_2e / km
Bus	0.071 kg CO_2e / pkm	0.021 kg CO_2e / pkm
Rental car	0.176 kg CO_2e / km	0.121 kg CO_2e / km
Taxi	0.352 kg CO_2e / km	0.15 kg CO_2e / km
Train / metro	0.0129 kg CO_2e / pkm	0.0107 kg CO_2e / pkm
E-bike	0.02512 kg CO_2e / pkm	0.02512 kg CO_2e / pkm
Cargo bike	0.01825 kg CO_2e / pkm	0.01825 kg CO_2e / pkm
Drop shop service	0.00167 kg CO_2e / km	0.00027 kg CO_2e / km
Robotic e-taxi	0.1155 kg CO_2e / km	0.0675 kg CO_2e / km

The limitation in the selected calculation approach is the inability to account for the overlaps between the use cases, as well as extend the new practice to an individual's whole lifestyle. The main consequence is limited results when comparing the use cases' impacts to the whole mobility-related carbon footprint. For example, if the use case includes biking a couple of kilometres to a shop and back, the reasonable amount of shop visits in a year is limited, causing only a minor improvement of one's carbon footprint, compared to car driving. However, if assuming that the new biking habit not only concerns shop visits, but all short-distance driving, the impact would be considerably higher. Especially the use cases that include futuristic elements, such as autonomous vehicles, could mean societal-scale changes that are greatly undermined by only including one or two example cases.

[7] Assumed: 50 kWh battery, 15 years lifespan, 20,000 km / year

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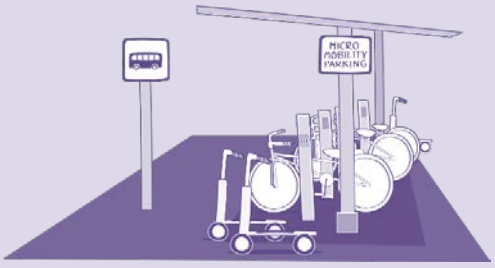
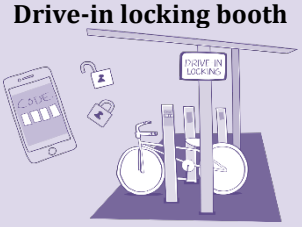
4.2.2 Concept 1: Micro mobility parking

Table 23: *Micro mobility parking* concept description and use cases

Description of the concept	
 *"As a citizen, I need secure and effortless solutions to park my valuable micro mobility vehicles in public spaces as part of multi-modal travel chains. The existing parking solutions feel unsafe, and it is frustrating to search for an available spot in a fully loaded parking space."*	To encourage citizens to favour low-carbon micro mobility vehicles and public transport requires seamless connection points and secure parking solutions. Micro mobility parking service aims to provide citizens secure parking and locking solutions as part of the multimodal travel chain to enable parking of (valuable) micro mobility vehicles, e.g., electric bikes, cargo vehicles, e-scooters. The service includes sheltered drive-in locking stations for leaving the vehicle effortlessly and maintenance services during/after the parking. Easy to access without registering or with a single payment. In the future, dedicated robotic elevators and surveillance solutions would enable easy accessibility and smooth travel chains for micro mobility users.
The value of this concept	
• Feeling of safety and security in parking • Smooth end-to-end travel chain • Prioritizing micro mobility users and their needs • Motivating to use low-emission mobility solutions	
The possible use context	
Micro mobility parking services should be provided at traffic connection points, such as shopping malls and different sized mobility hubs.	
Use case	

Name	**Description**	**"Business as usual"**	**CO_2e reduction** (kg CO_2e / person / year)
Drive-in locking booth 	A resident rides a bike to the shopping mall and locks it in a drive-in locking booth.	The resident takes the car or public transport to the mall.	H1: 135 kg CO_2e H2: 89 kg CO_2e H3: 3 kg CO_2e H4: 5 kg CO_2e
Check-in station 	A resident rides a bike to a check-in station and continues the journey by train.	The resident takes the car all the way to the destination.	H1: 216 kg CO_2e H2: 109 kg CO_2e H3: 23 kg CO_2e H4: 6 kg CO_2e

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4.2.3 Concept 2: Bicycle bonus

Table 24: *Bicycling bonus* concept description and use cases

Description of the concept	
 *"As a bicyclist, I want to use car-free mobility modes for shopping and wish that I am appreciated as a customer. Currently bicyclists are undermined as a customer group, without rewarding schemes for sustainable mobility choices."*	To encourage citizens to favour low-carbon micro mobility vehicles for the last-mile requires motivating behavioural change on a local level. The bicycle bonus reward system is a monetary bonus system for cyclists who arrive to a grocery store or a shopping mall with a bike and register their bike on the platform upon the arrival. The bicycle bonus is integrated on the grocery store's bonus card system or on a similar mobile application. The cyclist receives 1% bonus which is deducted from the total amount of purchases. The bonus platform would also enable tailored offers for the cyclists.

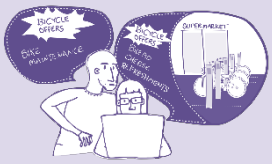
The value of this concept

- Monetary benefit / incentive and personalized offers
- Promoting carbon free mobility and helps to achieve sustainability goals
- Experience of being appreciated as a cyclist
- Safer streets and less car traffic in the cities

The possible use context

Bicycle bonus should be provided for customers of shopping malls or larger grocery chains.

Use cases

Name	Description	"Business as usual"	CO_2e reduction (kg CO_2e / person / year)
Personalized bicycle offers 	A senior couple bikes to the supermarket and back.	The senior couple uses their car for the trip instead.	H1: 72 kg CO_2e H2: 61 kg CO_2e H3: - kg CO_2e H4: 4 kg CO_2e
Discount for a bike user 	A resident decides to take the bike to the supermarket, since there is a discount for bike users.	The resident takes the car instead of a bike.	H1: 72 kg CO_2e H2: 61 kg CO_2e H3: - kg CO_2e H4: 4 kg CO_2e

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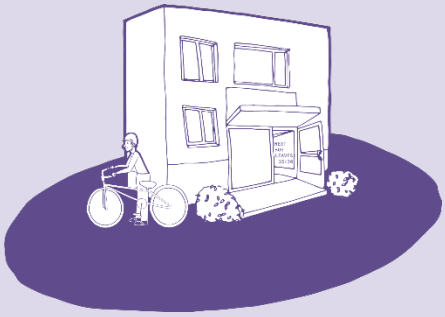
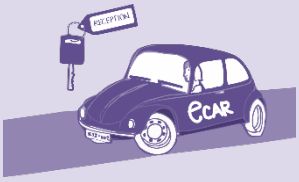
4.2.4 Concept 3: Community vehicles

Table 25: *Community vehicles* concept description and use cases

Description of the concept	
 *"As a citizen, I wish to have shared vehicle services for irregular driving, which are safe and clean. Using open car sharing services feels unsafe and I don't know is the vehicle maintained. I want to be able to trust the people in the community sharing, driving, and maintaining the vehicles."*	The service platform allows people living or working in a same building to access and use dedicated vehicles in shared use. The service model is based on leasing model or a peer-to-peer model where private users share their vehicles within a familiar circle. The service has an easy Community Vehicle booking system to see the availability of the vehicles. In the leasing model, the vehicles are only electric vehicles to highlight the environmental benefits and save costs through sharing. To encourage users to use sustainable mobility modes, the system would have a reward system. Fleet of vehicles is calculated based on the demand.

The value of this concept
• Trustworthy and safe sharing community • Access for multiple and different type of vehicles within a close distance (e.g. parking place of a housing complex) • Sharing costs of the vehicle (economic savings) • A low barrier to try shared (e-)vehicles and reduce private car ownership

The possible use context
A housing association, a neighbourhood, or a workplace/office as a known circle.

Use cases			
Name	**Description**	**"Business as usual"**	**CO_2e reduction** (kg CO_2e / person / year)
A shared office e-car 	An office worker drives a Community Vehicle platform e-car to a lunch meeting on the other side of the city.	The office worker takes a car fuelled by gas or diesel instead.	H1: 139 kg CO_2e H2: 139 kg CO_2e H3: 139 kg CO_2e H4: 139 kg CO_2e
Peer-to-peer vehicles for neighbourhood 	A family takes a day trip by e-bikes.	The family takes the car for a day trip.	H1: 34 kg CO_2e H2: 13 kg CO_2e H3: 6 kg CO_2e H4: -4 kg CO_2e

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4.2.5 Concept 4: Shared mini cargo vehicles

Table 26: *Shared mini cargo vehicles* concept description and use cases

Description of the concept	
 *"As a citizen, I need last-mile micro mobility solutions for moving everyday goods when using hybrid mobility modes. Owning a mini cargo vehicle is too expensive and troublesome, because it requires storage spaces in the crowded bike shelters."*	The service model includes shared micro mobility cargo vehicles for moving everyday goods, such as heavy groceries, instruments, training gears, parcels etc. The fleet of vehicles is available in mobility hubs and in 2 km radius around the hub. The vehicles are electrified to make the driving experience comfortable also with a bigger load. Different kind of vehicles are included in the fleet to meet different end-users' needs (safety, stability, heavy loads, light load etc.). The end-user can book the cargo vehicle through an online system beforehand or take it into use on the street. The service is based on a subsidized pricing model, which includes free trips for short distances from/to the hub. The pricing model varies for longer distances and monthly subscriptions to be affordable for different end-users.

The value of this concept
• Fast and easy solution for moving goods occasionally • Sustainable option for the last-mile • Easiness of parking, locking and maintenance • Access for different micro mobility cargo vehicles without ownership

The possible use context
The fleet of cargo vehicles is within 2 km radius of mobility hubs. The vehicle can be picked up from and left to dedicated spots around the hub.

Use cases

Name	Description	"Business as usual"	CO_2e reduction (kg CO_2e / person / year)
Shopping bags to home 	A commuter takes a cargo-bike to carry groceries home from the supermarket.	After arriving home from work, the commuter drives to the supermarket and back to get the groceries.	H1: 72 kg CO_2e H2: 61 kg CO_2e H3: - kg CO_2e H4: 4 kg CO_2e
A weekend boat trip 	A family uses a cargo vehicle for taking their stuff to the port. The cargo vehicle is picked up 400 m from the family's home and left to the port 2 km away from their home.	The family takes their car to the port.	H1: 14 kg CO_2e H2: 7 kg CO_2e H3: 0 kg CO_2e H4: 0 kg CO_2e

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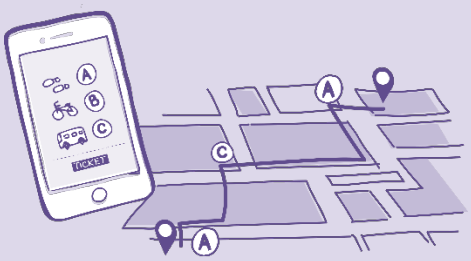
4.2.6 Concept 5: Door-to-door travel chain

Table 27: *Door-to-door travel chain* concept description and use cases

Description of the concept	
 *"As a citizen, I want to able to combine different mobility modes in effortless ways including easy and quick changes from a vehicle to another. The guidance at the hubs is confusing to follow and causes misunderstandings, which may lead to missing the next connection."*	Through data combined from different sources, the solution suggests optimized routes and mobility connections for a user based on the user's needs and preferences including the external factors such as weather. The service platform allows user to easily pay for different mobility modes despite e.g., a user's age. Solution provides seamless outdoor navigation as travel chains often include different mobility modes in urban environment. The solution supports the user to make sustainable decisions and provides clear and understandable data on carbon footprint caused by different travel chains.

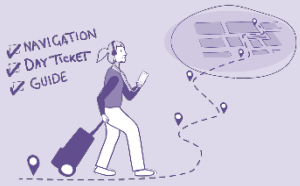
The value of this concept

- Finding and choosing the best travel option for personalized needs
- Saves time and decreases the need to own various vehicles
- Solution provides seamless outdoor navigation to improve the user experience
- Supports to understand complex data about e.g., carbon emissions and sustainable decision making

The possible use context

Urban environment with multiple optional mobility modes.

Use cases

Name	Description	"Business as usual"	CO_2e reduction (kg CO_2e / person / year)
Route planning and unified ticket system 	A family uses the route planning and unified ticket system to get home from the airport.	The family takes a taxi home from the airport.	H1: 5 kg CO_2e H2: 3 kg CO_2e H3: 2 kg CO_2e H4: 2 kg CO_2e
Sustainable route guidance 	A resident decides to take the most sustainable route to work.	Because of the weather, the resident takes the car to work.	H1: 239 kg CO_2e H2: 1772 kg CO_2e H3: - kg CO_2e H4: 106 kg CO_2e

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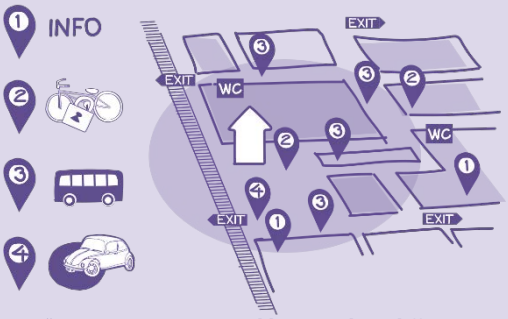
4.2.7 Concept 6: Smooth mobility hub navigation

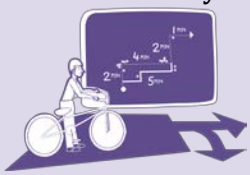
Table 28: *Smooth mobility hub navigation* concept description and use cases

Description of the concept	
 *"As a citizen, I want to able to combine different mobility modes in effortless ways including easy and quick changes from a vehicle to another. The guidance at the hubs is confusing to follow and causes misunderstandings, which may lead to missing the next connection."*	Mobility hubs are increasingly important points as part of the travel chains. Often, they combine multiple mobility modes (private, shared and public transportation) and other services including e.g. shops, restaurants and parking places. In the future, these hubs will serve as connection and charging points for several electric mobility modes. Due to several different tenants, there is currently no actor who oversees the people flow, guidance and navigation. Concept includes several different user interfaces and methods to guide people and vehicle flow in smooth ways.

The value of this concept
• Helping the end-user to find the best connections and vehicles in mobility hubs • Reducing the stress of navigating in large mobility hubs • Guidance and information about services in the hub in clear and multisensory ways

The possible use context
Different sized mobility hubs, like metro and train stations in mega cities, bus terminals and airports.

Use cases

Name	**Description**	**"Business as usual"**	**CO_2e reduction** (kg CO_2e / person / year)
Easy change with a bike to subway 	A resident uses the mobility hub for a journey and combines cycling and subway to reach the destination.	The resident takes a car instead.	H1: 183 kg CO_2e H2: 83 kg CO_2e H3: - kg CO_2e H4: -3 kg CO_2e
Car driver using the Park & Ride stations 	A resident drives their own car to the Park & Ride station and continues the journey with railway transport to the city center.	The resident drives a gas or diesel fueled car to the city center.	H1: 24 kg CO_2e H2: 4 kg CO_2e H3: - kg CO_2e H4: 0 kg CO_2e

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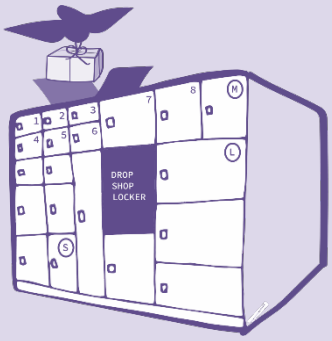
4.2.8 Concept 7: Drop Shop

Table 29: *Drop shop* concept description and use cases

Description of the concept	
 *"As a citizen, I prefer quick yet affordable delivery options. As ordering all kinds of products and groceries to home has increased, I don't want to sit and wait at home until the delivery company arrives."*	The next generation solution for 24/7 package deliveries in megacities. The Drop Shop consists of autonomous drone service for delivering goods to Drop Shop parcel locker containers located in the neighbourhoods. The end-user can order parcels and get them delivered cost-efficiently to the nearest Drop Shop locker to be picked up when suitable for the user. A drone drops the ordered parcel on a slow speed to a flexible net on top of the Drop Shop locker. The parcel is caught by the net and slides into the locker system. A robot will scan the parcel and place it to a locker box to wait for the end-user to pick it up. The unmanned locker container has a large parcel storage capacity and is accessible 24/7 with a barcode, which the end-user receives electronically. The end-user can choose the best time to pick up the parcel.
The value of this concept	
• Fast delivery time • Flexible pick-up time 24/7 • Environmental solution for the last mile logistics • Cost-efficient way of delivering goods	
The possible use context	
The Drop Shop parcel locker can be installed outdoors in city blocks, residential areas or on top of tall buildings. It reduces the need for space in megacities.	

Use cases			
Name	**Description**	**"Business as usual"**	**CO_2e reduction** (kg CO_2e / person / year)
Delivery to another recipient 	A resident sends an online-bought gift to a friend by a Drop Shop service walking distance away.	The resident uses a delivery service to get the gift to the friend.	H1: 35 kg CO_2e H2: 35 kg CO_2e H3: 35 kg CO_2e H4: 35 kg CO_2e
An ultra-fast spare part delivery 	A maintenance worker orders a spare part with a drone and picks it up at the closest Drop Shop.	The maintenance worker drives to the warehouse and back with a car.	H1: 124 kg CO_2e H2: 124 kg CO_2e H3: 124 kg CO_2e H4: 124 kg CO_2e

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4.2.9 Concept 8: Robotic taxi

Table 30: *Robotic taxi* concept description and use cases

Description of the concept	
 *"As a citizen, I dream about hassle free and flexible transportation system that fits to my personal needs, schedules and routes. Current public transport which follows only certain routes is slow and annoying but, in the future, an autonomic robotic-car-traffic can solve the challenge."*	Robotic taxi in an autonomous electric vehicle that serves citizens based on their needs. A small sized shuttle bus is planned to drive short distances on certain routes, e.g., between residential areas and mobility hubs. For more personalized routes, users can order an autonomous taxi to needed destinations which enhances citizens' mobility modes and flexibility of moving. Users can earn discounts / rewards if they share their journeys with more users. Robotic taxi functions with easy booking platform where personalized wishes can be also defined. To enhance the feeling of safety, users can follow the journey from the screens and e.g., parents can remotely follow their children's journey.

The value of this concept

- Resource utilizing with autonomous technology
- Personalized routes with easy booking
- Possibility to move people and goods together

The possible use context

Robotic taxis can serve citizens in and around mobility hubs such as shopping malls, city center around train stations, and airports. In the future, autonomous taxis are spread around cities as part of the traffic.

Use cases

Name	Description	"Business as usual"	CO_2e reduction (kg CO_2e / person / year)
Shuttle e-bus for daily routes 	A child uses a shuttle bus to get to his/her hobby.	A parent drives the child to his/her hobby, drives back home and picks him/her up after the session.	H1: - kg CO_2e H2: 166 kg CO_2e H3: - kg CO_2e H4: 53 kg CO_2e
Ridesharing on personalized routes 	A resident shares a robotic e-taxi with another passenger, getting both of them from home to their destination.	Both the resident and the other passenger take their own car to their destinations.	H1: 50 kg CO_2e H2: 22 kg CO_2e H3: - kg CO_2e H4: -3 kg CO_2e

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4.3 Sports community mobility pilot

One of the main outcomes of SPARCS community engagement was a mobility pilot implemented together with a local sports club represented in Figure 37. This chapter delves into the key results of the pilot. The pilot process and schedule are described in chapter *3.1.1 Studying and co-designing for sustainable urban mobility behaviours* under the section: *Sports community mobility pilot*.

Figure 37: Illustration of the community mobility pilot where sport team members were tracking their daily mobility and related carbon footprint with Moprim Move Together. Image: Saga-Sofia Santala and Satu Niemi. (Source: KONE)

KONE piloted a new way to make mobility related CO2e footprint visible and relatable within local communities together with the city of Espoo, mobility data company Moprim Ltd. and Tapiolan Honka basketball club. Different stakeholders of the pilot had a different role, and their collaboration was shaped in mutual interaction throughout the pilot:

- *The city of Espoo* was a matchmaker between different stakeholders and had an interest to learn from the results related to mobility data and habits within leisure time communities.
- *Moprim* was a technology provider and developer of Moprim Move Together platform, which was selected to the pilot based on Sustainable Mobility Challenge. Their interest was to further develop their solution and the data platform.
- *KONE* was a facilitator of the pilot process and defined a framework for the content, made contracts with different partners, defined the Moprim Move Together community and was the owner of the collected data, collected insights based on community engagement work and user research, and provided rewards for the participants. They had an interest to study wider sustainability impact through a community intervention and experiment with a new mobility data solution to improve the urban flow.
- *Tapiolan Honka* provided access to the community and the pool of participants. They selected the participating teams based on collectively defined specifications. The pilot was part of carbon neutral Honka initiative with an aim to reduce

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mobility related carbon footprint as a club and do fund raising. The club was rewarded based on the number of active weekly participants.

- *Participants of the pilot* were members of two existing Honka basketball teams. They had a crucial role as users of Moprim Move Together to collect data, engage with the topic and participate in the user research activities conducted by KONE. Their interest was to learn from their own mobility behaviour and contribute to the Honka community and do fund raising.

One of the key findings from SPARCS mobility research was the importance of local social communities on changing (or stabilising) individual citizens' mindset and mobility behavior in cities. Through the earlier mobile probing study, it was discovered that family members, friends, and leisure time communities, among other things, have a great impact on Espoo citizens' daily mobility choices (Santala et al., submitted). Through the mobility pilot, we found out that leisure time activities can count for an extensive amount of individuals' mobility related CO_2e footprint (up to 20% of weekly mobility) and being part of a leisure time community impact individuals' attitudes to change mobility behaviour. Sport clubs, and in particular, established sport teams form a close social community in which the members know each other well, they share similar life situations and experiences, and shape social norms together. Also, mobility practices connect tightly to sport teams, as doing sports requires commuting from home to the rehearsals and tournaments. Our pilot showed that mobility practices within two sport teams were well established and difficult to change. Therefore, reaching a wider sustainability impact requires engaging a group of people (rather than individuals) and building on existing relationships.

With Moprim Move Together application, longitudinal location and sensor-based mobility data was collected from individual members of two separate sports teams. Moprim delivered data sets, which KONE research team members turned into a week-by-week data visualizations and shared those with the sport team members (Figure 38). In this way, it was possible to follow how the mobility behaviour changed on a weekly basis and impacted the data.

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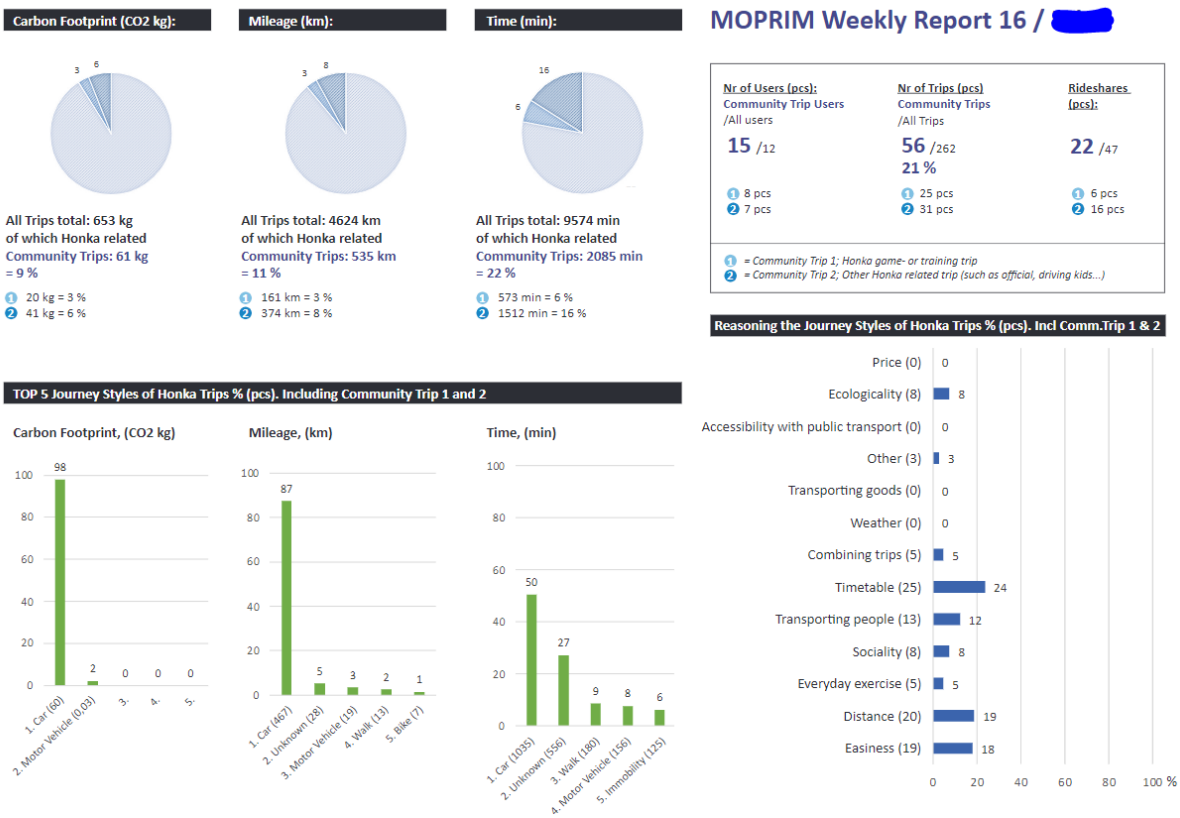

Figure 38: Data visualization sheet of the female team mobility habits on week 16. The darker blue area on the pie charts represents the amount of weekly mobility related to Honka sports club. (Source: KONE)

As a result, KONE research team produced data visualisation sheets based on Moprim data and conducted interviews and observations with both teams by visiting their training and tournaments. Both team members also replied to background survey in the beginning and feedback online survey at the end of the pilot. After the pilot period ended, two feedback sessions were held with the teams, where they got to interact with the data visualization sheets, comment on them and the possible change in their mobility habits that they had experienced during the pilot. Especially interesting in the results were the differences between male and female teams in their weekly travel kilometers and the number of car-pooling to the rehearsal. The female team had less weekly travel kilometers (2099-9759 km/week) but they shared rides more often than the male team (6032-19898 km /week). The number of weekly users varied in both teams drastically. In the beginning of the pilot, there were ten individual weekly users per team registering their community trips. At the end of the pilot period, there were only three individual weekly users of the application per team. There were several reasons for the number of dropouts, the biggest reasons expressed by the participants were the technical difficulties to register and use the application, combined with changing personal schedules on a weekly basis. As an example, some participants were only training once a week. Some had physical injuries or operations which prevented to train or join the tournaments.

Some experienced the application and the data it produced more insightful and were eager to change their habits, the others did not gain so much from the data and did not go to check it regularly. The user interviews revealed mobility patterns and strong opinions

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regarding the environmental impact of different mobility modes, as reflected by one of the team members when arriving at a basketball game:

> *Usually, I use tram to get here, it is convenient. But today, I got a last-minute call to the game, that's why I took my car as it is the fastest. And my car uses biogas, so it is zero emission and an even greener way to move than a tram.*
>
> *(Team member)*

The pilot validated that the most popular mode of transportation to basketball rehearsals and tournaments was a private car, with approximately 80-90% of the weekly Honka-related travel kilometers. However, the pilot showed that there are various reasons for choosing a specific mode of mobility ranging from easiness and timetables to giving a lift to someone or socialiing. One team member commented on her unusual choice of driving alone to the game:

> *Usually, I drive with a teammate, we are neighbours. But today I came earlier, and she wanted to come later. I guess, it's the convenience why choosing a car. I have an electric car.*
>
> *(Team member)*

The pilot showed that changing mobility behaviour is not easy, and that social support or peer pressure might not produce a desirable change. For some participants, comparing and seeing each other's mobility data did not create a willingness to change behaviour – quite the opposite – comparison to peers helped to justify own existing mobility choices. Biking to the rehearsals was seen suitable for the team-mate with an electric bicycle but was considered unsuitable mobility mode for the other person due to distance and lack of suitable gear – justifying private driving. Also, the pilot revealed different social norms in different teams, in particular the differences between female and male teams. The female team favored car-pooling and enjoyed sharing rides to rehearsals and away games. The male team, in turn, prioritised driving on their own even to long distance away games and did not value ride sharing or socialising on the road.

4.4 Sustainable business model co-creation results

Business design and business model innovation can be a powerful method for creating businesses that contribute to sustainable development goals. For new sustainable products and technologies to reach their full potential, there is a need to innovate new business models and methods of creating, capturing, and delivering value.

As part of the Subtask 3.8.1, business models have been researched and developed thought co-creation methods and in collaboration with several different stakeholders, as presented in the chapter 0. In this section we present the main findings and results of this mobility-focused business design work, including a Business Model Playbook developed with Embassy of Design, the refined business model concepts for community vehicles and mobility hub navigation, as well as the initial business model concept co-created with mobility data company Moprim.

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4.4.1 Business model co-creation playbook

Based on lessons learned from the business design workshops (4-8/2021), KONE produced a business design co-creation handbook in collaboration with Embassy of Design. A guiding question for the work was *'How can we design business models that are desirable, viable, feasible, and sustainable for people, planet, and businesses?'* The developed handbook is a practical guide to inspire and support co-creation of business models, and it is created for planning, building, and executing co-creation session with various stakeholder groups in a remote environment. The playbook is published on SPARCS website and can be found from here: https://sparcs.info/what-is-new/news/business-model-co-creation-playbook-kone

The business design method presented in the playbook includes three phases or modules – planning, execution, analyze & report – and a set of final deliverables (see Figure 39). The playbook provides insights and experiences on co-creation project planning and objective setting, tools and tips for facilitating online co-creation workshops with different stakeholders, as well as methods for analyzing and reporting results.

Figure 39: Business design co-creation modules. (Source: KONE)

By using co-creation as an approach and by inviting different external stakeholder groups to be a part of concept development, companies and organizations can make better decisions about how to evaluate and improve their ideas. Benefits of co-creation in

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business context also include improved quality of concepts, transparency of concept development, possibilities to meet and interact with end-users and potential partners, as well as community-building opportunities for citizens.

Nevertheless, there are some limitations of the business model co-creation method that need to be considered when implementing the process in different contexts. Firstly, the developed approach is highly dependent on the successful engagement of stakeholders, which then requires existing connections to and consistent interactions with relevant groups of customers, end-users, experts, and partners. In addition, it is good to understand the basics of design thinking and co-creation approach especially when gathering and analysing stakeholder-specific insights.

Four lenses of Innovation framework

As a basis of the process and method presented in the playbook, a conceptual framework named as '*Four Lenses of Innovation*' was developed for creating and measuring sustainable mobility concepts in collaboration with diverse city stakeholders (see Figure 40). The framework was primarily developed from KONE company perspective but can be applied also in other contexts to evaluate potential business concepts in the field of sustainable mobility.

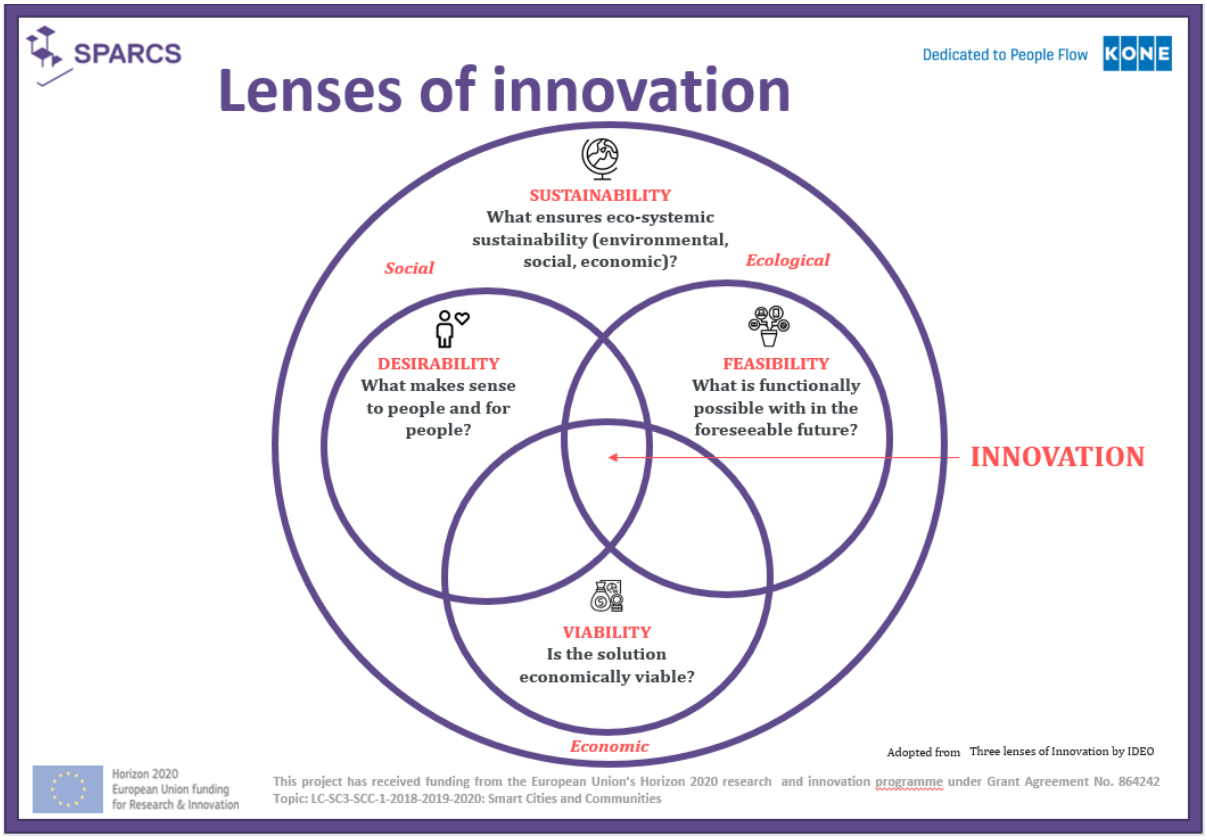

Figure 40: A framework of lenses of innovation combining both desirability, viability, feasibility, and sustainability. (Source: KONE)

The primary idea of the framework stems from design thinking and human-centred design, suggesting that innovations can be born if user needs (desirability), business (viability), and technology (feasibility) are combined. To complement this perspective,

sustainability was added as an overarching theme, including its ecological, social, and economic dimensions. There are several aspects to consider when designing a business that is economically viable (creating value for shareholders), ecologically sustainable (conserving and restoring the environment), and socially acceptable and inclusive (considering various human rights and needs), as opposed to more conventional business model innovation.

In this framework, *desirability* stands for a human-centric approach and guides to think whether a solution really solves the real user needs and makes sense for people. In the human-centric approach, users should be involved in the development process as they have an important role, for example, in giving feedback that can be utilized to improve the solution. Desirability from a citizen perspective can also be linked to social sustainability which describes individual's rights and needs for wellbeing, health, and good quality of life (Ryöppy et al., 2022).

To be successful for users, a solution should also consider the best possible way to make it feasible. Often *feasibility* is referred to technology, but it can also be understood more widely and cover for example materials and other resources to be used. Feasibility should guide to think what is functionally possible in the future. When thinking about feasibility from a sustainability perspective, we should be able to think about ways to execute the solution with the least impact on environment.

Innovations also need an economic perspective, especially when considering business innovations. From a *viability* perspective, topics such as viability of different revenue streams, market, and competitor analysis, as well as various partnership models should be studied. Businesses should be able to create long-term visions including plans for enhancing sustainability and for instance circularity in business operations.

4.4.2 Refined business model concepts

Based on the results of the business design co-creation workshops, **community vehicles** and **mobility hub navigation** mobility concepts were selected as the most promising ones in terms of the business design criteria of sustainability, scalability, inclusiveness, customer value, and differentiation. For the external mobility expert workshop, the differentiation criterion was left out due to the diverse specialization and field specific differentiation of the participating companies. These two concepts were validated in a citizen workshop, to evaluate whether they would fit into the everyday life of local citizen and to determine the willingness to pay for the developed concept. Lastly, the opportunities related to product/market-fit potential and KONE's potential role in these concepts were discussed in an internal result sharing workshop. The result of this work is summarized in the following chapters.

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Refined community vehicles concept

As presented in Table 25: *Community vehicles* concept description and use cases, the community vehicles concept is a service platform that allows a community of people living or working in the same building, access and use a mixed fleet of vehicles for different types of mobility needs. For the end-user, it aims to provide instant access to most typical everyday mobility needs, as well as ensuring a safe and secure way to move to and from a certain building.

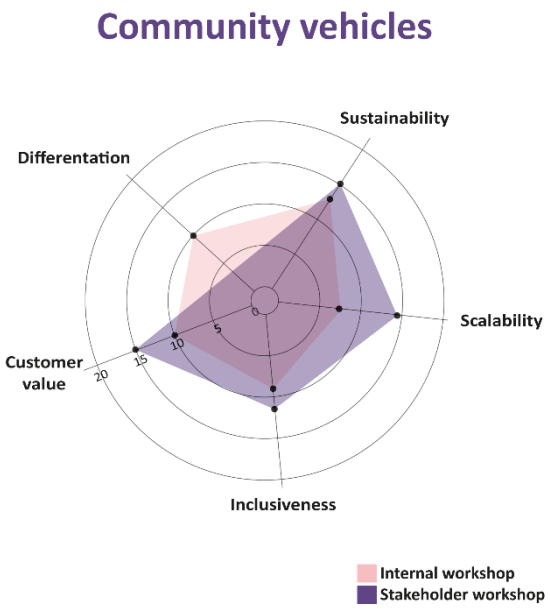

Figure 41: Community vehicles concept evaluation. (Source: KONE)

The community vehicles concept was evaluated by KONE internal employees and external mobility experts (see Figure 41 for evaluation scores). In addition, the concept was evaluated with a selected group of Espoo citizens without scoring. In the internal workshop, the concept received high ranking especially on sustainability and inclusiveness, while scalability was deemed as a little less high. From the external stakeholder perspective, the concept had high scores on sustainability and customer value, and a lower score for inclusiveness. It was seen to promote and build a 'sharing mindset' within the public, and to provide reliability and accessibility for the users. Ensuring a sufficient utilization rate and having an ability to build ecosystems and collaboration models were especially mentioned as success factors. During the citizen workshop, the participants validated the requirement for sufficient supply and demand of vehicles, as well as the user need for mixed fleet with multiple transportation methods, along with flexible pricing.

As highlighted in the workshops, *sufficient supply and demand for different mobility services* is critical in the development of this kind of mobility solution. For this reason, a 'home base', either a housing complex or an office building, should be taken as a starting point, as it helps to assure users of continuously available means of transportation. This kind of *building centric mobility model* also offers a closed circle of users, which makes the use of shared vehicles more safe and secure. Also based on the user studies, trustworthiness in shared mobility services is one of the main issues to be tackled. To cover the other key challenges of the users, the concept also needs to include features such as parking, charging, customer service, and other operational support – for instance in a form of a mobility application providing 'one access to all mobility needs'.

Although the community vehicles mobility concept is based on serving a specific group of users (residents or office workers of a certain building), *a free-floating component* could be added to offer more flexibility and reliability of vehicle supply. This means adding an opportunity for users to pick-up a vehicle and end the trip anywhere within a selected area. From the operations point of view, this could balance out fleet utilization during slow hours, so that no vehicles would remain stationary for excessively long periods of time. This feature could also be used to balance the business case from the revenue perspective. The solution would then consider both the building centric, 'private sharing', and the free-floating 'public sharing' to become economically viable.

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Potential revenue models were also discussed for the community vehicles solution, with building-based monthly fleet subscription fee (based on the number of users) as the most prominent one. Different service extensions (free-floating, fleet extent, service) could also be paid for separately. The solution could then have a base pricing / user for free of charge, with paid extensions and paid overcharge possible for different use cases.

KONE's potential role in this solution could be providing a seamless mobility access in-between buildings through developing a platform or integration for building-level operations. In this case, KONE's value proposition could be around the theme of converting buildings into 'mobility ready smart buildings' and unleashing their mobility potential as a key enabler for more sustainable urban flow. This would require partnering, for instance, with companies already providing a white label mobility experience that could be purchased without branding. The platform partner ecosystem would then include owners (an end-to-end mobility solution provider and KONE providing seamless mobility in-between buildings), various partners (fleet providers, mobility operations and infra entities as well as technical solution providers), and peer consumers (building owners and developers).

Refined Mobility Hub navigation concept

The second promising concept chosen for further business development was the mobility hub navigation concept (*see* Table 28: *Smooth mobility hub navigation* concept description and use cases*)*, which is targeted to solve end-user navigation challenges in existing urban environement. It aims to provide users with context-aware and practical navigation support when travelling through mobility hubs. The service platform includes several different user interfaces (for instance an application suggesting optimised routes and a ticketing system), connecting seamlessly navigation and mobility service providers. It can be offered as all-in-one solution, for example, as an extension of existing navigation software or ticketing service for public transportation.

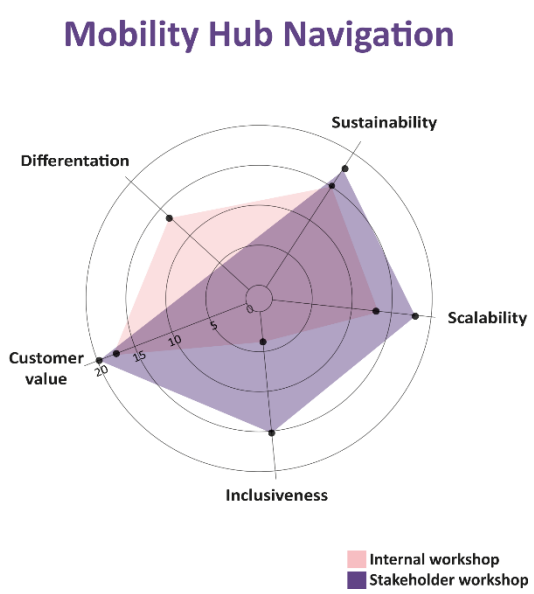

Figure 42: Mobility Hub Navigation evaluation scores. (Source: KONE)

During the mobility workshops, the need for this kind of concept was clearly validated *(*see Figure 42 for evaluation scores*)*. In the internal workshop, KONE representatives gave high rating especially for customer value and sustainability, while inclusiveness was deemed low. During the external stakeholder workshop, the mobility hub navigation concept performed consistently across the business design criteria, with highest score on customer value. During the citizen workshop, the participants confirmed the challenges in the existing navigation landscape, found the benefits of the proposed solution, and indicated the willingness to pay for such a solution.

The mobility hub navigation concept was seen to nudge users to adopt a more sustainable lifestyle, or at least to start making more meaningful and relevant sustainable mobility choices in their lives. Users can apply a

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wider set of parameters for routing than only the shortest or fastest route, including, for instance, factors such as weather and CO_2e emissions for different mobility modes – supporting the user to make sustainable decisions.

The mobility hub navigation concept has a strong user experience case, but to be realised, the concept needs *various ecosystem partners* to be involved. Nudging users to adopt more sustainable mobility choices in their lives and providing the scale of mass tailoring required by the concept can be a complex and time-consuming product development exercise. For KONE, the mobility hub navigation concept could potentially be a part of the 'mobility access package' as the community vehicles solution requires navigation also in-between buildings. This would require partnering with different stakeholders, including for example, public transportation operators, building owners, developers, and operators/facility managers. This kind of co-operation was particularly emphasised as one bottleneck in the mobility expert workshop.

4.4.3 Sustainable ecosystem-based business model concept with Moprim

As continuation for SPARCS Sustainable Mobility Challenge conducted in autumn 2021, KONE started a co-innovation process with the challenge winner, Moprim, to create a concept for a joint ecosystem-based sustainable business model *(as described previously in chapter 0)*. The business design work was focused on developing a potential platform to collect, enrich and utilize urban mobility data provided by Moprim to design more optimized and sustainable people flow particularly in large mobility hubs.

As a result of four workshops centered around platform business design, KONE developed a multi-sided business model for an ecosystem centered around the joint vision of helping property developers/operators to design more optimized and sustainable people flow in mobility hubs and large multimodal stations. In the multi-sided business model canvas, the business design team identified the goal and benefits of each stakeholder for joining the ecosystem as well as the key capabilities and resources they provide to the ecosystem vision. The main activities that each party would perform to ensure the ecosystem value proposition were also listed, along with the main transactions of value between the ecosystem members (for instance money, data, reputation, feedback etc.).

In this hypothetical ecosystem model, the key stakeholders included 1) the end-user of the Move Together app creating personal mobility data by moving around and in-between buildings/mobility hubs, 2) the technology partner Moprim collecting and compiling the data, 3) the KONE people flow consulting enriching the data with vertical mobility insights, and 4) the mobility hub developer/operator paying for the location-specific insights of the (potential) building/area use and related CO2 emissions generated by its visitors. However, after internal evaluation of the model, some concerns were raised especially regarding the role of KONE as the ecosystem owner (versus mobile operators or other multinational technology companies), data ownership and quality, alternative ways of collecting relevant people flow data, as well as actual customer needs and readiness to pay for visitor-related mobility and related CO2 insights.

In general, developing a platform business model simultaneously from multiple stakeholder perspectives and creating a truly shared value proposition was found to be a complex and challenging task. This was mainly due to a lack of *a joint customer with a clear challenge to be solved* between KONE and Moprim, either from an end-user or building developer perspective. The starting point was mostly the current technology,

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that is, the existing mobile app Move Together and the potential use cases of this type of horisontal mobility data for KONE customers. It was therefore concluded that, to do concrete business model development work, there needs to be a potential customer (and perhaps a preliminary business idea) in mind from a focal company's perspective.

4.5 Insights on Espoo citizens sustainability values and desired ways to participate

Based on the compiled sustainable lifestyle report Espoo citizens find sustainability as an important value and hope that the city would support and enable sustainable lifestyle. Citizens see sustainable lifestyle through three themes: *Nature*, *Sustainable mobility*, and *Sense of community and participation* (Figure 43).

Figure 43: Three main themes representing sustainability for Espoo citizens. (Source: KONE)

Energy did not come up as an important factor. Citizens may not have a clear view of how they can participate in energy related issues. That may be the reason why it did not come up as an important theme for everyday sustainability. Mobility on the other hand is seen as an important part of everyday sustainability. Citizens find it very important that transport and mobility would be sustainable and that owning a car would not be mandatory. In addition, the mobility system should be affordable, accessible and that the traveling times should be reasonable.

All in all, citizens find it important to live a sustainable life. For citizens sustainable lifestyle means living near the nature and taking care of the environment, being able to do affordable, sustainable, and easy mobility choices and feeling a sense of community and participation. Active and conscious citizens give a good ground for developing sustainable lifestyle in Espoo. Still, citizens may need more information and participatory actions on energy issues, especially when it comes to their own role as energy citizens.

How citizens of Espoo want to participate?

Espoo citizens find it very important to be able to participate and to develop their own residential areas. Citizens hope that they could participate more and that their opinions were heard already at the early state of projects. They hope that the dialogue would be open and different groups, especially young people, could be heard better. Citizens also wish that participatory events could happen in their everyday places, for example schools, residential areas, and shopping centres. Especially young people hope for new ways to participate. Younger citizens find for example workshops, events, and interaction in social media meaningful ways to participate. Citizens also hope that when they take part in developing, they could hear afterwards about the results and how their opinions are considered.

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4.6 Engaging the youth

Working with and involving young people in adopting a sustainable lifestyle is very important for the City of Espoo and Citycon. Developing a city sustainably and telling young people about it helps to build a more sustainable city, develop services, and embrace topics that truly serve the needs of the resident. The vision of young people helps to develop the city and its services in a long-term and user-oriented way.

For Citycon, engaging the local community is one part of the sustainability strategy. The overall goal is to make the centres community hubs where people, in addition to shopping and services, meet their friends and spend time with their family. Young people are an important focus group for Citycon. The purpose of interacting with young people is to ensure that youngsters spending time in the shopping centres feel well and safe.

Working with young people requires listening and flexibility. The topics to be addressed have arisen in discussions with young people. For example, the worry and feelings of climate anxiety has been perceived as important among young people (buddy class). A sustainable lifestyle adopted and valued at a young age contributes to supporting more sustainable choices as adults. For its part, City of Espoo needs even more active and alert residents in the future, and open discussion with young people is a key to this as well.

When working with the youth, it is important to listen to the students with a sensitive ear. For example, the themes of the workshops must be in some way touching the young person's life, resonating with his or her daily life and kept short and simple. Once the young person has been able to influence the choice of topic, they are more likely to be more committed to the topic and to participate more actively.

Observation is important. Must consider even the smallest nuances and be able to communicate with young people in their language, casually and understandingly. Many of the topics covered in the workshops and discussions have arisen directly from the young people themselves through the discussions. For example, thoughts of climate anxiety, how to minimize the carbon footprint or urban infrastructure challenges are themes that young people have a lot to do with.

Even if the cooperation with the Youth Service Organization will continue until the end of year 2022, some preliminary observations can be made of the youth engagement work. Youngsters spend a lot of time in Lippulaiva, and they have been satisfied with the solutions implemented in Lippulaiva and the library based on their wishes. There are for instance an ice cream kiosk, lots of benches, sockets, and green plants, as well as a game area in the library, a billiard table, quiet study spaces and a communal kitchen – all at the request of the youth.

Feedback has been collected from the youngsters, and based on the feedback, a large part of the participating young people has felt that they have been able to influence and have been heard. The workshops and other events of the project have been popular and up to 50 young people have been present at the same time. The young people have spread the word to their friends and some of the young people have been involved in the project from the beginning and participated in all the events.

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4.7 Co-creation model for sustainable and smart urban areas

To create new approaches for smart city planning that could also take into consideration the PEDs, the City of Espoo conducted a process to create a co-creation model for sustainable and smart urban areas. The work is mostly located under the *Task 3.5 - Planning of Energy Positive Districts* but affects the other tasks as well. As a result, a co-creation process has been designed which is presented here in the result section instead of the process chapter. The process can be seen as one valuable outcome from an engagement project.

The main goal of the co-creation model is to present ways and tools on how to develop urban districts as sustainable and smart city areas in co-operation between the city organization, companies, educational institutions, research institutes, other organizations and associations, and citizens. Instead of developing separate solutions within city districts, the model aims towards a more holistic approach to city planning, where smart and sustainable solutions are developed together as integrated, interacting and supporting parts within smart city areas, forming a larger smart city ecosystem. Developing such a smart city area as a whole required new tools, practices and processes of co-creation and dialogue to connect the different stakeholders, builders, investors, policy makers, organizations and citizens together in the city planning. This process covers the whole life cycle of the area from the initial planning to the in-depth design, construction, and use and operation phases.

The model itself is being built using co-creation methods: starting with the definition of shared objectives and by promoting open communication. The model will focus on the themes of energy, mobility, and land use development, which have a significant impact on the City of Espoo's goals of becoming carbon-neutral by 2030. Tackling these themes with new smart and sustainable solutions is key in creating new or redeveloping and retrofitting already built areas into new green urban districts, where solutions are readily available for the local residents, workers and other users of the space. The model will also support the development of partnership work on sustainable development.

To find a suitable subcontractor for building the co-creation model, a tendering process was performed in the autumn 2021. As a result, WSP Finland was chosen as the subcontracted party. The actual development process started in December 2021 and is planned to be finished by December 2022. After the completion of the procurement phase, the actual co-creation model development process was started in M27. A steering and sparring group was formed, and regular meetings have been held since. To improve communication about the co-creation process within the city of Espoo and the Center of excellence in sustainable development, Morning Coffee Talks have been held every second week in the beginning of the process M28-30.

The co-creation model development process is a service design process, comprising of a series of case project reviews, workshops, questionnaires, webinars, and other activities that have been directed to different stakeholders. The aim is to co-create the co-creation model with the relevant stakeholders from the very beginning.

Throughout the process, a total of four online workshops will be held in form of Design Sprints, three of them arranged as a two-half-days event and the fourth one as a shorter event. The Design Sprints are aimed for different types of organizations, companies, policy

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makers and the City of Espoo units and departments. The workshops all utilize MS Teams, Miro, and Mentimeter tools for online co-creation.

The Design Sprints are all connected to one another as one large process, developing the model from the initial strategic phase towards the more detailed planning, construction, and utilization phases of smart and sustainable solutions in urban areas and districts. The co-creation model focuses on the themes of energy, mobility & urban services, and nature & green-and-blue infrastructure (including land use development), which all have a significant impact on the City of Espoo's goals of becoming carbon-neutral by 2030.

The different Design Sprints and their aims and outputs are presented below:

1. Design Sprint, Feb 2022: The first Design Sprint was organized on the 14th and 15th of February 2022 online. The first sprint focused first of all on sharing information with the participants about smart and sustainable city development models by presenting case-examples and sharing experiences from other projects and/or cities. During the first sprint another aim was to identify not only critical steps (Figure 44) within co-creation processes but also to identify possible solutions and point out good examples of how to develop co-creation processes (and for example, incorporate co-creation into the city planning process). 26 persons from different organizations participated in the workshop in addition to the project team.

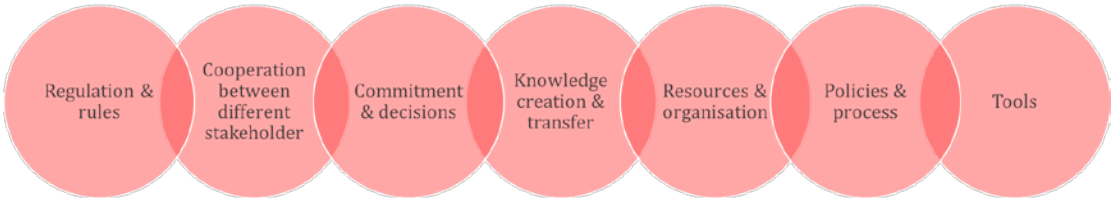

Figure 44: The co-creation model's critical building blocks recognized during the 1. Design Sprint. (Source: City of Espoo & WSP).

2. Design Sprint, Mar 2022: The second Design Sprint was organized on the 15th and 17th of March 2022 online. The aim of the second sprint was to develop a new overall concept of co-creation, building on the results of the first Design Sprint. During the Design Sprint, the key process elements and methodologies to address the identified challenges for smart and sustainable city development were identified (Figure 45). 17 persons from different organizations participated in the workshop in addition to the project team.

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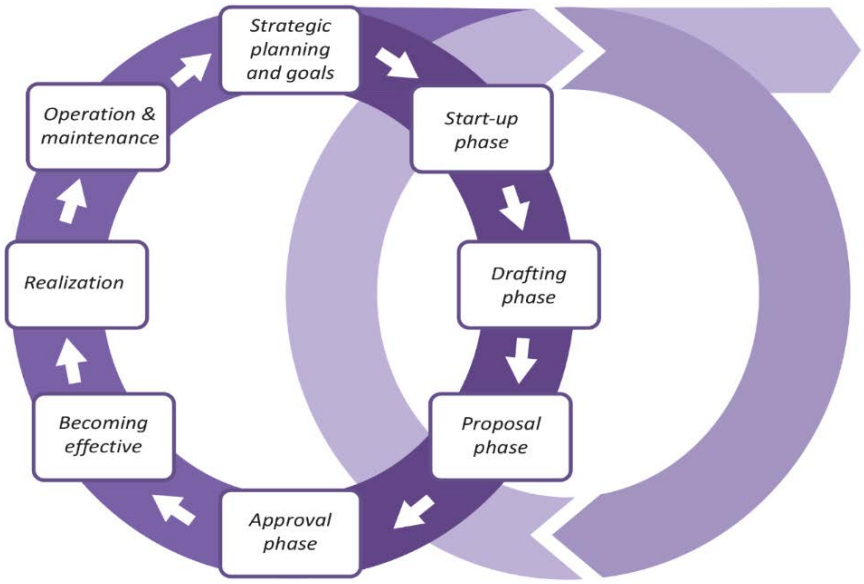

Figure 45: Concrete ways of co-creation related to energy, mobility & services, and nature were identified during the 2. Design Sprint. (Source: City of Espoo & WSP)

3. Design Sprint, Apr 2022: The third Design Sprint was organized on the 26th and 28th of April 2022. The third Design Sprint focused an applying the preliminary results from the co-creation model process to the context of Kera and the ongoing land use development measures there. The aim was to test the interim findings and collect feedback about the development of the co-creation model. 15 persons from different organizations participated in the workshop in addition to the project team.

4. Design Sprint: The fourth Design Sprint is planned to be organized in August-September 2022. The aim of the last sprint is to fit the model to suit different kind of urban typologies. These typologies refer to different kinds of factors and characteristics that create the local context, such as the area's development process (is it, for example, an area in a planning phase, a redeveloped area, or an infill development area), land ownership, geography and location, density, and size. The model was 'tested' and fitted into the Kera context in the third Design Sprint, and the aim here is to further develop the model so that it can used in any case area in Espoo (and beyond). The relevant typologies have been identified together with the city's Urban Planning department.

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Results of the Design Sprints have been shared with all stakeholders and interested parties in form of short webinars organized after each Design Sprint. Information and results related to the co-creation model is also being shared on a separate web page (https://co-creatingsparcs.fi/), which has been created by the subcontractor WSP Finland. The final toolbox and all the produced material from the work process - Design Sprints, case reviews, citizen engagement - will be available at the website by the end of December 2022. The model comprises different steps and tools that support the co-creation of an area from the first initial (strategic) planning and visioning phase, more detailed planning and the construction phase(s), the utilization and maintenance phase(s), and the re-development of the area (as a continuous process). The Design Sprints have generated the insight and knowledges that form the basis of the identified tools and steps.

Citizens have been reached by conducting an online survey during February-March 2022. The survey was shared via the social media network (Facebook) of the City of Espoo and received 118 responses. As the presented questions were mostly open-ended, the survey produced valuable information about the citizens' perspectives on current smart city and sustainable city development from their own contexts. Next to different concerns related to the themes in mobility, energy and green spaces that are in the center of the co-creation model, many responses included the notion that the possibilities for participation still require improvement - an issue that has been commonly identified as a challenge for cities. A separate online event was also organized to present and further discuss these results with the citizens in March 2022. A workshop was also planned and scheduled for May 2022 to further work on the themes with citizens directly, but unfortunately due to low interest the event was cancelled. The Covid-19 situation might have also played part in the low interest for the participation in a face-to-face event. Municipal worker's strike also had an effect to the workshop as the Tapiola library - the planned venue of the workshop - was closed due to strike during the scheduled time of the workshop. Another workshop might be organized during the fall.

The work will continue up to December 2022, when the final model will be ready and available at the aforementioned website for open use. In addition to the visualized model, the process will also result in a virtual toolkit for supporting the development of sustainable and smart urban areas. The model was developed during the spring 2022, utilizing Kera as a case area. In the fall 2022, the model will be further elaborated on, and it will be fitted to suit different kind of areas in Espoo (and beyond). The model will also be actively communicated to different partners and collaborators in Espoo and beyond, citizens, and other stakeholders.

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5. ADDED VALUE AND REPLICABILITY POTENTIAL

In this section, we reflect on the added value and replicability potential of chosen demonstrated community engagement methods and activities presented in this report. We also evaluate the overall value and replicability potential of the community engagement approach as a whole. The reflection aims to contribute to the replication actions conducted by fellow cities as part of SPARCS in the next two years (M37-M60), as the goal of SPARCS is to replicate and scale up the holistic solutions developed within the project, in SPARCS Fellow cities and in other cities in Europe. These reflected activities aim to support a transition towards more sustainable lifestyles in future PEDs.

5.1 Added value and replicability potential of selected community engagement methods and activities

In this chapter, we reflect on the added value and replicability potential of selected community engagement methods and activities. We discuss ways in which these enhance engagement and provide key learnings from the process. Also, the level of replication is discussed, as different activities may be suitable to be replicated on different levels (such as city level, in another country/city/context or inside EU). We aim to provide insights for the replication of the activities especially for the SPARCS fellow cities.

5.1.1 Mobile ethnographic user study

The mobile ethnographic user study activity was highly successful in engaging and committing Espoo citizens in the activity. Simultaneously, it provided a starting point for most of the mobility actions conducted as part of T3.6 and T3.8, by creating understanding about Espoo citizens' mobility related needs, desires, challenges, and behaviours.

Setting up the activity. The activity was planned and conducted mainly by one design researcher from KONE. The planning phase included planning the objectives of the engagement activity, finding a proper tool for collecting mobile ethnographic user study material, as well as identifying and recruiting relevant users. After this, participants were delivered phones face-to-face for engagement purposes. During the actual user study, participants were sent weekly probing tasks. The research process required *commitment* both from the researcher and the participants for half a year.

An online participation method was used to collect ethnographic insights from participants everyday experiences related to mobility. The participants documented their everyday mobility through WhatsApp in the form of images, text, voice messages, videos, and screenshots. Each participant had their preferrable formats for documentation, which they typically used throughout the study. Two other possible online ethnographic research tools were identified during the planning phase, and one of them in addition to WhatsApp was also piloted. However, WhatsApp proved to be most simple and well known of the options. It enabled documentation in many formats with a familiar app that many had on their phones already from before. It also enabled real time interaction between the researcher and the participants. Simultaneously, the online-based mobile ethnographic method enabled engaging a higher number of participants compared to traditional ethnographic research, where the researcher observes a participant in their physical everyday life context for a long period. It was also a suitable method for studying

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urban mobility, where it would be challenging and even risky to observe participants in their actual everyday environment.

Committing the participants was highly successful as all participants finished the study as planned. Reasons for this might be that participants received smart phones as research tools and they got to keep them, if they finished the study. These phones were also delivered face-to-face to participants' home for building trust between participants and the researcher and to engage the participants more deeply. The physical meeting also provided different kind of understanding about the participants which could not have been acquired in other ways, due to the online study method.

Access to research data. Access to the documented data was restricted, as the researcher used a separate phone with a separate WhatsApp-account set up only for the study purposes. Thus, only she was able to access the data. It was good to have a separate phone and account, to make a distinction between work and leisure time. However, the phone required managing continuous charging, going through research material, and interacting with the participants through messages. The data was transported from WhatsApp by the researcher through screenshots through WhatsApp web. Laborious transcribing was required for also storing the voice and video-based material sent by the participants. All the material was then moved to Adobe InDesign, for creating pdfs with images and text for accessible analysis. The data handling was highly time consuming. Pdfs with anonymized research data were shared with another KONE design researcher in the SPARCS project for co-analysis.

Replication: The activity is especially suitable in the beginning of a research and innovation project for gaining a holistic understanding about mobility related matters from a citizen perspective. The research process requires good planning and commitment. However, the online method enables also more flexible focus on interesting matters as they are documented by participants. The researcher can react in real time and ask for more detailed reflection or insights on specific matters from the participant. Committing participants is crucial for the success of the activity. Here, face-to-face contact and sending short weekly reminders is important. Plenty of time should be reserved for data handling and analysis. For efficiency, the documentation formats could be limited to text and images to avoid the extra transcribing work. However, this might affect the depth of documented material and insight into participants' experience. It might also restrict participants' documentation in situations, where they are most comfortable with documenting their experiences through speaking or their ability to write is restricted.

5.1.2 1.5-degree lifestyles workshops and follow-up study

The 1.5-degree lifestyles workshops activity was a joint effort between KONE, D-mat ltd., Norstat, and the city of Espoo.

From online to offline. The workshop was originally planned to be conducted remotely due to the Covid-19 restrictions. *The Climate Puzzles* were sent by post to participants, and the workshop would have been facilitated through Zoom. However, due to a considerable amount of last day cancellations, the original workshop was cancelled. As the pandemic situation got better, preparations were later started for organizing a face-to-face workshop. Due to previously low attendance interest, a recruiting company was utilized for finding diverse households from the areas of Leppävaara and Espoonlahti to

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participate in the workshops. Finally, 26 households (out of 30 households) successfully participated in the workshops.

The workshop was facilitated by experts from D-mat ltd., who held a presentation of climate change and 1.5-degree lifestyles in the beginning of the workshop to set the stage for the game activity and educate people, and then facilitated the different game phases. The presentation included, for example, a diagram of all households' carbon levels for enabling comparing one's households' carbon impact with other households. The participants played the game in their own household member groups. The value of a face-to-face workshop including other fellow citizens could perhaps have been utilized more.

Validity of the game contents seemed good, although the carbon impact calculations are currently based on generalisable estimates in the Finnish context. The workshop brought forward that, for example, the characteristics of participants' vehicles varied even though the carbon impact estimates in the puzzle pieces were the same for all. This can be seen as a limitation to be still worked on to provide as accurate data as possible of participating households' carbon footprints and related reductions. In addition, KONE developed additional mobility actions based on SPARCS user research and concept development work, which D-mat ltd. implemented as new puzzle pieces in the game. The additional pieces were welcomed by the participants and selected as new actions in both workshops, especially the following actions: *I combine going to the grocery store with running other errands* and *I use muscle power on short trips*.

Accessibility for scaling up Climate puzzle game has been a development goal identified already previously (Nielsen, 2020). Our experience supports the need for enhancing the accessibility, as partners from other countries have communicated an interest towards replicating the activity in other geographical contexts. This includes considering different languages and local CO_2e baseline values for wider scale distribution. Since the SPARCS 1.5-degree lifestyle workshops in Fall 2021, the Climate Puzzle game has been published in Swedish and English with Finnish data. The game can also be played without facilitator or expert, which makes the game more affordable for smaller communities or even families. Also, a small edition of the Hungarian, Swedish, Latvian, German and Spanish versions with country specific data are underway within the context of https://onepointfivelifestyles.eu/ project. Preliminary online versions of the game include https://susla.app/ created in suslife.info project.

A follow-up study was organized 6-months after the workshops by KONE utilizing a group interview method for studying how the planned actions had been implemented by the households. The group interview method was suitable for studying how exactly the planned actions were implemented and how related behaviour change had unfolded in social interaction between family members regarding the different actions implemented. However, it was challenging to motivate some of the workshop participants to participate in the follow-up study, even though this was a pre-condition for participating in the workshop activity. Thus, all the perspectives of the household community could not be captured when considering the process of how behaviours unfold in social interaction. This was also affected by participants' challenges in identifying and communicating different steps of their behaviour change process. There was an incentive based on the amount of participating household members. However, it could have been made as a precondition for the interview to have more than one participant from each household to capture more perspectives. D-mat ltd. has had their own one-month testing period for

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participants after the workshop with successful outcomes. This could be applied as a follow-up activity for the workshop in future replication activities.

Replication: The more households are engaged in the activity, the more value it provides, as more people get to develop a pathway towards more sustainable practices. Also, engaging as many members of a household as possible is relevant, for committing household members to perform planned carbon reduction actions. Different matters require consideration depending on whether the workshop is conducted online or offline. The activity requires access to and results from household-based carbon footprint calculations for setting the baseline carbon level for each household. Household participation in a follow-up study could be encouraged by an incentive requiring participation from all members of a household. The Climate Puzzle design game includes instructions and can be played as such. Enabling the activity to be performed without facilitation would make it more effective for a wider amount of people to access the game and related knowledge and insights. However, some actions might not be applicable to other countries (such as warming up the sauna in Finland) and thus the action catalogue needs to be designed country-specifically. Also, the puzzle pieces require that carbon reduction values are based on the country specific CO_2e baseline data, for example driving and charging an electric vehicle has a different CO_2e footprint in Germany compared to Finland, because of different energy production methods.

5.1.3 Community mobility pilot

Multi-stakeholder collaboration played an important part in carrying out a successful pilot. The community mobility pilot was a joint effort between KONE and Moprim ltd. implemented with Tapiolan Honka basketball club with support from the city of Espoo. Diverse stakeholders had a different role and interest in setting up, facilitating, and participating in the pilot as described more detailed in the results chapter 4.3.

Stakeholder interest was strong at Honka club and the city of Espoo as the pilot was producing mobility data and insights on team members' mobility habits. Collecting mobility data was already in the interests of Honka due to their carbon neutrality project (Hiilineutraali Honka) and they had identified a problem in changing mobility habits which they were seeking new solutions for. Once the initial agreement had been done, it was very easy to proceed with the collaboration due to the high interest. As a non-profit association, an important factor for Honka was also that they received a reward based on the number of active participants.

Committing the participants during the pilot was handled by setting a reward based on the number of participants and their weekly use of Moprim Move Together mobile application, providing data visualisation sheets and by organizing face-to-face sessions with both teams at the beginning and during the pilot. However, these were not sufficient incentives for the participants and there was a considerably large number of dropouts during the 8-week pilot. From participant point of view, it is difficult to commit for such a long pilot period, because of changing life situations. As an example, there were few team members who had injuries during the pilot and some that had work trips and could not attend their rehearsals. For the participants, the use of application required registering to the platform, registering their data, and manually annotating the data points daily, which was perceived as a laborious activity. The number of active users changed week by week and impacted the quality and granularity of the collected mobility data. The application is

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highly dependent on the active use and annotation of mobility data, which again is dependent on the user engagement. Even though, KONE research team was meeting the participants in observation and interview sessions, the participants did not share that they had stopped registering trips in the application. These experiences transpired only during the final dialogue session at the end of the pilot.

Agility of the pilot community, the project team and the app development team was an important factor for the success of the pilot. Moprim was able to develop new features in the app according to the needs of the client and the pilot. There were resources to develop and launch new update to the app rapidly, thanks to the company size and internal development capabilities. Regarding the participation of Honka, despite being the largest basketball club in Finland, they were able to commit quickly and find the fitting teams eager to participate. The project team at KONE was also adjusting and responding to the changing situations during the pilot and worked based on the collected data.

Replication: For replication of the pilot, it is important to consider the limitations regarding scalability of the app. The GPS tracking and other phone-based sensors work globally but are dependent on the existing phone models, internet, and GPS-connections. Stability of the network and mobile phone battery are crucial. In addition, there are country-specific differences in CO_2e emission data, and those values must be updated in the application by the development team to get accurate data, for instance related to the local energy source of cars and busses. Data privacy aspects in different countries vary and data privacy agreements should be done between different partners prior the pilot. The commitment of participants is crucial, since the number of active users of the app is directly contributing to better quality and granularity of mobility data. Commitment can be supported by providing help with the use and deployment of the application. Successful pilot requires physical kick-off event(s) where the participants can get guidance on installing the application, ask for more and get information on the pilot. During the pilot it is needed to collect feedback and meet the participants regularly, for example during interview and observation sessions along the pilot. Monetary or other kinds of rewarding models are good to agree when setting up the pilot. For associations the reward that the community receives might play an important role in committing them. For individual participants, it is important to highlight how their participation contributes to the bigger good that their community receives.

5.1.4 Business design

The business model development work related to sustainable mobility was centered around the two refined mobility concepts (community vehicles and mobility hub navigation), as well as the platform business model design with the mobility data company Moprim. Both processes created valuable lessons learned related to business model innovation in an ecosystem context, and business design process in general (some of which are shared in the Co-creation Playbook published in SPARCS website).

First important notion related to the collaborative approach in business model design is the *importance of trust* between ecosystem actors. A safe and confidential space is vital for sharing information, (business) motives and goals among other participants. The needs and motivations for different businesses can vary greatly, as they have modified their strategy and operations to serve their own mission and customer base. This kind of a complex project requires enough time for the introduction of the output, method, and

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principles of the work – which then calls for discussion and alignment. One useful topic to discuss here is the *end-result*: is the focus more on innovating multiple, more abstract ideas of new business, or is the goal to already develop a detailed business model concept, with separate value propositions and revenue models for each participant? Foremost, the business design process would also benefit from first identifying *a joint customer with a clear challenge to be solved.*

It can also be beneficial to highlight the *iterative and explorative nature* of the design process, as commitments and detailed decisions are made at a later phase, if seen fit. Participants should be encouraged to step away from their current (business) models and restrictions and start from a clean slate, preferably from the end-user/shared customer needs. The more established the organization is, the more difficult this can be. Platform/ecosystem approach brings a useful framework for innovating models which can bring value for all stakeholders, but the actual business model development work would still be recommended to start from *one focal organization's perspective*. For this, sufficient communication with business representatives is needed to understand the potential link to existing strategic objectives and current operating models.

Replication: For a successful replication of business model co-design process, it is recommended to identify one (sustainability-related) focal problem and the customer who has an interest to find a solution for the problem, rather than starting from existing technology or solution owned by one of the ecosystem members. When the problem has been identified and shaped seek for wider understanding from the customer or end-user perspective. Build an ecosystem of key stakeholders based on the problem. Try to find ecosystem stakeholders from as many perspectives as possible. More insights on the practical facilitation of business design work can be found from the Co-creation Playbook published in SPARCS website: https://sparcs.info/what-is-new/news/business-model-co-creation-playbook-kone.

5.1.5 Buddy class actions

Espoo aims to conceptualize the buddy class activity by the end of Spring 2023 when the buddy class activities end. The Buddy class activity is a useful tool for the city to reach young people and the aim would be to get the concept implemented in different units in the city of Espoo as well as in other cities in the project.

As mentioned, the actions, tasks and themes have been shaped by the wishes, challenges, and topics that the students in the buddy class brought up. The aim is for young people to be actively involved in the city's activities. This is important so that future residents of the city think sustainably and know about their opportunities to influence what the city does. Also, the author's own agenda defines the tasks to be done and themes to be addressed. The conceptualized plan does not describe precise steps for conducting a buddy class activity. Rather, it addresses reasons for and general ways in which the activity should be conducted: What to consider when working with young people and how to get the most out of it. In the SPARCS project, as said, the buddy class has concentrated on the sustainable lifestyle through different workshops, meetings, and discussions. These activities serve the themes of the project and address them broadly and can of course give some inspiration and ideas about the activities done by the follower of the concept. It is important to keep in mind to tailor the themes and actions per agenda and needs of the project conducting a Buddy class activity.

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For Citycon, it is important to engage young people. In the SPARCS project, this was done when the new center was developed and therefore it was a natural choice to choose one buddy class for three years. In the future, it could be considered if existing centers could have their own buddy classes. In that case, it would be beneficial to have a special theme for the buddy class actions.

Replication: For buddy class activities to succeed, the work requires persistency and long-term commitment both from the organizer and the participating school and pupils. This negotiation is good to start in good time to establish a trustful relationship with the school and also select a class that will be in the same group for several years, and preferably with the same teacher. It is important to plan a good balance of different events and meetings. In the beginning, the emphasis should be on face-to-face events, but as the buddy class activities proceed, it is beneficial to include also remote meetings. Finding best possible digital platforms and an easy way to use them is important for a good collaboration. Communication is one important aspect to take care of before, during and after the activities. The participating pupil and teacher usually wishes to know how their suggestions and input has been taken further. The experience of participation is not fulfilled if the participants do not get to know how their participation was useful and beneficial for the development work. Communication activities related the buddy class actions requires also special attention and own kind of communication style from the organizing institution or company to succeed. Think about how to communicate long-term horizon and visions of the future (for example, what is expected in 10 years or 20 years from now) in an engaging and visual forms.

5.1.6 Co-creation model

The work on the *Co-creation model for smart and sustainable urban areas* has so far - the active development work continues up until the end of 2022, and further dissemination activities beyond that as well - already provided valuable insight to urban development and the incorporation of energy and mobility solutions in new and existing urban areas. The co-creation process, utilized to develop the model, has highlighted the importance of dialogue and shared goals between the different stakeholder in district level development. The work has identified different key steps, tools and practices that support the development of an area as a system, or as a 'whole', where one smart and sustainable solution supports, benefits (from) and works together with the other solutions, for example, through the utilization of side currents and flows. Over 80 individuals from over 50 different organizations, departments, cities, and companies have participated in the activities, and over 110 citizens have been reached through the engagement activities so far.

The model was generated by making use of the Kera case as an examplewhich was used to ground the learnings and insights generated in the Design Sprint process. Kera provides valuable insight for co-operation between different local stakeholders, in specific on developing shared goals and targets for the area's sustainable development. The co-creation model is then generalized to support the development of urban areas and districts in other national and international contexts. The local context - the socio-cultural-policy-material framework of the city and the district - is a key framing element for each area's development process, of course, but the generated model provides general steps, tools and practices for the co-creation process that are applicable in different kinds of areas, each with their own local context and case. Through dissemination activities,

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aimed for both city's internal and external stakeholders, the replication potential of the co-creation model will be further developed and investigated.

The work on the Co-creation model for sustainable and smart urban areas continues in fall 2022. The aim is to finally generate a generalized model that can be utilized in any urban context in Espoo and beyond from the developed model tested in the Kera area setting in spring 2022. For more specific thematical approaches developed in the co-creation model, please see SPARCS Deliverables D3.4 on energy, and D3.5 on mobility. The main dissemination work begins after the model is completed by the end of 2022. The model, of course, is an iterative process, and develops and transforms continuously as an active *process* both during and after the SPARCS project.

5.2 Added value and replication potential of the community engagement approach in general

In this chapter, we summarize the challenges and lessons learned related to the community engagement approach in general based on our experience. The aim is to provide insights for replicating the approach elsewhere.

Dependency on participation. Taking a community engagement approach is dependent on the participation of citizens and other stakeholders. This makes it a time consuming and challenging approach, even risky. Our experience shows that sometimes even a well-prepared community engagement activity, such as the remote 1.5-degree lifestyles workshop version, can fail due to last minute cancellations. Participation can thus be perceived as a great commitment from all the involved parties. It can cost the organizer an extensive amount of human resources and money to organize a new event. For a citizen to be willing to allocate required time for the engagement activities calls for some form of a gain. In addition to rewarding, these gains can also be, for example, an interest in the topic for educational purposes, having a networking opportunity, or having a possibility to affect matters close to one's heart. Simultaneously, it enables a more democratic city development approach, where diverse end users have a say in matters that affect them. Participants can be personally contacted beforehand to create trust and engagement between the organizer and the participants, and a reward can be given after the activity has ended. In addition, ethics of participation requires careful consideration of rewarding, GDPR matters and how the rights and risks of participation are communicated to participants. A common practice is to request the participants to sign a consent form. The downside of consents is that those become often heavy documents that can even drive people away and should thus be made as simple and concise as possible. Successful participation can also be supported in many other ways, which we describe in the following paragraphs.

Stakeholder reach. Identifying and reaching relevant stakeholder groups and individual stakeholders is a key to successful community engagement and building sustainable research ecosystem (Hyvärinen et al., 2021). During the community engagement activities in Espoo lighthouse city, several stakeholder groups were identified as relevant and engaged in the activities to reach the objectives of the tasks T3.6 and T3.8 throughout the project. Figure 46 presents the engaged stakeholder groups, which can be grouped into citizens, NGOs and local associations, City of Espoo, private businesses, and research organizations. Diverse citizens were approached through social media channels, schools, libraries, City of Espoo's official webpage, and for specific workshops, a recruiting

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company was used. For Non-Governmental Organisations (NGOs), a local sports club and youth work organization was approached directly and invited to collaborate on specific engagement activities. The city of Espoo utilised their internal networks by engaging city planning experts and contacting local schools and libraries to support engagement actions. To contact private businesses, an array of different engagement approaches was used: expert interviews and snowballing method helped to identify relevant mobility experts and service providers in the beginning of the project, a design company recruited mobility service providers and real-estate stakeholders to business model co-design workshops and a consulting agency was used to identify and contact mobility and IT start-ups for Sustainable Mobility Challenge. Different business stakeholders were also contacted directly, for example as experts for workshops or exhibitors for the mobility event. Finally, research organisations were involved to conduct sub-studies and to initiate student projects and thesis works for more specified mobility-related topics.

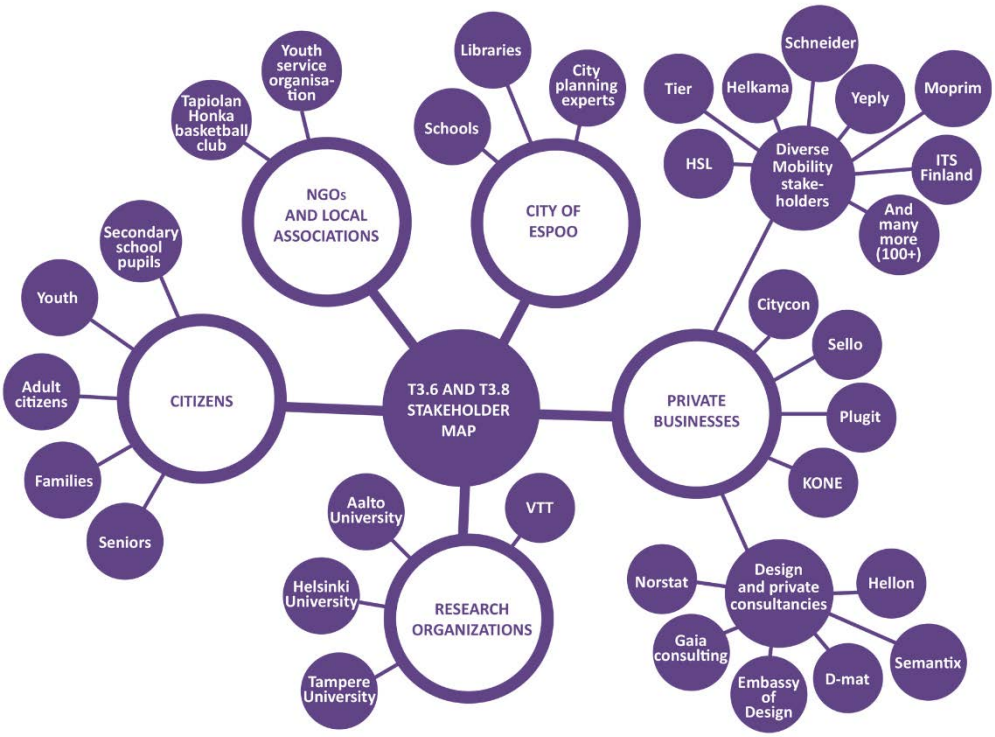

Figure 46: Stakeholders engaged through the presented community engagement activities. (Source: KONE)

Stakeholders cannot be approached as generalised groups or faceless organisations. Establishing a meaningful interaction requires reaching the right person from an organisation, which again requires wide networks and good interpersonal skills to get access to people. Stakeholder engagement benefits also from matchmakers or broker organisations, which can connect people, for example the city of Espoo was matching public and private partners or recruitment companies could be used to reach out to targeted user groups. When it comes to discussing business critical topics, collaboration requires trust and sharing between the involved stakeholders. The organisers and facilitators have an important role in enhancing open sharing culture in the workshops and events. They also should consider confidentiality aspects by making mutual agreements between partners, for example by requesting participating organisations and individual participants to sign Non-Disclosure Agreements. In retrospective, reaching a

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wide network of stakeholders might seem easy, but in a complex project environment it takes a lot of time and resources, and requires competences in building trust and new relationships.

Representativeness of engaged end users. Another relevant matter to be considered in a community engagement approach is the representativeness of engaged participants. In our case, this required identifying especially relevant citizen segments, as diverse citizens were engaged as part of the activities presented in this report. These included secondary school pupils, youth, adult citizens, families, and seniors presented in Figure. Among these were also represented diverse cultural backgrounds, different age groups, and several impairments. However, not all these groups were represented in each activity. In some cases, this was justified and in other cases a wider demographic sample would have been beneficial to represent a greater variety of people in with different demographic characteristics. For example, a more diverse cultural background would have been beneficial for the mobile ethnographic user study, as one participant estimated the immigrants being a relevant user segment of mobility services in the future:

> *Now the participants were educated adults from the local population, unlike the future urban dwellers, who are young adults from a migrant background. They should be studied and involved more instead of us.*
>
> *(Mobile ethnographic user study participant)*

Related to this, there should always be an understanding of who has been included and who has not been represented in an engagement activity, and what impact this has on the outcome. In the case of T3.6, diverse segments were engaged in diverse activities, but no activity engaged all diverse citizen segments. It also raises the question: What kind of citizens should we engage? Should we reach for citizens, who have a personal interest in the subject matter and might be more interested and active to participate? Or should we reach for citizens, who are more reluctant to the subject matter but are relevant, for example, in order to achieve a required change in behaviours? Often, people who have an intrinsic desire to change things sign up for these kinds of activities, such as in the 1.5-degree lifestyles workshop most of the households had already a low baseline carbon footprint. In this case, the challenge was in engaging people with a high baseline carbon footprint in the activity. In many of the community engagement activities, a sample that represents the population of Espoo, more precisely Leppävaara and Espoonlahti districts, was aimed for. Simultaneously, the more specific and rarer the demographic needs and geographical framing are, the more challenging the recruiting becomes and the risk of not reaching the desired participants grows. To reduce this risk, we recommend recruiting extra participants, also outside the specific scope, and to reserve additional budget for communication activities and unexpected occurrences.

Online engagement and digital participation. During the project, Covid-19 caused major restrictions for social distance and organising social gatherings, which meant that all the face-to-face meetings and events had to be cancelled or postponed. Therefore, all the project meetings, citizen engagement activities, co-design workshops and business model activities were re-planned and translated to diverse online formats. This impacted radically on the engagement work, creating several challenges on reaching people, planning new online engagement activities, finding, and providing digital tools and access to all the stakeholders, learning to use new online technologies, and designing and facilitating online activities. All Espoo Lighthouse partners participated actively in finding

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and developing new solutions for online engagement, which meant that we could continue engagement activities with minor delays and changes in the project plan. However, changing to an online environment impacted the level and quality of engagement from citizen and stakeholder perspectives. Key take-aways from these experiences are that digital participation: 1) offers new online experiences for engagement (easy, effortless, and fun), 2) requires good communication skills and ability to instruct remotely, 3) relies on good digital skills and access to the tools and technologies, 4) makes it harder to build long-term relationships and engagement.

Ways of participation and optimal channels for community engagement. Different citizen groups need different ways of participation. During the Covid-19, it became clear that there are more channels for participation than was previously expected and novel remote formats had to be invented to comply with the changing situation. The channels for participation have transformed, and for example live streaming online events has become more popular. When choosing ways and channels for participation, the target group needs to be considered; younger citizens prefer different ways to participate than older generations. Thus, when planning participatory actions, the target group should be defined carefully. Then the different ways and channels for participation should be chosen according to the needs of that chosen target group. There might also be a big miss-match between organisers' and participants' expectations for participation channels and formats. According to the Finnish Innovation Fund Sitra (2022), citizens favour anonymised, easy, and digital participation formats for civic engagement whereas decision makers prefer face-to-face encounters. The contradicting expectations cannot be avoided, but those can be discussed and opened up from diverse perspectives before deciding on one format or channel. It is worth to consider if the activity can be organised in different formats, for example, a hybrid workshop or seminar enables to participate both online and face-to-face. To succeed in engagement from the beginning to the end, it is important to inform citizens about the results of the participatory actions. If the citizens hear afterwards how their opinions were considered and how their ideas were implemented, they are more engaged to participate in the future.

Communication and dissemination were playing a big role in SPARCS taking place through several channels, such as webinars and events, newsletters, blog posts and articles, social media, and academic publications. Like described previously, planning of the main points of communication starts by choosing the target segment and thinking about suitable channels to reach them. The arenas and points of the communication should be clearly thought through. Continuity in communication is important so that the recipient has a genuine memory impression and desire to participate in an event. Since Covid-19 moved many of the actions online, the competition for the citizens' and other stakeholders' time is even more challenging. The SPARCS project provided a good basis for tackling this challenge by using wide-ranging multi-channel communication and reaching out to the residents. Multi-channel and carefully planned communication actions becomes even more important when there is a high competition of participants' attention. As seen in the SPARCS project, the communication process needs to be the focus point of the engagement actions. It is important to actively share and re-post the articles in each partners' own channels. To do so, we advise to pay attention to internal communication actions, so every stakeholder and partner is aware of the actions happening. When engaging citizens to participate on their free time, it should be as easy and clear as possible. It is not recommended to spread the messages and information for many

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different channels and posts simultaneously, but to spread the posts to a wider time range to reach residents as effective as possible. Also, the tone of voice and visual components need to be well planned and part of the communication strategy in an early stage of, for example, webinar communication. These must also be related to the general communication of the project and provide input to the project management and reporting.

Who drives community engagement? And finally, the most important question cannot be stressed enough: On whose premises do we do community engagement? In the beginning of a research and innovation project, we should always ask: *Which stakeholders should participate and how? Why should and would citizens be interested in taking part? Who has the final say in what is developed and how? Are citizens able to make an actual contribution through the proposed engagement activity and process?* In the SPARCS project, new concepts have been developed based on end user needs identified from the user studies and co-developed further with the citizens and other stakeholders. Simultaneously, the initiative for these activities came from the organising partners and their business objectives combined with SPARCS objectives. Throughout the project, multiple private businesses, NGOs, and public sector organisations have also engaged to the process with multiple interests and motives to the engagement. In a project like SPARCS, there are at least three different perspectives co-existing at the same time: the citizens' daily needs, city development needs and business needs. All these aim for a different outcome and have different interest to drive engagement work. If a company takes ownership of the development work and wants to create better urban spaces by engaging end users, they also want to make economical profit. If the city is on the driver seat, they might want to make better places to live for their citizens, considering the social welfare and equal access to new services. If citizens drive the work, it might remain as grass-root activism which is beneficial mainly for the local community. However, one cannot succeed without the others. In the business model co-design work, it was found out that the work needs a focal point. One key stakeholder or one key partnership model between two stakeholders as a starting point for the design work. Narrowing down in the beginning helps to create focus for the work. To achieve truly citizen-led city development would require rethinking the budgeting and development processes of these kinds of projects. It would require a desire from citizens to take initiative to actively contribute to their neighbourhood development and to bring together relevant actors to enable these developments. One way to achieve this might be to allocate a certain budget for the development of the district, a cross-sector team to facilitate activities and gather an expert panel to co-design future solutions together. In the panel, there could be representatives from all the relevant local stakeholder groups.

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6. CONCLUSIONS

This deliverable presents several community engagement activities developed and demonstrated in the SPARCS lighthouse city of Espoo as part of *T3.6 Community engagement* task, including input from *T3.5 Planning of Energy Positive Districts* and *T3.8 Smart business models.* The activities were conducted by KONE, Citycon, and The City of Espoo in 2020-2022 and focused on supporting a sustainable mobility and lifestyle transition in collaboration with citizens and diverse stakeholders.

In the deliverable, we have provided understanding of methods, activities, and concept solutions to motivate more sustainable behaviours and lifestyles among citizens of future PEDs. As a result of the work, we propose a bottom-up community engagement approach based on an iterative co-design process, citizen participation and collaboration between smart city stakeholders. Our key findings from the work include detailed engagement activity descriptions to replicate the work, behavioural insights produced as an output of the process, solution descriptions in form of sustainable mobility concepts, business model concepts to build platform-based ecosystems, and a co-creation model for smart city development through multistakeholder collaboration. All these results were produced in close collaboration with citizens, private businesses and public sector stakeholders. Finally, the report presents an assessment for the added value and replication potential of the proposed community engagement approach, thus paving the way for democratic and collaborative development of PEDs in other cities.

Based on our experience, we can conclude that community engagement approach requires ability to step into the unknown and bear the risk that the engagement efforts does not carry out successfully. Due to the interactive and social nature of the work it can be easily affected by global phenomena, such as COVID-19. Simultaneously, it enables engaging diverse citizens and stakeholders in the joint effort of smart and sustainable city development. Community engagement has a potential to improve and optimise people flow and user experience in cities, because it places the end-user at the center of attention and allows diverse perspectives to co-exist. The strength of community engagement is that it creates an ecosystem of public and private stakeholders and considers new platform-based business models that have a potential to create wider sustainability impact.

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7. ACRONYMS AND TERMS

Acronym/term	Description
Citizen engagement	(see *community engagement*)
Co-design	(also *collaborative design*) refers to inviting various people to participate in and contribute to a design process (Sanders & Stappers, 2008)
Community engagement	(also *citizen engagement*) is defined as public participation, stakeholder involvement, co-creation, civic engagement, participatory democracy, or activism (M.X.D et al., 2004)
Design research	refers to research activities conducted by a researcher/designer for understanding the needs, desires, and challenges of end users and utilizing this knowledge for design purposes (Cooper, 2019; Margolin, 2016)
eV	Abbreviation of an electric vehicle, which is a vehicle that uses electric motors for propulsion.
Energy community	refers to a social concept focusing on local energy production and distribution
Mobility	moving from place A to B
PED	(also *Positive energy district*) defined as geographical locations that produce more energy than they consume while providing ancillary services like flexibility and storage to the grid
People flow	(also *urban flow*) refers to people and material streams in the urban environment as well as the daily experiences of citizens related to mobility, moving from place A to B
Sustainable business model	refers to 'a model whose rationale for value creation, delivery, and capture allows an organization to contribute to solving sustainability challenges and to promoting sustainable development' (Lüdeke-Freund et al., 2021).
Sustainable lifestyle	Espoo aims to be carbon neutral by 2030, and this requires active residents who make more sustainable everyday solutions. These solutions make sustainable lifestyle, and the aim is to spread this with the citizen engagement actions.
Sustainable urban mobility intervention	refers to concepts and solutions developed for creating behaviour change towards more sustainable urban mobility and motivating the adoption of more sustainable mobility practices
User experience	(also *UX*) refers to the overall experience of a person using a product, service or similar, evoking diverse feelings, beliefs, and preferences (see also *People flow*)
Intervention	refers to concepts and solutions developed for creating desired (behaviour) change

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