IRIS

Integrated and Replicable Solutions for Co-Creation in Sustainable Cities

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Vaasa replication plan

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Disclaimer

Executive Summary

The main objective of this Deliverable is to provide a planning template for potential replication actions and development projects for Vaasa's ecosystem. Additionally, the Deliverable strives to prioritize the potential replication activities, to promote Vaasa's decarbonization aspirations with well-described and feasible integrative solutions, to describe the risks involved, and to provide implementation of KPIs monitoring plan. Moreover, this replication report focuses on removing obstacles from investments and capital expenditure planning, by providing visibility and technical assistance about the integrated solutions. It also provides knowledge, technical assistance and visibility for replication activities in wider perspective for key stakeholders, and utilizes the latest and established financial resources.

The replication plan follows the structure, process and tools described in the D8.1, Roadmap for Replication Activities. Furthermore, the Deliverable presents each task's schedule, responsible partners, related subtasks and related deliverables, and dependencies linked to other tasks. The following key activities have been undertaken for enabling effective replication of the selected integrated solutions:

- Setting up coordination structures in align with the transition tracks and horizontal WPs of IRIS.
- Defining the roles and responsibilities of the replication manager, FC site manager, WP8 Task Force for Vaasa, TT and task leaders, and local stakeholders.
- Coordinating regular scheduled meetings with a Vaasa Task Force team, including the City of Vaasa, The University of Vaasa and Technology Centre Merinova.
- Coordination of communication at Vaasa ecosystem level, via the setup of a Local News Desk and cooperation.
- Cooperating with WP1-WP9 partners, to support the analysis of integrated solutions demonstrated by the LH cities, and to develop a process for the selection of replicable integrated solutions for Vaasa.
- Setup of a joint approach with the three LH cities and three other follower cities (FC), intended to endure the duration of the IRIS project.
- Reporting to the European Commission, the project coordinator and the Utrecht ecosystem about the IRIS project's progress.
- Verification and updating the investment plan, submitted in the application phase.
- Aligning project planning and investments with activities and investments outside the IRIS project by identifying local risks and mitigation measures.

The City of Vaasa's project partners, the University of Vaasa and Technology Centre Merinova, have contributed to the creation of the Vaasa Replication Plan. The focus has been on the analysis of the lighthouse cities' demonstrations, and sharing deeper knowledge about the details regarding potential replication activities, and Vaasa's needs. During the process of preparing the Deliverable, ongoing discussions and contact with the presented local key stakeholders, as well as regional and national funding agencies, have been kept. Thus, all parties have been aware of the on-going planning progress, and they have been enabled knowledge sharing, and to discover possibilities and measures aiding the replication activities.

The desired end-result is, that at least some of the IRIS integrated solutions will be implemented in Vaasa ecosystem, in short period of time. The well-executed replication plan aids in securing robust and efficient

integration process for the replicable solutions. For other IRIS integrated solutions, the replication may take longer. However, the process of finalizing the replication plan for the later solutions is defined in this report, so that subsequent replication can be implemented with lower risks, and higher effectivity.

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List of Abbreviations and Acronyms

Abbreviation	Definition
BESS	Battery energy storage system
BEV	Battery energy vehicle
BIPV	Building installed PV
BIM	Building Information Model
CIM	City Information Model
CIP	City Information Platform
DH	District heating
DoA	Description of action
E-	Electric-
ESS	Energy storage system
EU	European Union
EV	Electric vehicle
FC	Follower city
G2V	Grid-to-vehicle
HEV	Hybrid energy vehicle
KPI	Key Performance Indicator
LH	Lighthouse city
MaaS	Mobility as a Service
Oy	Ltd.
PHEV	Plug-in energy vehicle
POC	Proof of concept
PV	Photovoltaics (Solar energy by using solar panels)
QoL	Quality of Life
R&D	Research & development
RES	Renewable energy sources
RM	Replication manager
SCC	Smart Cities and Communities
SME	Small and medium sized enterprises
TBA	To be announced
TT	Transition Track
V2G	Vehicle-to-grid
WBS	Work Breakdown Structure
WP	Work Package

1. Introduction

Vaasa is a medium size city on the west coast of Finland. Approximately 68.000 inhabitants live in the City's region, and 120.000 in total with its sub-regions. Vaasa is known as the Nordic Energy Capital, due to its unique and vigorous Energy Vaasa Cluster (www.energyvaasa.fi). The annual business turnover of the companies belonging to the Cluster, is around €5 billion euros. The export rate of Energy Vaasa Cluster is over 80%, representing 30% of Finland's total energy-technology export value.

The City of Vaasa has committed strongly to the climate work. The City Council set a target for Vaasa in December 2019, to become carbon neutral by 2030. Due to the unique energy expertise in the Vaasa area, with the ongoing technology development work and large investments, and the commitment to decarbonisation activities, the replication actions will be evaluated, and when possible included in the ongoing climate actions.

Many of the solutions demonstrated in the lighthouse cities represent solutions and activities, which in Vaasa, and in whole Finland, may belong to line of businesses, which are operated by, or are more suitable and potential for private sector companies, thus not necessarily being under the direct influence of Vaasa. Hence, such companies are not directly linked to the IRIS Smart City project at the beginning. Furthermore, if and when, an external company comes involved, eventually it is up to the company itself to decide upon the replication.

The replication measures outlined in this report are dependent on decision making of both the City of Vaasa and different partner organizations as well as other stakeholders. The decision making of the City is confined to the boundaries set out by the administrative regulations and subsequent rules of procedures. Through its share ownership in certain local companies, which are current or potential future stakeholders or partners in different replication activities, the City of Vaasa can influence actions beyond the direct actions and decision making of the City.

1.1. Scope, objectives and expected impact

The main objective of this Deliverable is to provide a planning template, i.e. a roadmap, for potential replication actions and development projects for the Vaasa ecosystem. It follows the step-by-step process described in the D8.1. This replication report focuses on removing obstacles from investments, by providing visibility and technical assistance. It also provides knowledge, technical assistance and visibility for replication in wider perspective, and makes intelligent use of the latest and established financial resources.

The secondary objectives of this Deliverable are:

- Prioritizing the replication activities of integrated solutions in the Vaasa ecosystem.
- Describing the risks and the mitigation plan concerning the replication activities.
- Providing implementation of KPIs monitoring plan.

The desired end-result is, that some of the IRIS integrated solutions will be, in some extent at least, implemented in the Vaasa ecosystem, in short period of time. As for the other IRIS integrated solutions, the replication may take longer. However, the process of finalizing the replication plan for the later

solutions is defined in this report, so that subsequent replication can be implemented with lower risks, and higher effectivity.

1.2. Contributions of partners

The City of Vaasa's project partners, the University of Vaasa, and Technology Centre Merinova, have contributed to the creation of the Vaasa Replication Plan. The focus has been on the analysis of the lighthouse cities' (LH) demonstrations, and in creating deeper insight into the details regarding replication, and Vaasa's needs. Through a meticulously executed replication plan, Vaasa aims to secure a robust and efficient integration process for the demonstrated replicable solutions.

Additionally, ongoing discussions and contact with the presented local key stakeholders, as well as regional and national funding agencies, have been kept. This is to help all parties to be fully aware of the situation analysis, to enable knowledge sharing and discovery of possibilities and measures aiding the replication activities.

In addition, several of the University of Vaasa's graduate students have been involved in the creation of the Vaasa Replication Plan, focusing on the City's capabilities and needs to replicate the LH cities' IRIS Smart City activities.

1.3. Relation to other activities

WP8, T8.3 has interdependencies with several other WPs.

Interdependencies with WP1

Deliverables D1.2 to D1.7 provided preliminary information about the demonstrations and activities of each transition track (TT). They have been demonstrated by the LH cities, thus providing the necessary information, on which the Vaasa replication planning is based on.

The LH city documents define thoroughly each solution's requirements/specifications (geographical, technical, operational, legislative, regulatory framework, business), before the solutions are to be deployed and demonstrated.

Interdependencies with WP2

The City of Vaasa is the work package leader of WP8, and the head of the Replication Manager (RM). The RM has a central role in the Iris Smart Cities project concerning replication activities. The SCC- Lighthouse projects (Smart Cities and Communities) work on the European level, and with tight collaboration, has created cooperation groups between the SCC- projects. The IRIS Smart Cities project act as chair for the Replication Task Group in Europe. The Chair is held by the WP2 project leader and the RM together.

The Replication Manager is actively sharing knowledge and experiences gained from the replication task group. On the national level, the City of Vaasa, as well as the Vaasa Region Development Company - VASEK, have taken an active role in creating the national network for SCC-projects. The national network has an essential role in replications, since many processes and challenges are similar, e.g., legal, administrative and governmental, and knowledge sharing is essential.

Interdependencies with WP3

Business models are a central theme when considering replication activities in Vaasa, particularly in risks assessment, analyzing barriers and drivers and the replicability in general. WP3 is important for replication processes, and in establishing profitable business models.

Interdependencies with WP4

According to the Description of Action (DoA), WP4 aims at "offering an open, reusable and reliable platform for sharing data, expediting innovation, standardization and implementation of smart applications." Mainly, this is to be executed by the City Information Platform (CIP).

In the context of Vaasa, the CIP is a vital feature of the project, since it will act as an interface and enabler for the City Information Model (CIM). Through the CIP, users and third-party developers will have the opportunity to access and use the data, which is stored and organized in the CIM.

Interdependencies with WP5, WP6 and WP7

WP8 is fully dependent on the results and progress of WP5, WP6 and WP7, regarding the design, implementation and monitoring of demonstrations of integrated solutions. Reports from each LH city provide a base for analysis of the feasibility of each selected integrated solution, for replication in Vaasa ecosystem.

Interdependencies with WP9

The detailed description of the organization, and the process of the City of Vaasa's interventions developed in this Deliverable, will provide input to the assessment, so a coherent monitoring program can be constructed. A set of key performance indicators (KPIs) and target numbers will be designed, based on the information in this Deliverable. They are to be developed jointly, thus enabling fully the evaluation of the effectiveness and impacts of the proposed integrated solutions now and in the future.

Interdependencies with WP10

WP10 is in relation to WP7. See chapter 3.2 for specification and description.

Interdependencies with WP11

Organizational structure and procedures described in this Deliverable, have been set up in accordance with the principles outlined in WP 11 Project Management.

Interdependencies with WP12

The objective of the Ethics Board, that will be operating within WP12, is to establish the procurement of ethical, legal and privacy issues, for the technologies developed in the demonstrations. Gothenburg is a member of this board, with duties relating to the objectives.

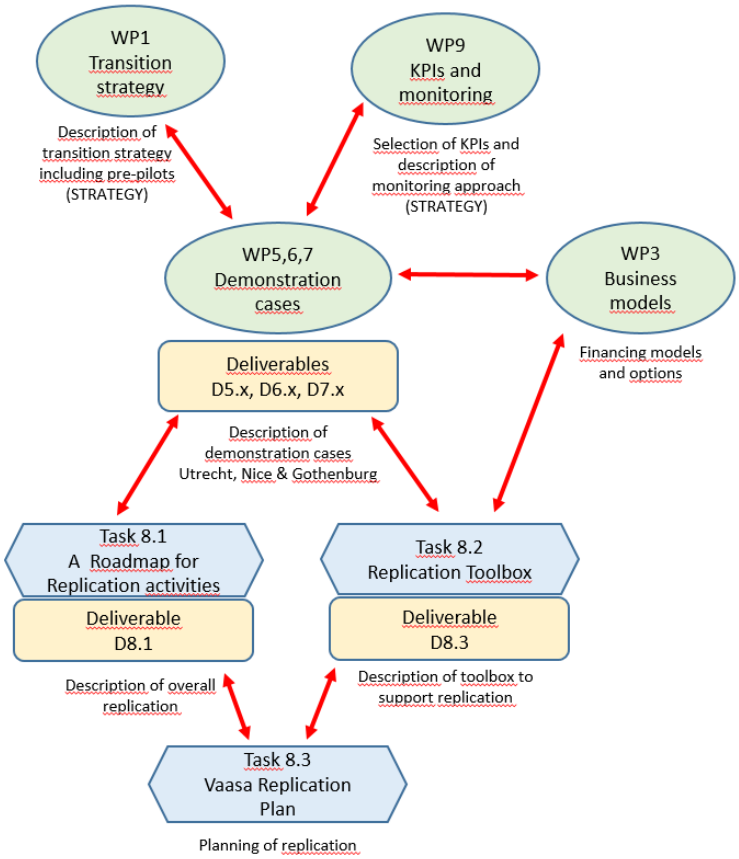

Figure 1. *Main relations of this Deliverable with other deliverables and work packages.*

1.4. Structure of the Deliverable

- Chapter 2 presents the methodology on which D8.4 is based, highlighting specifically the joint approach adopted, aiming to endure the whole project, fostering exchange of good practices among the IRIS project cities.
- Chapter 3-7 report Transition Track (TT) levels, situation analysis, background information, planning etc. of the Vaasa replication activities. Description of investment plans associated with the replication activities, Gantt charts, and risk management are expressed.
- Chapter 9 presents the interdependencies between other Work Packages and Tasks.
- Chapter 10 presents conclusions, drawn from the data in the report.
- Chapter 11 lists the references used in the report.

2. Methodology

Introduction

According to the DoA, Deliverable D8.4 is a replication plan, which includes business/financial plans for post-project replication with a Gantt charts and a Work Breakdown Structures (WBS). Additionally, the plan presents each task's schedule, responsible partner/-s, related subtasks and related deliverables, and dependencies linked to other tasks. The report focuses on removing obstacles from investments, by providing visibility and technical assistance. It also provides knowledge, technical assistance and visibility for replication in wider perspective, and makes comprehensive use of the latest and established financial resources.

The replication plan follows the structure, and the step-by-step process and tools described in the D8.1, Roadmap for Replication Activities. The work undertaken in T8.3, entails setting up current coordination structures and procedures, which will enable effective replication of the selected integrated solutions. Hence, the following key activities have been undertaken:

- Setting up coordination structures in align with the transition tracks and horizontal WPs of IRIS.
- Defining the roles and responsibilities of the Replication Manager, FC Site Manager, WP8 Task Force for Vaasa, TT Leaders and Task Leaders, and local stakeholders.
- Coordinating regular scheduled meetings with a Vaasa Task Force team, including the City of Vaasa, The University of Vaasa, and Technology Centre Merinova.
- Coordination of communication at the Vaasa ecosystem level, via the setup and collaboration with the Local News Desk.
- Cooperation with WP1-WP9 partners, to support the analysis of integrated solutions demonstrated by the LH cities and developing a process to select replicable integrated solutions for Vaasa.
- Setup of a joint approach with the three LH cities and three other follower cities (FC), intended to endure the duration of the IRIS project.
- Reporting to the European Commission, the Project Coordinator and the Utrecht ecosystem about the IRIS project's progress.
- Verification and updating the investment plan, submitted in the application phase.
- Aligning project planning and investments with activities and investments outside the IRIS project by identifying local risks and mitigation measures.

Observing LH report 5.1 & Roadmap is recommended for extra assistance.

2.1. Replication methodology

The City of Vaasa has committed to the Covenant Mayors program, which requires preparation of the Sustainable Energy Action Plan (SEAP)[1]. The City of Vaasa's preliminary target was to be carbon neutral by 2035. However, in 2019 the City Council set the target a new deadline: to achieve carbon neutrality by 2030[2].

The Vaasa region is known for its unique diligence and cooperation. Some IRIS solutions are already operational and will be implemented by the local stakeholders. Experiences and knowledge about the various IRIS solutions are been shared and analyzed. Some projects, which are at their preparatory phase, are been studied in order to establish possible connections to IRIS solutions. A whole solution, or part of it, can be implemented later in cooperation with local stakeholders, depending on a business case model or funding. For some solutions implementation is not currently a feasible option in Vaasa.

2.2. Creation process for replication plan

The structure of IRIS project is based on five Transition Tracks (see Table 1).

Table 1. *IRIS Transition Tracks.*

Transition Track #1	Transition Track #2	Transition Track #3	Transition Track #4	Transition Track #5
Smart Renewables and Closed-loop Energy-positive Districts	Smart Energy Management and Storage for Grid Flexibility	Smart e-Mobility Sector	City Innovation Platform (CIP) Use Cases	Citizen Engagement and Co-creation

For each one of the TTs, the City of Vaasa has assigned a partner, which provides technical approach with the stakeholders involved, and oversees the activities during the preparation of the replication plan. Project partners are assigned as Transition Track Leaders.

Table 2. *Vaasa Transition Track Leaders and the responsibilities, i.e. the Vaasa Task Force team.*

List of roles and responsible partners		
Assignment	**Partner**	**Assigned Person**
FC City Site Manager (FCCSM)	The City of Vaasa (VAAS)	Pertti Onkalo until 1.6.2020 Mika Hakosalo from 25.1.2021
TT#1 – 8.3 Task Lead	Technology Centre Merinova (MERI)	Johan Wasberg
TT#2 – Task Lead 7.4	Technology Centre Merinova (MERI)	Johan Wasberg
TT#3 – Task Lead 7.5	The City of Vaasa (VAAS)	Pertti Onkalo until 1.6.2020 Mika Hakosalo from 25.1.2021
TT#4 – Task Lead 7.6	The City of Vaasa (VAAS)	Teemu Lehtonen
TT#5 – Task Lead 7.7	The University of Vaasa (UVA)	Mona Enell-Nilsson

The City of Vaasa leads the replication activities as the Site Manager. Additionally, The City of Vaasa oversees the WP8 activities, led by the Replication Manager Mauritz Knuts. Financial matters are the responsibility of the City of Vaasa. See further details in Table 2.

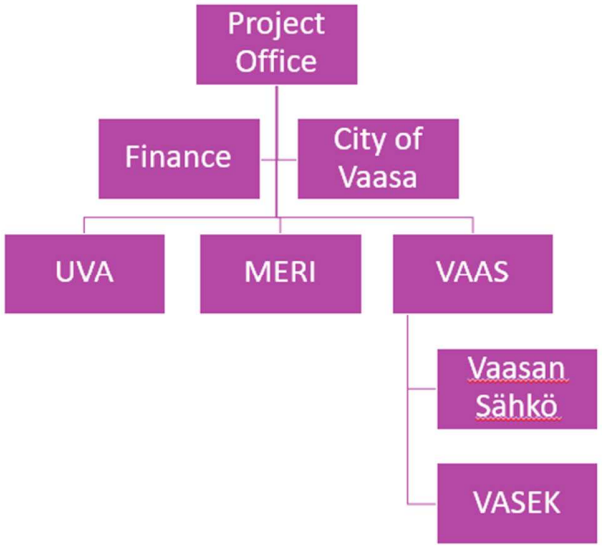

Figure 2. *The operators in WP8, T8.3 activities.*

The City of Vaasa has a major role in WP8, T8.3 activities. To improve the collaboration and operative effectiveness of the City's participation - mainly technical department's responsibilities; city planning, infrastructure, traffic, construction and building management. Effective collaboration with the City of Vaasa owned energy-company Vaasan Sähkö Oy is a self-evident necessity.

In order to ensure the City of Vaasa Management's and Government's continuing commitment, the Vaasa Task Force team reports to the City´s Energy and Climate Program's Steering Group.

2.3. Solutions chosen for replication

During the application process, the City of Vaasa, due to its broad development work and demanding targets regarding energy and climate related issues, expressed its keen interest and strong attempt to replicate several solutions.

Table 3. *Status of the solutions to be replicated.*

Transition Tracks	Integrated solutions	Follower Cities	
		Vaasa	Status
#1 Smart renewables and closed-loop energy positive districts	IS-1.1: Positive energy buildings	R	
	IS-1.2: Near zero energy retrofit district	R	
	IS-1.3: Symbiotic waste heat networks	R	
#2 Smart energy management and storage for energy grid flexibility	IS-2.1: Flexible electricity grid networks	R	
	IS-2.2: Smart multi-sourced low temperature	R	
	IS-2.3: Utilizing 2nd life batteries for smart large scale storage schemes	-	
#3 Smart e-mobility sector	IS-3.1: Smart Solar V2G EVs charging	-	
	IS-3.2: Innovative mobility services for the citizens	R	
#4 City innovation platform (CIP)	IS-4.1: Services for urban monitoring	R	
	IS-4.2: Services for city management and planning	R	
	IS-4.3: Services for mobility	R	
	IS-4.4: Services for grid flexibility	R	
#5 Citizen engagement	IS-5.1: Chnaging everyday energy use	R	
	IS-5.2: Participatory city modeling	R	
	IS-5.3: Living labs	R	
	IS-5.4: Behaviour changing information	R	

Colour	Description
	Design of replication projects started
	Replication objects identified
	Replication projects to be investigated

Table 4 illustrates a summary of the replicable solutions. It indicates the chosen solution and the LH city demonstration acting as basis of each replication. Additionally, potential replication project, partners and potential time period are clarified. One should bear in mind that with many of the solutions planned to be replicated, the decision-making concerning the final execution of replication activities, is not solely dependent on of the City of Vaasa, due to the City's organizational structure.

Table 4. *Solutions chosen for replication, and those yet to be determined.*

TT#1: Smart renewables and closed-loop energy positive districts			
Integrated solution	**Project name**	**Partners**	**Estimated period**
✓ **IS-1.1: Positive Energy Buildings** (Nice: Palazzo Meridia (self-consumption, PV, BESS) & IMREDD + Gothenburg: Brf Viva (PV, BIPV, local ESS, 2nd life batteries) + Utrecht: Bo-Ex (PV, smart metering)	Wasa Station	YIT Oy, The City of Vaasa, Granlund Oy, Vaasan Sähkö Oy	2021-2023
IS-1.2: Near zero energy retrofit district (Utrecht: Bo-Ex refurbishment, PV, smart metering)	Several potential targets in the city; single apartment buildings or whole city blocks, e.g., Olympia, Ristinummi (TBA)	The City of Vaasa, Pikipruukki Oy, VOAS	TBA
✓ **IS-1.3: Symbiotic waste heat networks**	Vaskiluoto heat storage	Vaasan Sähkö Oy, Westenergy Oy	2020-2021->
TT#2: Smart Energy Management and Storage for Grid Flexibility			
Integrated solution	**Project name**	**Partners**	**Estimated period**
✓ **IS-2.1: Flexible electricity grid networks** (Gothenburg: 350 V DC building microgrid utilizing 140 kW rooftop PV installations, 200 kWh BESS + Nice: Flexible electricity grid networks + Utrecht: V2G, smart charging, BESS)	Smart Grid (see previous Sundom Smart Grid project)	Vaasan Sähkö Oy, Vaasan Sähköverkko Oy, The University of Vaasa	2020-2022->
✓ **IS-2.2: Smart multi-source low temperature district heating with innovative storage solutions** (Nice: Smart multi-sourced low	Suvilahti self-sufficient district & Ravilaakso low temperature DH	The City of Vaasa, Vaasan Sähkö Oy, Westenergy Oy	2022-2025

temperature DH with innovative storage solutions + Gothenburg: low temperature DH 45/30 system & cooling)			
IS-2.3: Utilizing 2nd life batteries for smart large scale storage schemes (Nice: IMREDD (RES, BESS, 2nd life) + Utrecht: apartment buildings, V2G, smart charging + Gothenburg: 200kWh energy storage)	TBA	The City of Vaasa, Vaasan Sähkö Oy, e-vehicle manufacturer/-s	TBA
TT#3: Smart e-Mobility Sector			
Integrated solution	**Project name**	**Partners**	**Estimated period**
IS-3.1: Smart solar V2G EVs charging (Utrecht: WeDriveSolar + Gothenburg: EC2B + Nice: SmartSolar V2G)	TBA	Vaasan Sähkö Oy, Vaasan sähköverkko Oy	TBA
✓ **IS-3.2: Innovative Mobility services for the Citizens** (Gothenburg: EC2B Viva & Campus, MaaS + Nice: Innovative Mobility Services, EV fleet + Utrecht: WeDriveSolar)	EC2B Ravilaakso: EVs (fleets), car sharing, smart charging schemes, Sustainable mobility, cycling, public transport development	Yrjö & Hanna Foundation, The City of Vaasa, Trivector, a vehicle provider (TBA)	2022-2025->
TT#4: City Innovation Platform (CIP)			
Integrated solution	**Project name**	**Partners**	**Estimated period**
IS-4.1: Services for Urban Monitoring (Nice: Sensors data collection in air quality + Gothenburg: CIM pilot + Utrecht: Monitoring E-Mobility, Smart Street Lighting with multi-sensoring)	TBA	Vaasan Sähkö Oy, TBA	2021-
IS-4.2: Services for City Management and Planning (Nice: BIM/CIM data display + Gothenburg: CIM platform + Utrecht: 3D City Innovation Model)	TBA	The City of Vaasa, TBA	2021-

IS-4.3: Services for Mobility (Nice: Data control and monitoring for Smart e-mobility + Utrecht: Monitoring E-Mobility)	TBA	The City of Vaasa, TBA	2021-
IS-4.4: Services for Grid Flexibility (Nice: Data interoperability with energy cloud + Gothenburg: The City Information Platform + Utrecht: Monitoring Grid Flexibility)	TBA, Connection to IS 1.1, 1.2, 2.1, 2.3, 3.1 & 3.2	Vaasan Sähkö Oy, TBA	TBA
TT#5: Citizen engagement			
Integrated solution	**Project name**	**Partners/Engagement**	**Estimated period**
☑ **IS-5.1: Changing everyday energy use** (Utrecht: Community building by change agents)	TBA (relation to TT#1 & TT#3 activities) Ristinummi district, The Olympia-block (TBA)	The City of Vaasa, the University of Vaasa, Novia, Ristinummi district and The Olympia-block citizens, residents associations, district councils, Vaasa Setlementti Association	TBA
IS-5.2: Participatory city modelling	TBA	The City of Vaasa, citizens	TBA
☑ **IS-5.3: Living labs** (Utrecht: Co-creation in Local Innovation Hub)	LähiöInno (Ristinummi district, The Olympia-block)	The City of Vaasa, The University of Vaasa, NOVIA, Ristinummi district and The Olympia-block citizens, resident associations, district councils, Vaasa Setlementti Association	2020-
☑ **IS-5.4: Behaviour changing Information** (Nice: Public awareness campaign Energy – School & College; Youth & Family + Utrecht: Campaign District School Involvement)	Energy Education Path	The City of Vaasa, pupils and students in Vaasa and their families, teachers and schools' staff	2017-

Figure 3 shows the integrated solutions' locations in Vaasa region.

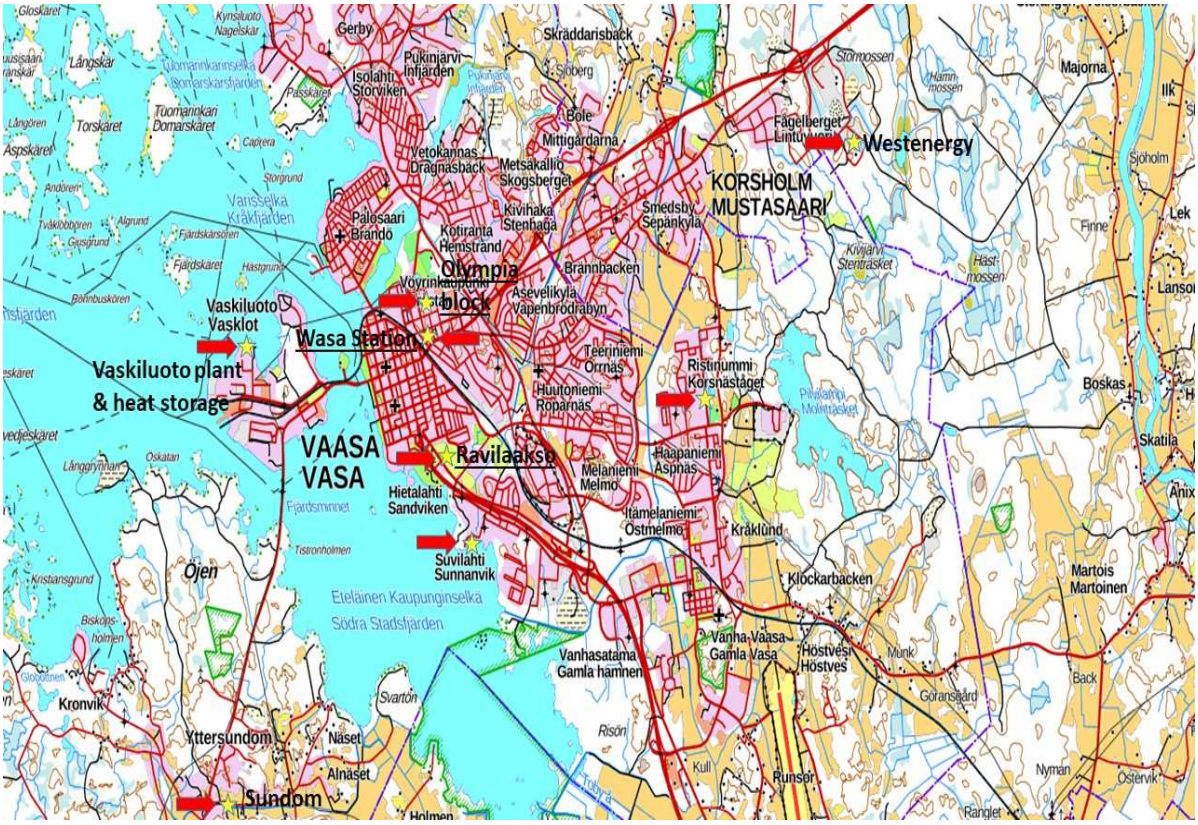

Figure 3 *Integrated solutions' locations (marked with an arrow and a star) in Vaasa region.*

3. City needs, challenges and prioritization

In 2016 the Finnish Government set new national energy and climate strategy for 2030, based on the 2016 Paris Agreement. The main objective of the strategy is to reduce greenhouse gas emissions by 40% before 2030, and by 80-90% before 2050 from 1990 level. The use of renewable energy sources is targeted to be increased by 27% before 2030. Additionally, the national goal of Finland is to reduce its emissions from traffic by 50% by 2030 from 2005 level. In 2005 Finland's total carbon footprint was 33,7Mt CO_2. With the measures previously mentioned the carbon footprint will be reduced to 20,6Mt CO_2 by 2030, out of which traffic's total effect will be approximately 3,1Mt CO_2. The Government of Finland's ambitious goal is to reach total carbon neutrality by 2035. Nevertheless, the City of Vaasa decided in 2019 to reach carbon neutrality in 2030.

The City of Vaasa needs to find new ways to maintain its sustainable development, while ensuring the wellbeing of the citizens, population growth, increment of employment rates, and economic growth. The transition process to carbon neutrality requires fast, decisive measures, without risking profitability. To achieve this, new innovations and joint export concepts are needed.

The City of Vaasa launched its Energy and Climate Program[2] in 2016 prioritizing in five main goals:

- Improving energy efficiency by saving energy and intensifying its use.
- Adding renewable energy sources: solar, hydro, wind, wave, geothermal and bio energy.
- Developing energy services for neighborhoods, constructors and renovators.
- Reducing CO_2 emissions by 30% by 2020 from 1990 level.
- Buying only green electricity for public buildings.

The City of Vaasa's primary objectives are to hold its significant position as an active center in energy technology innovation on the European level, and to honor its commitment in achieving carbon neutrality by 2030. In order to reach these assertive goals, close cooperation is required with energy industry in piloting and demonstration of new technologies and solutions.

The City of Vaasa strives to enable the commercialization of energy technology and innovations that promote carbon neutrality goals. Several investments and decisions have been made successfully to achieve reductions in emission levels. Furthermore, Vaasa has several renewable energy-pilot production plants of significant national and international importance, e.g., Vaskiluoto, the world's largest biomass gasifier plant, and Westenergy waste incineration plant.

In 2019, the City of Vaasa decided to achieve carbon neutrality by 2030[3]. Eventually, this goal set the framework for the *Carbon Neutral Vaasa 202X* roadmap designed together with the local business community, universities and public bodies. The aim is to link relevant urban development projects to the piloting and testing of new technologies and solutions. Fighting climate change requires a systematic change with committed involvement from all actors. To engage citizens more strongly than before is an important goal as well. The IRIS Smart Cities project is a perfect enabler to reach these objectives.

The City of Vaasa's firm ambition is to achieve the objectives of the Paris Agreement through genuine business-public-university collaboration, joint development platforms, and by effective development of

new technologies, innovations and research. The Paris Agreement creates great opportunities for Finnish companies to develop and export clean technology (Cleantech), related to, e.g., renewable energy, energy efficiency, intelligent systems, and reductions in energy production and transport emissions.

The Carbon Neutral Vaasa 202X program strives to create the most credible path for fast and profitable transition to carbon neutrality, by facilitating the energy transition away from non-renewables, and developing export concepts for complete carbon neutral city solutions. This presents a perfect opportunity, a showcase, for Vaasa region companies to increase their international visibility, and push their products, services and knowhow to foreign markets. The involvement of the SME sector is essential as well.

Vaasa, "The Nordic Energy Capital", is a global energy and climate forerunner and acts as a testbed for companies' energy technology solutions. It attracts both professionals and companies globally. High-quality and up-to-date research infrastructures and test environments are central to the further development of an internationally competitive research and innovation ecosystem.

The work and ambitions are summarized in **Figure 4**

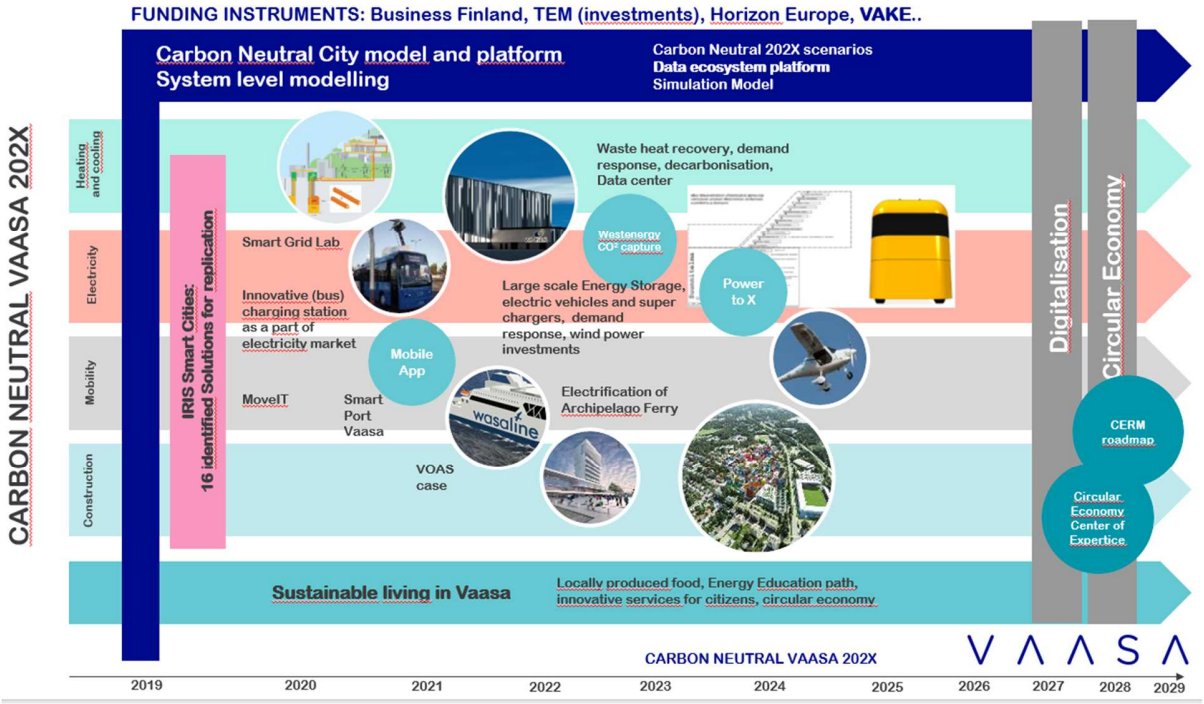

Figure 4. *The system level modelling and platform for the Carbon Neutral City Vaasa work.*

4. Transition track #1: Smart renewables and closed-loop energy positive districts

4.1. TT#1 Replication in a nutshell

- IS-1.1: Positive Energy Buildings:

Wasa Station, the new urban event center, which is under development, will be both multifunctional complex and a pioneer in energy-efficient construction. Wasa Station will include congress and music center, a hotel, a shopping center, apartments and a sports and multipurpose hall, making it an urban meeting place for business and leisure. The complex is designed to have an innovative and cost-effective energy system, making it virtually energy self-sufficient. The energy solutions to be utilised are, e.g., geothermal heat, solar heating and solar power.

- IS-1.2: Near zero energy retrofit district:

Vaasa's Ristinummi district, and other possible retrofitting targets in the centre of the city.

- IS-1.3: Symbiotic waste heat networks:

Most of the buildings in Vaasa are connected to the district heating network owned by the City utility company Vaasan Sähkö Oy. Heat is produced mainly by a combined electricity/heat power plant (CHP) in Vaasa, and by waste heat from waste incineration plant of Westenergy Oy.

Additionally, the new and one-of-a-kind heat storage prepared in Vaskiluoto district, will help Vaasa to achieve carbon neutrality in heat production by its set deadline, 2025. The heat storage enables more flexible utilization of renewable energy sources, e.g. shaving district heating consumption peaks, and reducing peak and back-up oil and coal production in district heating. Due to the heat storage the use of coal will be reduced by 30%.

Please see more in Annex 1 for the LH cities demonstrations, which contributed to the City of Vaasa's replication plan.

4.2. Selection process

The retrofitting analysis of the current building stock was already carried out during the project preparation phase. At that time the areas considered for retrofitting were located in Ristinummi and Suvilahti districts. However, lately more suitable single targets for retrofitting have been found in other parts of the city, which enable quicker initiation of retrofitting. However, the final retrofitting activities and targets are yet to be decided.

4.3. Mapping of stakeholders

The replication activities presented in TT#1 are planned and executed in cooperation with the City of Vaasa, the City owned district heating and electricity company Vaasan Sähkö Oy, the electricity grid owner Vaasan Sähköverkko Oy, Technology Centre Merinova, the regional business and development company VASEK, and the University of Vaasa. Regarding the activities concerning the residential buildings, landlords and owners are involved as well. The main stakeholders for retrofitting activities are the City owned Kiinteistö Oy Pikipruukki Fastighets Ab, and the local student housing association VOAS.

4.4. Identified knowledge gaps

No major knowledge caps have been identified.

4.5. Capacity building and knowledge transfer

Due to the Covid19 pandemic during 2020, site visits have not been possible to organize, webinars and peer-to-peer meetings have been the only options. Concerning retrofitting, the first webinar/peer-to-peer session took place 29.10.2020 between Utrecht & Bo-Ex and the City of Vaasa. The other FCs were invited to attend as well.

4.6. IS-1.1: Positive Energy Buildings

Baseline

There are no positive energy buildings in Vaasa currently.

Ambitions

Wasa Station is planned to be an urban meeting place and event centre, which will include a congress and music centre, a sports and multipurpose hall, a hotel, apartments and a shopping centre. Wasa Station will be both a multifunctional complex and a pioneer in energy-efficient construction. An innovative and cost-effective energy system has been developed for the complex. The goal is to have a district that is virtually energy self-sufficient. The energy solutions to be utilised are, for example, geothermal heat, solar heating and solar power.

The project is currently under development, and it has received an initial funding of over €1 million from the Ministry of Education and Culture for 2020.

Planning of replication activities

In 2013, the City of Vaasa organized a contest to find the best solution for the “Old bus station area”. The company Lemminkäinen Oy (merged with YIT Oyj in 2018) won the contest and signed an implementation agreement with the City. Sustainable development and innovative energy solutions were especially emphasized in the agreement.

Important milestones in the planning process were:

- City planning of the area 2014-2016
- Draft planning of the complex 2015-2019
- The marketing of the area started in 2016
- Key stakeholder engaged in the project, including K-Supermarket, YLE (national TV channel), restaurant operators, operator of the parking area etc.
- Preliminary agreement signed with hotel operator Odyssey Hotel Group (Mariott)
- The project was chosen as an "Energy spearhead project" by the Ministry of Employment, and the Economy and awarded a grant for 2017-2019. However, the grant was not used since the project did not start right away.

The current situation with the Covid-19 restrictions has delayed both the planning process and implementation of the project.

Organization of work

The construction company YIT Oyj is responsible for the development of Wasa Station. YIT Oyj creates better living environments by developing and constructing housing, business premises, infrastructure, and entire areas.

The key planning partners in Wasa Station projects include:

- Arosuo Arkkitehdit Oy (architecture)
- Granlund Oy (energy solutions and calculation)
- Ramboll Finland Oy (construction)
- Akukon Oy (acoustics, noise abatement and audiovisual design services)
- Markku Kaurila Oy (fire safety design)

The duration of the construction phase is planned to be two and a half years.

Data collection and management

The data collection and management are handled by the implementing company Lemminkäinen Oy / YIT Oyj.

Barriers and drivers

- Political
  - Driver: The City of Vaasa is committed to implementing the Wasa Station project in accordance with the implementation agreement signed with YIT Oyj.
  - Driver: The City of Vaasa will finance the construction of the Music and Congress Centre, and will be responsible for the operations and operating costs of the Music and Congress Centre once the complex is completed.
- Economical
  - Driver: Wasa Station will increase Vaasa's annual tax revenue by estimated €1.5 million. Additionally, it will create 400 permanent jobs and property tax income. It has been estimated that the project will have several indirect benefits for the City.
- Sociological

- Driver: Studies indicate that there are variety of expectations on the development of the urban living environment in Vaasa. “Smart” and “hyper-connected” city models are the least acknowledged and well-known ones, whereas, “green” and “renewable based” are the most accepted and popular city models. That is to say, the citizens seem to prefer to live in a “village like” green environment, more than in hyper-dense and –connected style constructed city areas. Hence, the technology and connectivity-based aspects of the solutions based on advanced management system, have lower value proposition for the wider public. Thus, these solutions may have to be made less conspicuous to the end-users.

- Technological
  - Driver: Wasa Station is designed to have its own innovative and smart energy system, which will function as a pilot project for future energy solutions in Vaasa.
- Legal/Regulatory framework
  - There are no legal barriers identified. Construction is done according to Finnish building regulations.
- Environmental
  - Driver: Improvement in energy efficiency, carbon footprint reduction, and adoption of renewable energy sources (RES), are the main drivers for the current regulations and reforms.

Figure 5. *Wasa Station will be both a multifunctional complex and a pioneer project in energy-efficient construction. (Arosuo Arkkitehdit Oy)*

Specifications

Wasa Station in figures

- Shopping center: 18 000 m^2
- Music and congress center: 10 000 m2
- Multipurpose hall: 3 000 m^2 (incl. sports and trade fairs)

- Hotel: 198 rooms
- Apartments: 104
- Parking space: approximately 600 car parking spaces and space for 655 bicycles

Energy requirement

The energy requirement for heating and cooling of the complex has been calculated. The electricity consumption is not included in the calculations. The table below shows that the total amount of energy needed for heating and cooling annually is 5720 MWh/a.

Table 5. *Calculated energy requirement for Wasa Station.*

Facility	**Heating**	**Cooling**	
Hotel	1090	70	
Apartments	370	20	
Shopping centre	1210	485	
Offices	120	20	
Multipurpose hall	470	65	
Music and congress center	780	295	
Parking hall	720	5	
Total	**4760 MWh/a**	**960 MWh/a**	

Energy efficiency requirements

The new energy efficiency requirements for buildings in Finland came into force on 1.7.2012. For new buildings an energy value, "E-value", is calculated on the basis of the need for external purchased energy, and the type of energy purchased. The E-value is expressed in kWh/m^2 per year. The smaller the E-value, the more energy efficient is the building. Different external energy sources have different calculation coefficients, for example:

- Electricity 1,7
- District heating 0,7
- District cooling 0,4
- Fossil fuels 1
- Renewable energy 0,5

The table below shows the E-values calculated for Wasa Station.

Table 6. *Calculated E-values for Wasa Station.*

Facility	E-value use category	E-value requirement kWh/m² (2018)	Calculate E-value kWh/m² (2018)	Energy efficiency class
Apartments	2 residential building	90	87	B
Hotel	5 accommodation	160	154	B
Shopping center	4 business building	135	135	B
Multipurpose hall	7 sports halls	100	87	A
Music and congress hall	4 business building	135	137	B
Offices	3 office building	100	97	B
Parking hall	9 other building	N.A.	68	A

Heat loss requirements

In addition to the E-value requirements, new buildings are required to fulfil the energy efficiency regulation of the Ministry of the Environment from 2018. The regulation states, that the heat losses from a planned building cannot exceed the heat losses of a "reference solution". The table below shows how Wasa Station relates to these regulations.

Table 7. *Calculated heat loss values for Wasa Station.*

Building	Reference solution, W/K (Maximum allowed)	Wasa Station, W/K
Apartments	2 758	2 742
Hotel	11 904	9 604
Shopping center	27 027	17 793
Multipurpose hall	3 224	2 031
Music and congress hall	8 910	6 213
Offices	901	716

Solar panel installation

Solar panels are designed to be installed on three sections of the roof. The key figures of the installation are presented in the table below.

Table 8. *Calculated solar panel installation in Wasa Station.*

Roof section	Panel area, m²	kWp	MWh/a	Investment, €	Roof area req. m²
1A	200	32	23,2	32 00	450
2A	445	71	53,0	71 000	1200
4B	65	10	7,8	10 500	170
Total	710 m²	115	84	113 500	1820

Citizen engagement

- Awareness of energy consumption, knowledge about the different causes of consumption (heating, ECS, electricity), appropriation of invoices, control of budget.
- Awareness of individual acts to collective return, sense of the common use, e.g., respect of the substation. Additionally, neither degradation, nor heating break or ECS. Improved comfort, lower costs.
- Awareness of individual acts to individual return, i.e. the impact of one's actions on one's electricity or individual water consumption.

Business model

- Surplus energy trading between legal entities in a district. Heating/cooling and electricity should be traded in real time. A market place will be created, facilitating energy trading and provision of system services, and providing sustainable and viable business opportunities. New applications and services through 3rd party innovation schemes are expected to be developed.
- Surplus energy trading between positive energy building and utility.
- Surplus energy trading between buildings and utility company, based on hourly spot prices on electricity and district heating.
- Surplus energy trading between legal entities.
- Electrical storage provided, including optimization of heat and electrical storages and switching of heat sources as a service.
- The "waste heat" from the office building, providing ability to charge the available boreholes.

Impact assessment

- Decrease the amount of electricity imported from the grid, thus reducing the CO_2 emissions associated with the centralized electricity generation from power stations, powered by fossil fuels.
- Increased degree of self-sufficiency, together with:
  - Better understanding of the usefulness of new sustainable and innovative energy systems.
  - Enabling a higher level of flexibility and ability to choose when to import energy to the building.
  - Ultimately reducing peak loads and CO_2 emissions.
- Reduced energy costs for tenants.

Implementation plan

The duration of the construction phase is planned to be two and a half years, but the current situation with the Covid-19 restrictions has delayed both the planning process and implementation of the project, e.g., recruitment of collaboration partners, financing etc. Currently no commencement date for the construction phase has been decided.

WBS – Work Breakdown Structure & Gantt chart

The duration of the construction phase is planned to be two and a half years, but no detailed chart is currently available.

Financing schemes and opportunities

Wasa Station is mainly an investment by a private construction company YIT Oyj. Part of the construction consists of a cultural center, where the City of Vaasa is providing funding. The project has received additional funding for innovative solutions from the Government.

The current situation, with the Covid-19 restrictions, has delayed the final financing of the project.

4.7. IS-1.2: Near zero energy retrofit district

Baseline

The Finnish housing system is largely based on private housing companies, where owners of the apartments hold shares of the company. Roles, responsibilities and the decision-making process are described by the law, and by rules of the company. For most of the issues related to retrofitting, and improvements requiring investment, there has to be a majority of shareholders to support the decision. In some cases, even one shareholder can prevent and delay the decision-making.

On social housing, there is a huge potential for retrofitting activities, especially in improving self-sufficiency with PV (photovoltaics), thermal energy etc. However, in most cases investments are financed by the Government owned organization for housing (ARA) through direct loans, guarantees for loans, or as subsidies. In such cases the project has to follow instructions provided by ARA.

In general, the effectiveness of building insulation materials (U-values) of Finnish residential building stock, is already relatively good compared to average European buildings. For example, windows with more than two panes have been a standard since 1970s in Finland. Hence, to produce an impact, the interventions of the solution 1.2 are focusing more on improving the overall energy performance of the buildings, rather than on renovation solutions of the building structures (e.g., insulation of the envelope or glazing). Installation of smart controls for managing the heating and electricity demand at the apartment level, is one of the key retrofitting interventions.

Several different funding models exist, however, there are some challenges as well. The main obstacle in private housing companies is the decision-making process. In the social housing sector, the capability to have feasible economical basis for investment, may prove to be problematic. In most cases, there are no possibilities to increase rent levels for residents to achieve reasonable payback time for the investment. LH city Utrecht's demonstration has partially faced similar challenges.

Ambitions

The total amount of apartments in Vaasa is little over 25.000 with surface approximate space of 2.500.000 m2, and inhabited by over 33.000 people. The rest of the city's inhabitants, above 33.000, live in detached houses and different type of townhouses. The estimated number of apartments requiring possible energy retrofitting, is approximately 8% of the total apartment stock in Vaasa.

Vaasa's aim is to achieve the highest possible level of energy independence. Additionally, one of Vaasa's most important environmental goals is the carbon footprint reduction. These aspirations have to be taken into consideration, when planning retrofitting solutions. While one solution can be low carbon and cost effective in the district level, it may not be as beneficial in the city level. A good example are solar collectors, producing renewable thermal energy. Despite the usefulness of PV energy, during summer time in Vaasa, there is already heat overproduction, due to the incineration plant of circular economy company Westenergy Oy's heat production.

When the IRIS project started in 2017 the most potential area suitable for retrofitting in Vaasa was the south-east district of Ristinummi. Most of the districts' buildings have been built during the 1970s, and these buildings are poorly insulated and do not often have energy labels at all.

Table 9. *Ristinummi district's building stock.*

Building stock (apartment buildings)	**Apartments (number)**	**Estimated surface area m2**	**Number of inhabitants**	**Estimated cost of energy retrofitting €**
Ristinummi district	4.350	326.000	6500	
Construction year 1970'	2.900	217.000	4.400	58.000.000
Construction year 1980'	665	50.000	1.000	13.300.000
Construction year 1990'	170	13.500	250	3.400.000
Total retrofitting estimate	3735	280.500	5.650	74.700.000

The Ristinummi district, as well as other possible retrofitting targets now considered more applicable for retrofitting than Ristinummi district, have many challenges to be resolved during the modeling stage. The biggest restraint is the lack of available roof space for installation of PV panels. Additionally, the needed space for ground source heat pump has not yet been planned. Efficiency of the PV can be greatly improved by implementing a smart automation and centralized electrical battery storage inside of the energy community.

The lighthouse city Utrecht has expressed similar barriers for implementing retrofitting. However, some of the barriers are to do with Finnish legislation on housing associations, and challenges in decision-making in those associations.

When a district is been retrofitted, environmental awareness and benefits are promoted. The district's level of retrofitting requires active participation through the implementation. It is one of many means for the City of Vaasa to achieve its climate and environmental goals. Improving housing conditions in the old districts is not only a technical issue, but it is also a matter of improving social standards, services and the environment.

In 2020 the Ristinummi district was accepted to the Finnish Government's "neighborhood-program" (*Lähiöohjelma*). The program was addressed by the Ministry of the Environment, and is coordinated by the Housing Finance and Development Centre of Finland (ARA). The total budget for the planned actions

in the program is €2,5 million. Some of the actions can include potential IRIS replication activities. For example, "The equality of education and the well-fare of children and youth, by developing the schools" action, includes extensions and renovation operations for the district's school building, its hall and the school yard. Several of the actions are focusing on citizen engagement activities and security, and some focusing on climate neutrality and mobility actions.

Planning of replication activities

As part of the refurbishment activities to increase energy efficiency, the following measures could be implemented **(Utrecht)**:

- New window frames and glazing (double or triple glazing)
- Insulation of outer walls and the ground floor ceiling
- Improvement of chinks (especially at the connection of the facade with the window frames)
- Mechanical ventilation (with natural or mechanical supply)

In apartment buildings, where energy efficiency could be improved, or energy self-sufficiency with PV installations increased, there is no commitment on replication activities with the main stakeholders. If there is available funding for retrofitting, and improvement on energy efficient solutions, replication can be launched after the project period.

Organization of work

Replication will be led by public and private housing companies. Construction works will be contracted through open tendering process. In social housing, if funding is organized through ARA, all plans and the budget have to be approved by ARA.

Data collection and management

Barriers and drivers

- Political
  - Driver: Self-consumption makes consumers active players in the energy transition, a key objective of the Energy Union.
  - Driver: The majority of the political parties in Finland agree on the need for reducing GHG (greenhouse gas) emissions, so unanimous political support for initiatives to support it exists.
- Economical
  - Driver: Self-consumption helps European consumers and businesses to control their energy bill. Self-consumption does not only provide cheap electricity to consumers, it also protects them against volatile energy prices.
  - Driver: Self-consumption increases retail competition and helps market transformation. The relationship with the consumer is the most important factor of differentiation between energy suppliers. The winners will be those retailers able to deliver new services. The ability to offer self-consumption solutions is an obvious pillar of such strategies.
  - Barrier: Usually, large investments are required.
  - Barrier: Large investments require substantial capital and long payback periods, which may act as a barrier for investors looking for quick return on investment. Long payback periods may also hinder market introduction for required state-of-the-art electricity applications.

- Barrier: Lack of knowledge of available financial instruments is fairly common.

- Sociological
  - Driver: Studies indicate, that projects with sharing of RES among neighbours, should face relatively high interest in current society, with higher bias towards younger working-class generations (and also towards individuals with higher education). This shows good potential acceptance of decentralized RES and potential energy sharing mechanisms.
  - Barrier: With the potential retrofitting areas, the main barriers are primarily the involvement and support of tenants. For example, in the Ristinummi district, several social challenges have been reported; such as poverty, criminality, vermin, poor traffic safety, and parking problems, which hamper the retrofitting process and its impacts.
  - Barrier: Challenges of cooperation can occur in the operating phase of the energy management system, if a private sector operator owns the building. Additionally, residents' lack of knowledge of energy related issues, might produce challenges, if the residents also own the apartments. Also, renovation of old buildings with Building-Integrated Photovoltaics (BIPV), would have an impact on the buildings' visual appearance. This may have a negative effect on gaining acceptance from both the residents, and the municipality's architects, who provide building permits.
- Technological
  - Barrier: Consumers' electricity and PV systems must operate on the same low voltage feeder.
  - Barrier: Due to the small number of projects done in Europe so far, profitability of different business models has not yet been validated.
- Legal / Regulatory framework
  - Currently the Finnish law states, that electricity from a solar panel installed on an apartment building can only be used for the property's common areas but not for the individual apartments. The law will change in 2021, making it legal to produce energy with PV in housing cooperatives in Finland. The new law introduces a term called "energy community", which makes it possible for privately produced electricity to be shared between the housing cooperatives' inhabitants. This can be achieved by utilizing the refund calculation model. The produced electricity's priority usage is to power the apartment building's basic functions, such as ventilation system and elevators. In case of excess electricity been produced, it will be distributed to the inhabitants. Utilizing this method, the investments in the energy community can reach financial feasibility, and electricity exports are minimized.
- Environmental
  - Driver: Energy efficiency improvement, carbon footprint reduction, and adoption of renewable energy sources (RES) are the main drivers for the current regulations and reforms. Similarly, environmental impact reduction via a more sustainable development model is a concern for the modern urban population.
  - Barrier: European and national regulations have already made big improvements in the promotion of RES and low carbon solutions. However, an overall strong signal is missing: the relatively low carbon tax and other tradeable related carbon bonds are still not effective enough to generate any direct market impact. This does not stimulate an uptake of low carbon technological solutions, and reduce the environmental footprint of the energy system at the local level.

Specifications

There are no specifications available at the moment.

Citizen engagement

The main focus is to increase the collective and individual knowledge and awareness of citizens of energy use, as well as to motivate individual energy conscious behaviour. Ongoing discussions with the Student Housing Association VOAS are constant, to link retrofitting with applications and interfaces for students' housing in the area. The replication of IS-1.2 should be combined with the replication of IS-5.1 "Community building by change agents", further described in section 8.1.

Business model

A business model should mainly be based on financial benefits of savings in energy. In most cases it is doubtful, that this could be achieved within normal economical calculations, hence additional funding or subsidies have to be made available.

Governance

Retrofitting projects will be led by private housing associations and public housing companies (Pikipruukki Oy, VOAS). Construction companies and solutions providers (PVs, automation etc.) should provide their expertise for the projects.

Impact assessment

- Decrease the amount of electricity imported from the grid, hence reducing the CO_2 emissions associated with the centralized electricity generation powered by fossil fuels.
- Increased degree of self-sufficiency, together with:
  - Better understanding of the usefulness and utilization of stationary battery systems.
  - Enabling a higher level of flexibility, and ability to choose when to import energy to the building.
  - Ultimately reducing peak loads and CO_2 emissions.
- Reduce housing costs in the long run.

Implementation plan

More detailed implementation to be cleared later, TBA.

WBS – Work Breakdown Structure & Gantt chart

Detailed plan to be cleared later, TBA.

Financing schemes and opportunities

ARA

The Department of the Built Environment, operating under the Ministry of Environment, is responsible for housing in Finland. Subsidies, grants and guarantees related to housing and building are granted by the Housing Finance and Development Centre of Finland (ARA), which also steers and supervises the use of the State-subsidized building stock of ARA.

Municipal funding (MuniFin)

MuniFin strives to develop the Finnish welfare society. MuniFin is the only financial institution in Finland specialized in financing the municipal sector and state-subsided housing production. Offering financing solutions to a variety of environmentally and socially responsible projects such as public transport, sustainable buildings, hospitals and healthcare centers, daycare centers and schools, and the production of affordable social housing and housing for special groups. Further, MuniFin promotes the achievement of Finland's climate targets by offering green finance for investments that have positive effects on the environment.

Banks

Banks have developed financial products that include energy efficiency and/or environmentally considering elements. For example, Nordea bank's Green Mortgage is granted on condition that the property meets at least one of the requirements set: energy class A, the property has been awarded the Swan Ecolabel or has an RTS building rating of at least two stars.

Leasing model

The service provider and the bank have launched a service for housing companies in which the energy renovation is paid according to the leasing model for a monthly fee. The bank finances the energy renovation and the service provider is responsible for the planning, implementation and follow-up of the renovation. The housing company does not need to commit equity to the project as before, with the aim of lowering the threshold for energy renovation.

Energy Service Company (ESCO)

Energy efficiency and ESCO services are a service business in which an external energy expert implements investments and measures in the customer company to improve energy efficiency. The costs of service is paid by savings resulting from reduced energy costs.

Energy aid & Investment aid

Government aid is available for the implementation of energy audits, investments that conserve energy and investments related to the use of renewable energy. The low-carbon economy is promoted by structural funds.

The Ministry of Economic Affairs and Employment may grant investment aid to business and corporations for projects that promote the conservation of energy with the help of new technology or advance the use of renewable energy. Businesses and corporations that are party to energy efficiency agreements can also apply for aid in relation conventional energy efficiency investments.

The Ministry of the Environment supports the energy audits of residential buildings through energy grants. Further information on repair and energy grants is available through municipal governments and the Housing Finance and Development Centre of Finland (ARA).

European Regional Development Fund (EAKR)

In the programming period 2014-2020, a total of 25% of the ERDF funding was directed at low-carbon activities. Good low-carbon projects have been carried out in such areas as cleantech and

sustainable development, and an investment or implementation model has focused on a substantial reduction in the carbon balance.

European Local Energy Assistance (ELENA)

Elena funding supports the preparation and background research of local actors' own investment programs to fight climate change. However, the investments themselves are not financed. The main investment programs supported by ELENA focus on the energy efficiency of cities and regions in buildings and public transport, as well as on the use of renewable energy sources.

European Energy Efficiency Fund (EEEF)

EEEF provides market-based funding for public sector energy efficiency and renewable energy projects. The fund's focus is on the smaller-scale financing needs of local authorities or energy service companies, especially in urban areas. EEEF provide funding for projects, either directly or through financial institutions. Possible support areas include the renovation of buildings, heating and cooling systems, clean urban transport and infrastructure renewal from smart networks to street lighting.

The European Fund for Strategic Investments (EFSI)

The European Fund for Strategic Investments (EFSI) offers guarantee arrangements and funding to support economically viable investments in EU. The aim is to direct the majority of funding towards infrastructural and industrial regeneration investments and to SMEs, both through loans as well as through investments through various funds. The funding available through the EFSI is also suited to joint public and private sector projects and PPPs as well as businesses' R&D projects. The EFSI does not offer grants, nor does it act as sole funder for projects. The funding provided by the EFSI aids with the obtaining of the remaining funding required for high-risk projects. In the projects, EFSI funding is combined with the project's own funding, funds obtained from other parties, and investor capital. The EFSI will support strategic investments in key areas such as infrastructure, energy efficiency and renewable energy, research and innovation, environment, agriculture, digital technologies, education, health and social projects. It also helps small start-ups expand and grow their operations by providing risk finance.

Nordic Investment Bank (NIB)

The Nordic Investment Bank (NIB) is an international financial institution owned by eight member states (Iceland, Latvia, Lithuania, Norway, Sweden, Finland, Denmark and Estonia). NIB provides loans and guarantees to private and public limited companies, governments, municipalities and financial institutions. It offers financing loans with tenors of up to 30 years to match the life cycle of the investment in infrastructure development, e.g., an airport, a road or railway link, street lighting, a hospital or school, a public transport fleet, or rolling out a mobile network.

Green bonds aka Climate bonds

The World Bank's Green bonds are intended to encourage sustainability and to support climate-related or other types of special environmental projects. Green bonds finance projects aimed at energy efficiency, pollution prevention, sustainable agriculture, fishery and forestry, the protection of aquatic and terrestrial ecosystems, clean transportation, clean water, and

sustainable water management. Additionally, they finance the cultivation of environmentally friendly technologies and the mitigation of climate change.

4.8. IS-1.3: Symbiotic waste heat networks

Baseline

District heating system.

Most of the buildings in Vaasa are connected to the district heating network owned by the City utility company Vaasan Sähkö Oy. Heat is produced mainly by a combined electricity/heat power plant (CHP) in Vaasa, and by waste heat from waste incineration plant of Westenergy Oy. Some key figures of the district heating network in 2016 are presented below.

Table 10. *Key figures concerning the district heating of Vaasa.*

Number of customers:	3 438 (2020)
Length of network:	251 km
Total amount of heat sold:	698 GWh
Price:	The heat price and the connection fees depend on the type of customer and how much heat the customer uses. An indicative price for the heat delivered, VAT excluded, is 56,00 – 57,24 €/MWh (VAT excluded). This equal is 78,00 – 79,00 €/MWh with the base charge included.

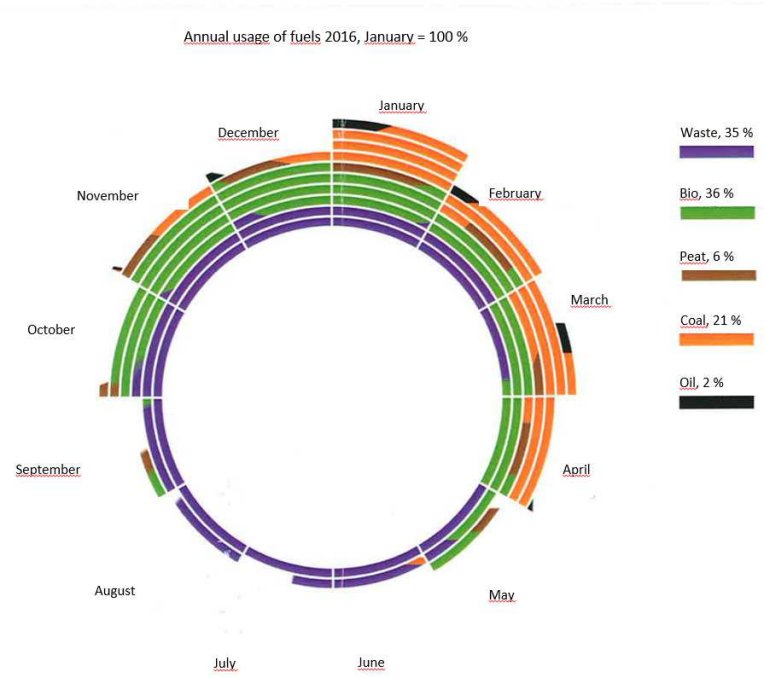

Figure 6. *Vaasa's annual usage of fuels in district heating in 2016.*

Production of district heating:

- 57% from the Vaskiluoto 2 cogeneration plant which uses biofuel, coal and peat. Coal is used for producing 9% of the district heating.
- 42% from the Westenergy cogeneration plant, using municipal waste as fuel.
- 1% from light fuel oil (peak capacity).
- 0,1% from landfill gas.

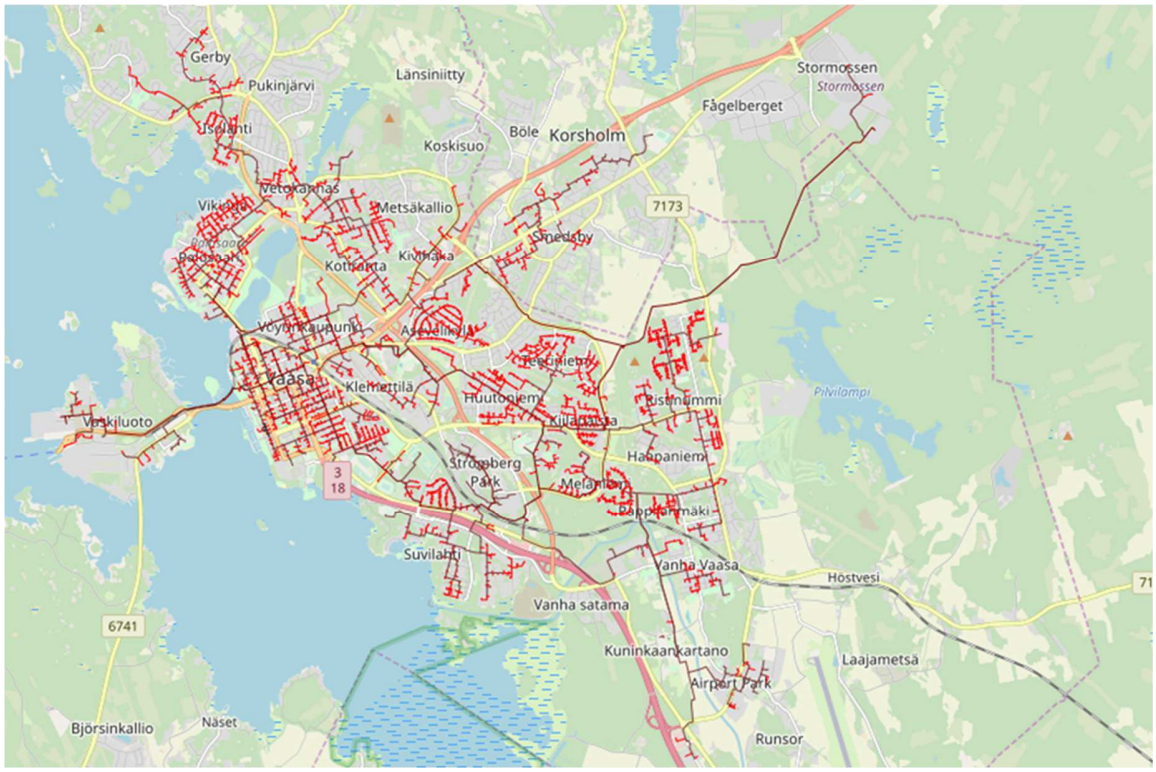

Figure 7. *The district heating network in Vaasa.*

Ambitions

The district heating network of Vaasa aims to achieve carbon neutrality in heat production by 2025.

Planning of replication activities

To achieve carbon neutrality in 2025, a heat storage's importance is paramount, making it possible to optimize the use of excess heat from the CHP plants, and integrating renewable energy and different waste heat sources into the district heating network.

In the lighthouse cities, these benefits of local energy storages - consisting of water buffer tanks, structural (thermal inertia of the building) storage, and long-term storage in boreholes - are well demonstrated in Gothenburg.

Organization of work

As the owner and operator of district heating in Vaasa, Vaasan Sähkö Oy plans and implements the development actions of the district heating in collaboration with other companies. The most important of these companies are:

- EPV Lämpö (EPV Energy Ltd) and Vaskiluodon Voima Oy, which currently produce 60% of the district heat in their CHP plant.
- Vaasan Voima Oy, which handles the heat storage located underground near the CHP plant.
- Westenergy Oy, which has signed an agreement with Vaasan Sähkö Oy, feeds the excess thermal energy produced at their waste incineration plant during summertime, into the district heating network. This heat can then be stored and utilized more efficiently, when there is a heat demand during colder periods of the year, or during power outages.
- The owner of the future large-scale battery factory to be established in Vaasa.

Barriers and drivers

- Political
  - Driver: The majority of the political parties in Finland agree on the need for reducing GHG emissions, so there is unanimous political support for initiatives helping to achieve it.
- Economical
  - Barrier: The cost of geothermal energy is not profitable compared to Vaasan Sähkö Oy's current district heating costs.
  - Barrier: The period of time between energy production investment and income generation, can prove to be a problem when making investment decisions.
- Sociological
  - -
- Technological
  - Driver/Barrier: Vaskiluoto's energy storage technology is very unique - the first of its kind in Finland. It will open new possibilities, but it can raise new kind of challenges as well.
  - Driver/Barrier: To gain maximal reduction in energy losses, and recover the waste heat optimally, the supply temperature needs to be lowered. The technology for lowering the temperature requires further investigation, and the possibility of lowering the temperature depends on the city-wide heating network, including the use of renewable energy for district heating.
- Legal / Regulatory framework
  - Barrier: Stakeholders (e.g., Vaasan Sähkö Oy) are not part of the IRIS project organization.
- Environmental
  - Driver: The energy storage provides an effective and versatile solution, when striving to carbon neutrality. It equalizes the peaks in district heating production, and enables in the long run more flexible and extensive use of wind and solar energy, and the utilization of waste heat generated in the Vaasa area.
  - Driver: With innovative solutions the district heating network takes part in circular economy by reusing and recovering the waste heat.

Specifications

The thermal energy storage is in two caves 30 meters below the ground level, near the CHP plant in Vaskiluoto.

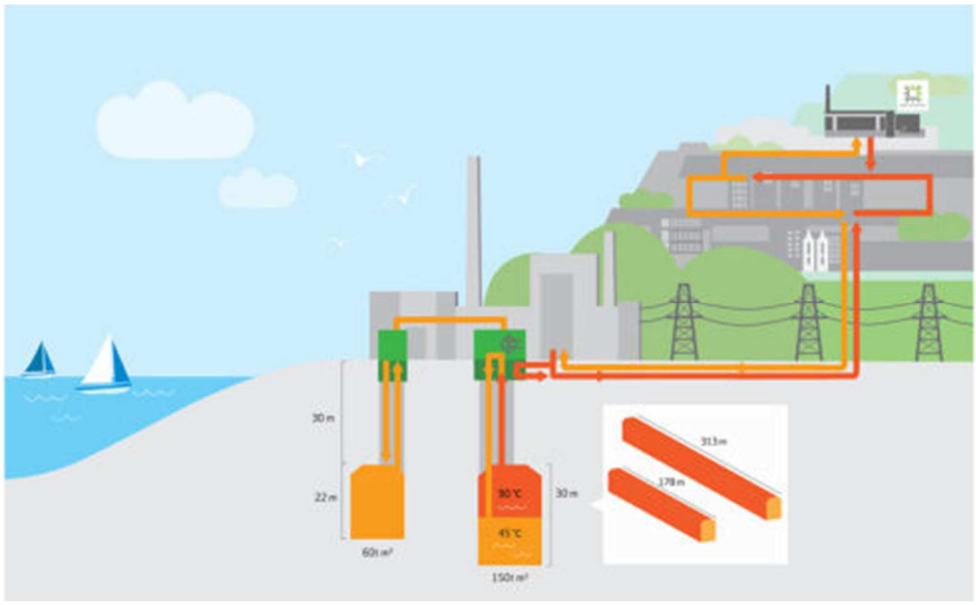

Figure 8. Basic concept of the Vaskiluoto heat storage.

Some specific details of the storage:

- The caves have a volume of 150.000 m³ ja 60.000 m³, in total 210.000 m³
- The capacity for charging and discharging is 100 MW.
- The stored energy lasts for 4-20 days depending on the discharging capacity. During the cold winter period the storage is able to provide heat for 4 days.
- The energy storage capacity is 7000–9000 MWh.
- Size: height 22 and 30 meters, length 178 and 313 meters.
- The caves were initially built during the 1970-ties for storage of fuel oil, but were emptied and cleaned in the late 1990's.
- An animation of the heat storage is available on https://www.youtube.com/watch?v=OYGLmbG9tQE
- Information on the current district heat production and energy storage is available on https://www.vaasansahko.fi/reaaliaikainen-kaukolampotuotanto/

Business model

The owners of the CHP plants, EPV Lämpö, Vaskiluodon Voima Oy, and Westenergy Oy, sell the produced heat to Vaasan sähkö, which owns and operates the district heating network with over 3000 customers. Vaasan Voima Oy operates the heat storage, buys and stores the excess heat from the CHP plant owners, and sells the heat into the district heating network owned and operated by Vaasan sähkö.

Impact assessment

The main positive impacts of the storage include:

- Increased flexibility to meet peak loads and demand variations in the district heating network.
- Increased possibilities to store and utilize excess heat from the CHP plants.
- Reduction in oil and coal usage in district heating - in coal by 30%.
- Easier to integrate renewable energy sources into the district heating.

In the future, the new energy storage makes it much easier to integrate renewable energy sources and waste heat into the district heating network. For example, the City of Vaasa is actively working for the establishment of a large-scale lithium-ion battery factory in the Vaasa region. This battery production technology is very energy intensive, shown in Figure 9 below. A battery factory of this type is likely to produce between 40-160 MW capacity of waste heat depending of its size. The new energy storage makes it easier to store and utilize the waste heat produced by the battery factory.

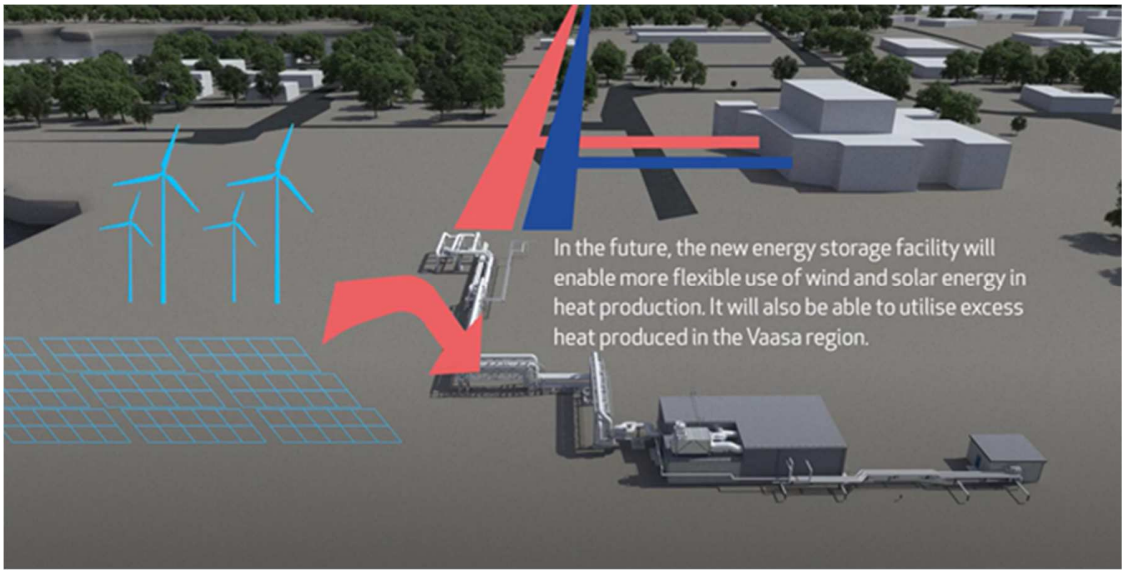

Figure 9 The new energy storage enables more flexibility and possibilities to utilize waste heat in the region

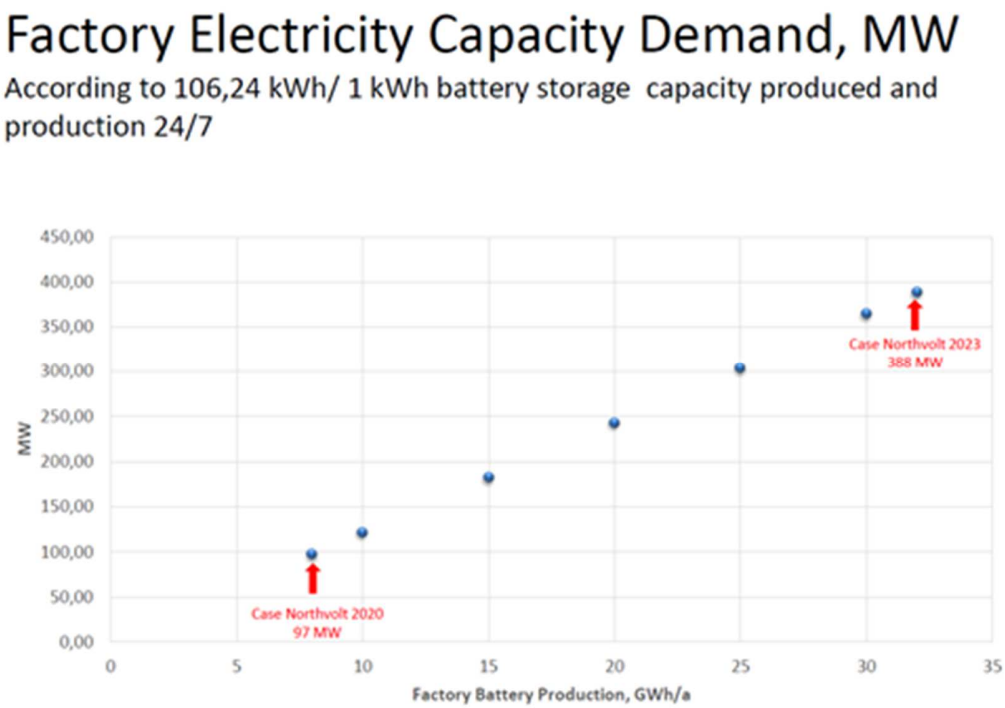

Figure 10 Energy demand for lithium-ion manganese oxide battery (LMO) factories

Implementation plan

The energy storage was constructed according to the plan and opened in September 2020.

WBS – Work Breakdown Structure & Gantt chart

The storage was constructed in 2019-2020 and will be used for the first time during the heating season 2020-2021.

Financing schemes and opportunities

The heat storage is financed by the company Vaasan Voima Oy which also operates the storage.

4.9. Conclusions on ambitions and planning of activities for TT#1 1 Smart renewables and closed-loop energy positive districts

The activities for Transition Track #1 in Vaasa aim at increasing energy system flexibility by new positive and near zero energy districts, as well as retrofitting old buildings, to be more energy efficient. Higher energy efficiency, lower consumption, and own production, will lower the energy costs for both property owners and residents. Adoption of renewable energy sources, energy storage capacity solutions for both electricity and heating, and lower self-consumption, aid Vaasa to achieve its environmental goals.

Wasa Station, the new urban event center, which is under development, will be both multifunctional complex and a pioneer in energy-efficient construction. Wasa Station will include congress and music

center, a hotel, a shopping center, apartments and a sports and multipurpose hall, making it an urban meeting place for business and leisure. The complex is designed to have an innovative and cost-effective energy system, making it virtually energy self-sufficient. The energy solutions to be utilised are, e.g., geothermal heat, solar heating and solar power.

Additionally, the new and one-of-a-kind heat storage prepared in Vaskiluoto district, will help Vaasa to achieve carbon neutrality in heat production by its set deadline, 2025. The heat storage enables more flexible utilization of renewable energy sources, shaving district heating consumption peaks and reducing peak and back-up oil and coal production in district heating. Due to the heat storage the use of coal will be reduced by 30%.

5. Transition track #2: Smart Energy Management and Storage for Grid Flexibility

5.1. TT#2 Replication in a nutshell

- IS-2.1: Flexible electricity grid networks:

Sundom district Smart Grid project, and smart grid development.

- IS-2.2: Smart multi-sourced low temperature district heating with innovative storage solutions:

Low energy network in Suvilahti district.

In addition, Vaasan Sähkö Oy will implement low-temperature district heating (DH) in the Ravilaakso district. The system is based on separate local network. The DH will be based on heat power from the waste incineration of Westenergy Oy's plant, and heat power from the Vaskiluoto's heat storage. The charging and discharging capacity of the thermal energy storage is 100 megawatts. The amount of energy stored is between 7.000 and 9.000 megawatt hours.

- IS-2.3: Utilizing 2nd life batteries for smart large-scale storage schemes:

Currently, there are no energy storage solutions in Vaasa applying 2nd life batteries. While the application of 2nd life Li-ion batteries for energy storage solutions is an interesting concept, in terms of future's energy solutions in Vaasa area, the limiting factor at the moment is the extremely low level of adoption of plug-in electric vehicles (PHEVs) and Battery Electric Vehicles aka full-electric vehicles (BEVs) in Vaasa area, and in Finland in general.

Please see more in Annex 1 for the LH cities demonstrations, which contributed to the City of Vaasa's replication plan.

5.2. Selection process

Energy Vaasa, the largest energy technology hub in the Nordic countries, encompasses the Vaasa region. Companies in the Energy Vaasa are world leaders within different technologies, such as smart electrical solutions, sustainable energy, flexible power generation and digitalization. Energy and energy knowledge are the main subjects and primary drivers in Vaasa´s development strategy. Based on the strategy, SEAP and other related commitments, TT#2 solutions are of high importance in the City's replication plan. The local energy company, Vaasan Sähkö Oy, is owned by the City of Vaasa, as is the local electricity grid owner, Vaasan Sähköverkko Oy. Both companies are committed to the implementation of projects that enable achieving the environmental goals, decided in the City's strategy. Integrated solutions are constantly studied, discussed and prioritized in detail with stakeholders. Local conditions and requirements play important role in the decision-making process.

5.3. Mapping of stakeholders

The activities within TT#2 have been discussed and prepared by the City of Vaasa, Vaasa owned district heating and electricity company Vaasan Sähkö Oy, electricity grid owner Vaasan Sähköverkko Oy, Technology Centre Merinova, the regional business and development company VASEK, and the University of Vaasa. For 2.1, ABB Oy developed automation and troubleshooting mains, and telecommunication company Anvia Oy developed data and cloud services for the electricity grid's needs.

5.4. Identified knowledge gaps

Since several Energy Vaasa Cluster companies are world leaders in smart grid technology, as well as in grid security development and solutions, there are no knowledge gaps in these areas.

The knowledge interest and needs relate to:

- Low temperature heating solutions
- Consumer flexibility solutions (storage, local multisource solutions etc)

The electricity supply in Finland has traditionally been "one way" from supplier to consumer, and the electricity price has been among the lowest in Europe. This has not encouraged flexible local solutions.

5.5. Capacity building and knowledge transfer

Knowledge transfer is best done by arranging visits for key stakeholders to the lighthouse cities and/or by arranging thematic webinars and workshops with the same stakeholders.

5.6. IS-2.1: Flexible electricity grid networks

Baseline

Intelligent and flexible electricity grids are very important concepts for Vaasa. Several Energy Vaasa Cluster companies are world leaders in smart grid technology, as well as in grid security development and solutions. Companies such as ABB Oy, Ampner Oy, Arcteq Relays Oy, BTB Plaza Oy, Comsel System Oy, Danfoss Oy, Gambit Labs Oy, The Switch Engineering Oy, Vamp Oy, VEO Oy and Wapice Oy form the very core of the cluster. They produce a variety of products for smart and flexible grids; AC drives, power converters, protection relays, switchgear, transformers, smart metering systems, monitoring systems, drive trains and electrification solutions.

Additionally, local higher education institutions (e.g., The University of Vaasa, Vaasa University of Applied Sciences (VAMK) and NOVIA - University of Applied Sciences) and active occupational training keep a keen focus on smart and flexible electricity grid operations and development. The electrical laboratories available include facilities for electrical power distribution, power transmission, power generation, electrical machine and drives, electrical automation, and for IEC 61850 electricity grid communication. The laboratories are located in Technobothnia facility, and in the Vaasa Energy Business Innovation Centre, Vebic.

Related links:

- https://www.technobothnia.fi/technical-collaboration/the-laboratories/electrical-laboratories/
- https://www.univaasa.fi/en/sites/vebic/

Upcoming amendments to Finland's Electricity Market Act, will come into effect in 2028. They will restrict the maximum limit for power outages, putting increased pressure on providers to ensure a consistent power supply. At the same time, overall energy consumption is increasing.

Technology Centre Merinova prepared and coordinated Sundom region's Smart Grid project, which was active between 1.6.2014 – 31.08.2016. The Project provided a living laboratory for testing and piloting the use of smart grid technology coupled with decentralised means of energy production, such as wind and solar power. The smart grid detected faults in the grid, and provided real-time data to the project partners through a fibre-optic network.

ABB Oy tested the Sundom automated fault management technology with four intelligent substations, which reported the network fault situations directly to Vaasan Sähköverkko`s control room, where transformer substations were also remote-controlled. The University of Vaasa explored underground cabling network automation, optimal combination of power grid security, and the economic point of view of an investment in the pilot.

Part of the smart grid pilot project in the Sundom district were 130 solar panels, which together provided a nominal power output of 33kWp, an estimated 14% of the annual consumption. The panels were installed on the local school`s roof. The City of Vaasa used solar panels to increase children's awareness of energy. Kindergarten and school children could follow how much energy the panels produced at any given time, as well as, how the electricity consumption could be affected by their own choices.

The goal of the globally unique Sundom Smart Grid pilot project was to make electricity delivery more reliable, and to establish the preconditions for solar and wind power utilization in the region's households. The project also delivered a more affordable electricity supply to residents, as well as opened up possibilities for utilizing green energy in more efficiently. Eventually, the pilot project ended, but the installed equipment had created a living laboratory in Sundom, where the research work could continue. The data collected from the smart grid is used by both the University of Vaasa and ABB's research laboratories.

Ambitions

For flexible electricity grid networks, Vaasa wants to find new development ideas, especially for the following:

- Changes and impacts of power tariffs
- Requirements for PV inverters
- Demand response
- Overall optimization of the energy system
- Second generation smart energy meters and their utilization, e.g., in demand response and low voltage network management
- Utilization of wind models, e.g., for adjacent forest management and network design
- New measurement centre solution

- FLIR (Fault detection, Location, Isolation and supply Restoration)
- Promotion of adaptive / dynamic charging systems for electric cars

Planning of replication activities

Future smart grid actions are currently being planned as a part of the Vaasa Carbon Neutral work, but no details are currently available.

Organization of work

It can be assumed that the same stakeholders, which took part in the Sundom Smart Grid project, will be interested in collaborating in new research projects, and replication activities, led by Vaasan Sähköverkko Oy.

In the Sundom pilot project the participants involved had the following responsibilities and objectives. ABB Oy developed automation and troubleshooting mains. Vaasan Sähkö Oy investigated the challenges in the producer-consumer business. Vaasan Sähköverkko Oy studied the optimal and cost-effective models for delivery. Telecommunication-company Anvia Oy developed data and cloud services for the grid's needs. Lastly, the University of Vaasa created a simulation model that examined various phenomena in the power network.

Data collection and management

Future smart grid actions are currently being planned as a part of the Vaasa Carbon Neutral work, but no details are currently available yet.

Barriers and drivers

- Political
  - Driver/Barrier: Cooperation in the field, and cooperation with authorities and policy makers, are needed in a number of areas, including clarifying the roles of the various actors in the sector. If in the future services are primarily marketed by electricity sellers or specialized service companies, then it is worth considering what solutions are needed nationwide in the area of all electricity networks.
- Economical
  - Barrier: The period between the investment and the earned income may be too long.
- Sociological
  - Driver: Studies indicate that projects with sharing of RES among neighbours, should face relatively high interest in current society, with higher bias towards younger working-class generations, denoting good potential acceptance of decentralized RES, and potential energy sharing mechanisms being achieved via thermal or electric grids.
  - Driver: Users should be able to maintain control and autonomy to decide on services themselves, without additional effort or unreasonable flooding of information. This is especially true for services that may prove to become a risk to consumers, or challenge their current level of convenience, such as services and contracts related to elasticity of demand. Thus, the contractual relationship emphasizes partnership and close cooperation with the customer and possibly also with other stakeholders.
- Technological

- Driver: A lot of the technology is mature, since it has already been tested in the Sundom smart grid pilot project.
- Driver: The data has been collected in Sundom since year 2014 by the University of Vaasa and ABB Oy, and has been used and saved for research and development purposes.
- Driver/Barrier: Maturity level of the different hardware and software related components for the setup of the ICT infrastructure to monitor and control the different assets related to the demonstration activity, are constituted mainly by market "mature" technologies.

- Legal / Regulatory framework
  - Driver: Current regulations encourage to measures improving energy efficiency, sustainability, adoption of RES and carbon footprint reduction.
- Environmental
  - Drivers: Energy efficiency improvement, carbon footprint reduction and adoption of RES, are the main drivers for the current regulations and reforms as cited in the "Law and regulation" section above.

Specifications

Future smart grid actions are currently being planned as a part of the Vaasa Carbon Neutral work, but no details are currently available yet.

Business model

The business model is mainly based on the research project, leading to the implementation of smart solutions to the electricity grid. It is necessary for the grid owner and the distribution company to be able to provide secure power supply in the changing energy environment. Whereas, for the consumer, it is in their best interest to have a possibility to pay for service, which provides energy savings and balances consumption peaks.

Governance

Activities are the responsibility of the electricity grid owner company Vaasan Sähköverkko Oy.

Impact assessment

Grid management improvement, energy savings and peak management.

Implementation plan

The implementation will follow the steps described.

1. **Re-evaluation** of the identified integrated solutions, in line with national policies, local conditions, stakeholders and ongoing research projects. The selection process of the measures to be replicated included deep assessment of the integrated solutions that are being demonstrated in LCs. Nevertheless, the potential changes in the local context before the implementation period, and the availability of valuable information mainly from the monitoring period of the demonstrations, are required to be included in this first step in the implementation plan.

2. **Feasibility study** of the selected measures has been developed, and the results are presented in this chapter. However, the feasibility study will be updated accordingly in case new data is available prior to

the implementation of each measure, including updates of the national legal framework in respect to the replication measures.

3. **Risk analysis** includes risk identification and description of the mitigation activities.

4. **Financial analysis** includes the most suitable investigation of financing schemes and opportunities being available for selection, prior to implementation of the specific measures and the preparation of an analysis. The financial analysis also includes development of a budget plan, regarding the costs estimated in the feasibility study. At this stage, the local energy company is expected to make a firm decision to implement each proposed measure, and select a targeted business model for implementation.

5. **Detailed design documents**. The local energy company will develop the technical documents required for the implementation. Depending on the complexity and innovation of the projects, detailed documents will be developed by external experts. The experts will be selected through public tender procedure.

6. **Procurement and contracting for installations**. Depending on the project, the installations are done either independently or through a public tender procedure, in order to select a suitable company. The tender documents are being developed strictly following the detailed design study of the previous step.

7. **Project implementation.** This includes the construction phase of the replication measure, including construction works and equipment installation.

8. **Commissioning**. Before starting the operation, the commissioning step's increased importance is recognized, due to the fact that the designed measures are innovative and complex.

WBS – Work Breakdown Structure & Gantt chart

No details are currently available.

Financing schemes and opportunities

The projects are likely to be financed by the participating companies and supported by national demonstration and/or research grants, but details are currently not available.

5.7. IS-2.2: Smart multi-sourced low temperature district heating (DH) with innovative storage solutions

Baseline

Vaasa has currently one near-zero energy and energy self-sufficient district, Suvilahti. It was constructed as a demonstration site for the national housing fair in 2008.

Figure 11. *Suvilahti district energy self-sufficient area.*

The key features of Suvilahti district energy self-sufficient district are:

Energy sources used

- Ground source heating extracted from the sea sediments.
- Landfill gas collected from a covered landfill area nearby.

Energy conversion and distribution

- The sediment heat collector, I.e., low-energy network, circulates the fluid to the houses through piping. Every house has its own heat pump, which is connected to the “fluid district network”. The heat pumps produce thermal heat needed for heating of the buildings.
- The landfill gas is transported through a gas pipe, to a “new energy building”, where it is cleaned and used for combined electricity and heat production with the following equipment:
  - 1 fuel cell with a capacity of 15kWe and 20kWth.
  - 2 gas micro turbines with a total capacity of 130kWe and 250kWth.
- Around 6kWe is used per heat pump in the buildings to produce 20kWth for heating, i.e., around 14 kW thermal capacity (2/3) comes from the sediment heat low-energy network, as illustrated below.

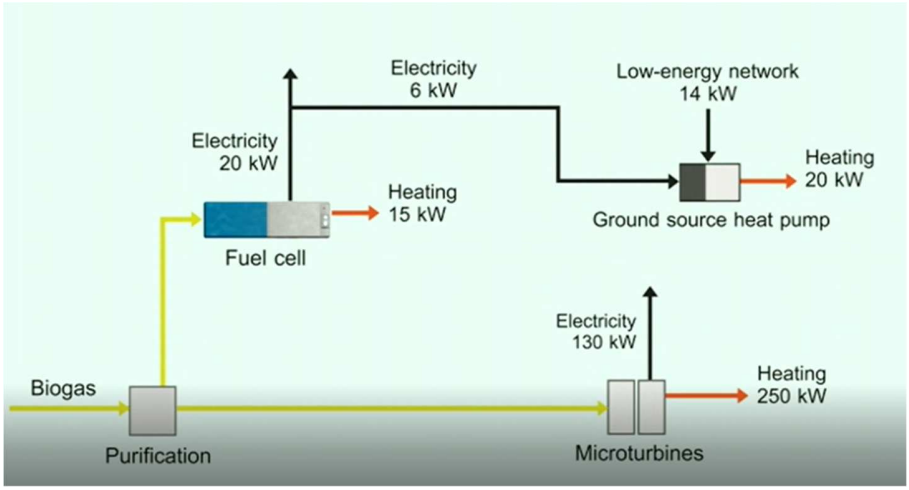

Figure 12. *Low energy network in Suvilahti district.*

The degree of energy self-sufficiency

- According to the calculations, 125% of energy is locally produced, and the area is "over" self-sufficient in terms of energy supply.

Further information and details of the Suvilahti district are available on:

- https://www.youtube.com/watch?v=yDs5Y500RlU (Video)
- https://www.techbusinessvaasa.fi/company/suvilahti-energy-self-sufficient-residential-area/

Ambitions

Vaasa's district heating network's target is to achieve carbon neutrality in heat production by 2025. In order to achieve this goal, an old underground fuel storage in Vaskiluoto has been prepared as a heat storage. The heat storage enables more flexible usage of renewable energy sources, e.g. in shaving district heating consumption peaks, reduction of peak and back-up oil and coal in district heating production. Heat, or its surplus produced with a high efficiency rate, will be stored in the facility when the need for heating is low. The new heat storage can be used throughout the year. Especially during winter, so it may not be necessary to resort to Vaasa's heating plant's oil or gas heat production, allowing reduction in the use of fossil fuels. At the same time, the use of renewable fuels and CHP will be increased. Overall, the investment in the heat storage will reduce the use of coal by 30%.

The charging and discharging capacity of the thermal energy storage is 100 megawatts. The amount of energy stored is between 7.000 and 9.000 megawatt hours, which is a thousand times larger than the storage capacity of the largest electric battery currently under construction in the Nordic countries.

Ravilaakso is a new planned residential area of 83 apartment buildings and 45 townhouses in Vaasa, which will be inhabited by 2500 people. The district is an extension to the City's current grid pattern. Ravilaakso used to be a horse race track area, before it was decommissioned in 2016. Civil engineering work began in 2019, and the construction of buildings is planned to begin in 2022. Once finished the total living area of the Ravilaakso district will be approximately 135 000 m^2.

In the developed Ravilaakso district, the aim is to achieve the highest possible level of energy independence. One of the most important environmental goals of Vaasa is to reduce the city's carbon footprint. This has to be taken into consideration, when modeling energy solutions for the Ravilaakso district. While a solution can be low carbon and cost effective in the district level, it may not be as beneficial for the whole city. A good example are solar collectors, producing renewable thermal energy. However, in the summer when the PV energy production is at its highest, there is already heat over-production at the city level, due to the operation of the waste incineration plant of Westenergy Oy.

Ravilaakso district has many challenges to be resolved during its modeling stage. The biggest restraint is the lack of available roof space for PV panels. Additionally, the needed space for ground source heat pump has not been designed yet. Efficiency of the PV can be greatly improved by implementing a smart automation and centralized electrical battery storage inside the energy community. There are no financial barriers to implement these technologies in the Ravilaakso district. By actively promoting environmental aspects during the construction phase of the district, their successful implementation can be guaranteed. This aids the City of Vaasa to reach the set climate and environmental goals.

Planning of replication activities

Low-temperature district heating (DH) will be implemented in Ravilaakso area. The whole district will be constructed in 3-4 phases. The DH will be based on heat power from the waste incineration of Westenergy Oy's plant, and heat power from the Vaskiluoto district's heat storage. Ravilaakso district's own middle-size borehole system will be designed and constructed, enabling additional heating/cooling capability and heat storage, if a business model is found viable.

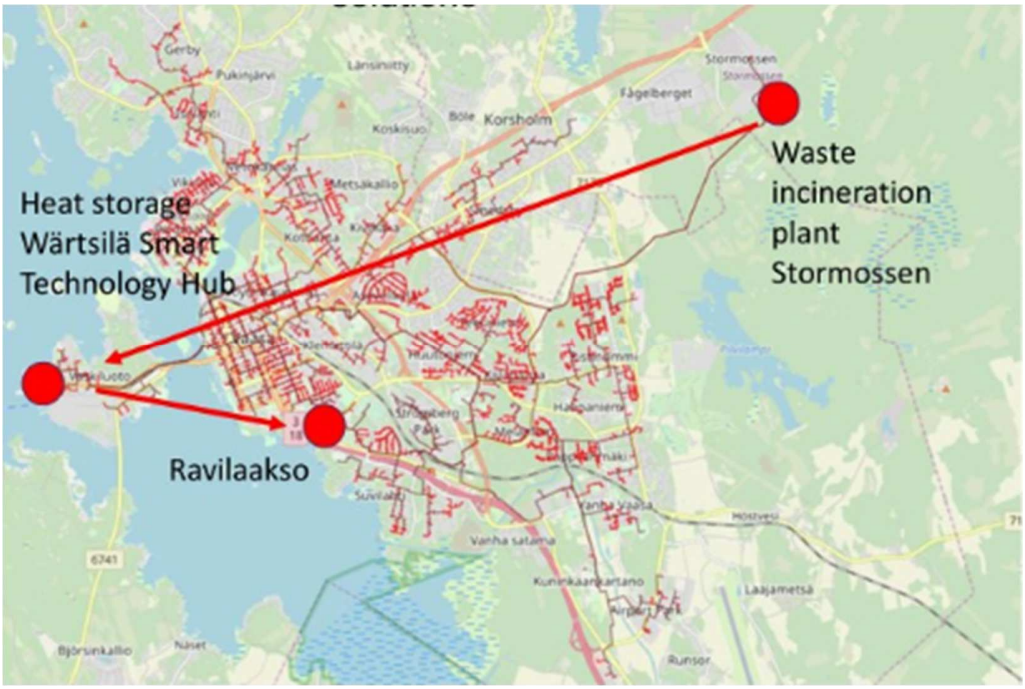

Figure 13. *Main elements of Ravilaakso's low temperature DH: Westenergy incineration plant at Stormossen, and Vaskiluoto district's heat storage.*

The construction of infrastructure's phase 1 will start in end of 2020, and the construction of the first district block is planned to start in 2022.

Organization of work

The DH system, will be built by Vaasan Sähkö Oy, being also the owner of the grid. All construction work related to the infrastructure are planned and implemented jointly by the City of Vaasa and Vaasan Sähkö Oy.

Data collection and management

No details are available yet.

Barriers and drivers

- Political
  - Driver: The strategy of the City of Vaasa, "Carbon Neutral Vaasa by 2025", sets up a strong political support and base for activities.
- Economical
  - Barrier: The cost of geothermal energy is not profitable compared to Vaasan Sähkö's current district heating costs.
  - Barrier: The long time period between energy production investment and income generation is often a challenge, when making investment decisions.
- Sociological
  - Driver: The new, modern, energy efficient and environmentally friendly Ravilaakso district will be attractive and valuable accretion to Vaasa and its citizens in general, and a pleasant and comfortable quality district for its inhabitants.
- Technological
  - Driver/Barrier: The Vaskiluoto energy storage technology is very unique, the first of its kind in Finland. It will open new possibilities, but it can raise new kind of challenges as well.
  - Driver/Barrier: To gain maximal reduction in energy losses, and recover the waste heat optimally, the supply temperature needs to be lowered. The technology for lowering the temperature requires further investigation, and the possibility of lowering the temperature depends on the city-wide heating network, including the use of renewable energy sources (RES) for district heating.
  - Barrier: Moving from the current temperature levels (90 °C on average) to a supply temperature of 60 °C, will result in lower heat transport capacities. This could be overcome by distributed pumping, but with added costs. Issues related to thermal strain in steel pipes are well-known, but their effect in maintenance are not. Most obvious barriers are the current building specific heat distribution systems, and the radiators within the buildings, compromising the old building stock. The radiator networks and heat exchangers in the old buildings are dimensioned for 90/60 °C temperatures, and replacing them during required renovations, would require thirty years timeframe, before all buildings' heating systems could have been changed. However, there is some over-dimensioning in the old radiators, thus the issue can be alleviated by increasing flow rates.
- Legal / Regulatory framework

    - Barrier: Stakeholders (e.g., Vaasan Sähkö Oy) are not part of the IRIS project organization.
- Environmental
    - Driver: The energy storage provides an effective and versatile solution when striving to become carbon neutral. It balances the peaks in district heating production, and also in the longer term, enabling more flexible and extensive use of wind and solar energy, and the utilization of waste heat generated in the Vaasa area.
    - Driver: With innovative solutions, the district heating network participates in circular economy, by reusing and recovering the waste heat.

Specifications

No details are available yet.

Business model

Presents a normal business case for the energy provider. However, when taken into account the current energy prices, the solution is not economically viable. In order to the environmental political commitments to have an impact, and CO_2 neutrality to happen, extra costs are unavoidable. Investments usually require subsidies or government funding.

Governance

The construction of infrastructure will be done as joint project with the local energy company Vaasan Sähkö Oy (electricity grid and district heating), the local water utility company Vaasan Vesi (water and sewage) and the City of Vaasa.

Impact assessment

The implementation of the Vaskiluoto district's heat storage, at the co-generation plant used in the city's district heating system, has been proved to be very efficient. It increases flexibility and security of the energy supply, and financial revenues of the district heating companies. The main advantages of the heat storage implementation in the district heating system are:

- A higher energy efficiency of fossil fuel utilization.
- Optimal, close to full load, operation of co-generation equipment.
- Reduced environmental impact.
- Electricity generation during high tariff periods.
- More stable operation of district heating networks.

A stationary battery will make an important contribution to the grid, making it more stable and resilient. Additionally, it provides important contribution to the city-wide 'virtual power/storage plant', which is being developed to provide sustainable energy, zero-emission mobility, as well as flexibility services on low and medium voltage levels.

Implementation plan

The urban plan for the Ravilaakso district is ready, and the infrastructure design is in development. The construction of the infrastructure has been planned to be take place in three or four phases, depending on the housing needs in the district. During the construction phase, the main principle is to use free areas

as temporary public spaces, thus developing participatory, co-creative approach on the district's planning, and land use. These activities are thoroughly described in TT#5 activities.

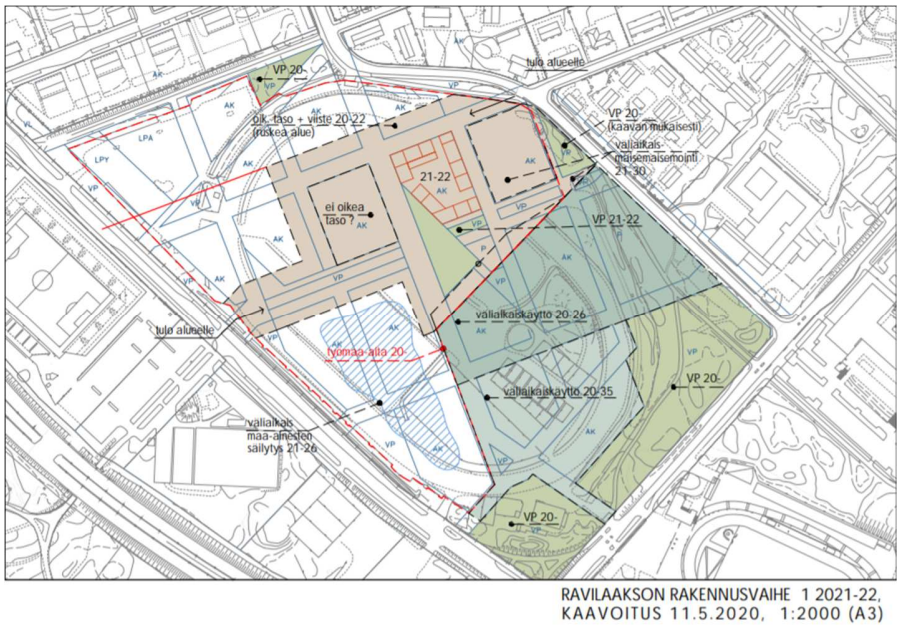

Figure 14. *Ravilaakso district's construction planning phase 2021-2022 (current tentative start in 2022).*

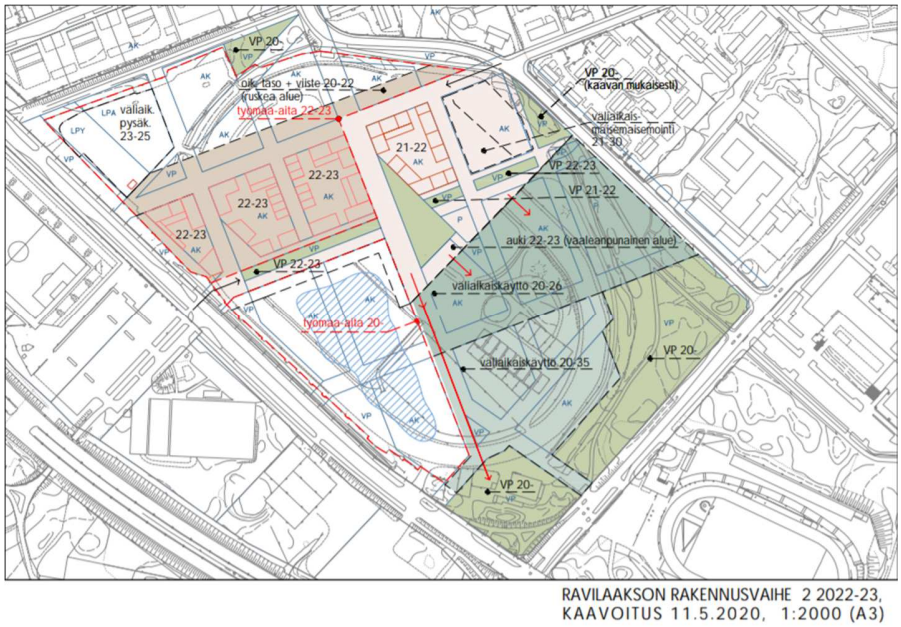

Figure 15. *Ravilaakso district's construction planning phase 2022-2023 (current tentative start in 2022-2023).*

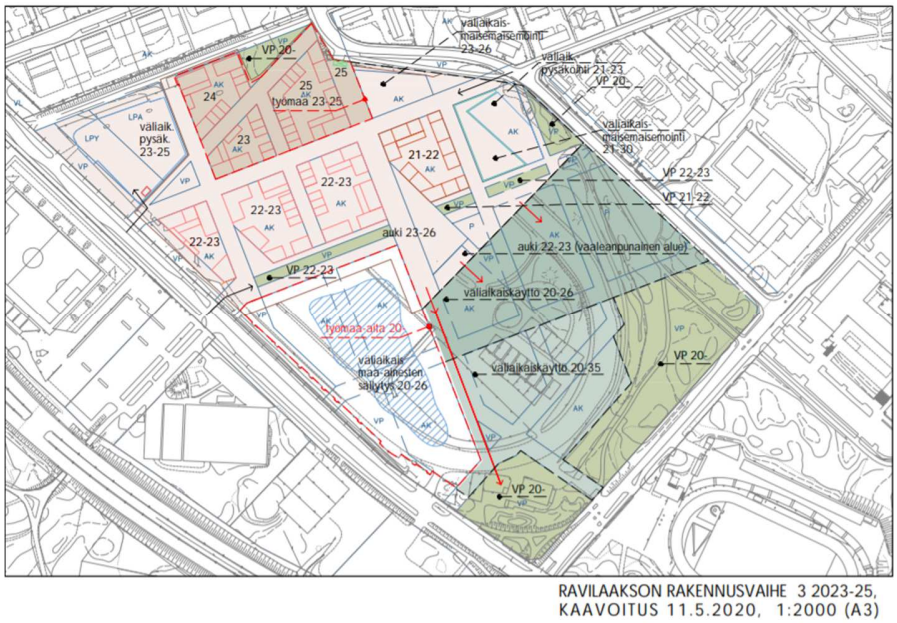

Figure 16. *Ravilaakso district's construction planning phase 2023-2025.*

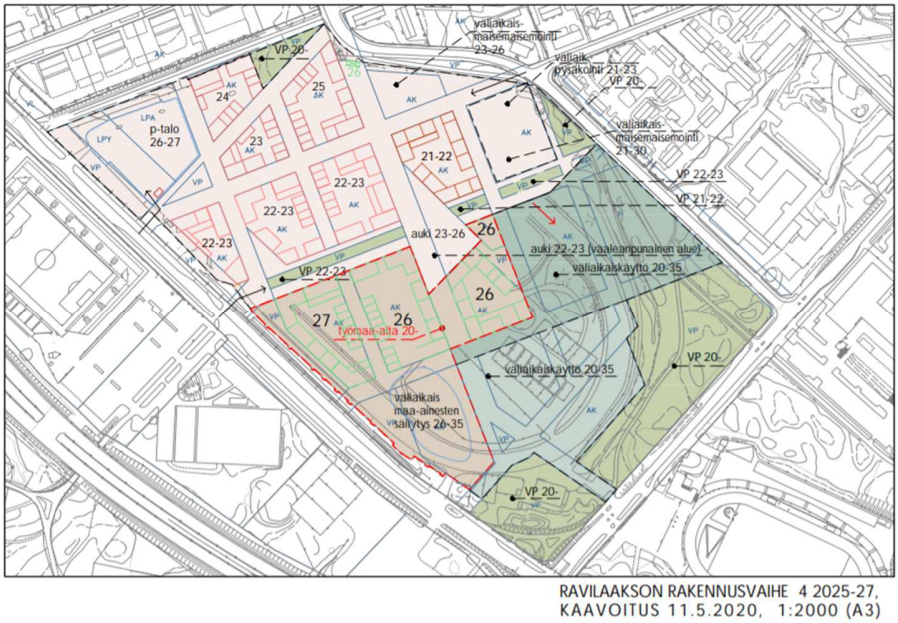

Figure 17. *Ravilaakso district's construction planning phase 2025-2027.*

Figure 18. *The first phase of Ravilaakso district's low temperature DH network.*

1. **Detailed design documents**. The City of Vaasa and local energy company Vaasan Sähkö Oy will develop the technical documents required for the implementation.
2. **Procurement and contracting for installations**. Depending on the project, the installations are done independently, or through a public tender procedure, in order to select a company. The tender documents are being developed strictly following the detailed design study of the previous step.
3. **Project implementation.** This includes the construction phase of replication measure, including construction works and equipment installation.
4. **Commissioning**. Before starting the operation, the commissioning step's increased importance is recognized, due to the fact that the designed measures are innovative and complex.

WBS – Work Breakdown Structure & Gantt chart

Task Mode	WBS	Task Name
	WBS2.2	**Low temperature DH for Ravilaakso**
	D2.2.1	Feasibility studies
	D2.2.2	Financial evaluation
	D2.2.2	Overall planning
	D2.2.3	Planning phase 1
	MS2.2.1	Budget decision 2021
	D2.2.4	Construction of 1 phase
	D2.2.5	Planning Phase 2
	MS2.2.2	Budget decision 2022
	D2.2.6	Construction phase 2
	D2.2.7	Planning phase 3
	MS2.2.3	Budget decision 2025
	D2.2.8	Construction phase 3
	D2.2.9	Planning phase 3
	MS2.2.4	Budget decision 2027
	D2.2.10	Construction phase 4

Figure 19 Work Breakdown Structure & Gantt chart for IS-2.2 projects

Financing schemes and opportunities

Normal business funding for investment, carried out by Vaasan Sähkö Oy.

The low-temperature DH is implemented as normal DH network, and therefore it is financed as normal investment by Vaasan Sähkö Oy. Financing schemes and opportunities are available, if a project includes energy storage, smart systems and smart grids. For the local energy storage described in the section 2.2., Vaasan Sähkö Oy has received funding from National funding sources.

5.8. IS-2.3: Utilizing 2nd life batteries for smart large-scale storage schemes

Baseline

At the moment there are no energy storage solutions in Vaasa applying 2nd life batteries. While the application of 2nd life Li-ion batteries for energy storage solutions is an interesting concept, in terms of future's energy solutions in Vaasa area, the limiting factor at the moment is the extremely low level of adoption of plug-in electric vehicles (PHEVs) and Battery Electric Vehicles aka full-electric vehicles (BEVs) in Vaasa area, and in Finland in general. If the situation is assessed with numbers, in the beginning of 2020 there were less than 34.000 PHEVs and approximately 6400 BEVs in use in Finland. On the national level the adoption of hybrid electric vehicles (HEV) is still far greater than PHEVs and BEVs.

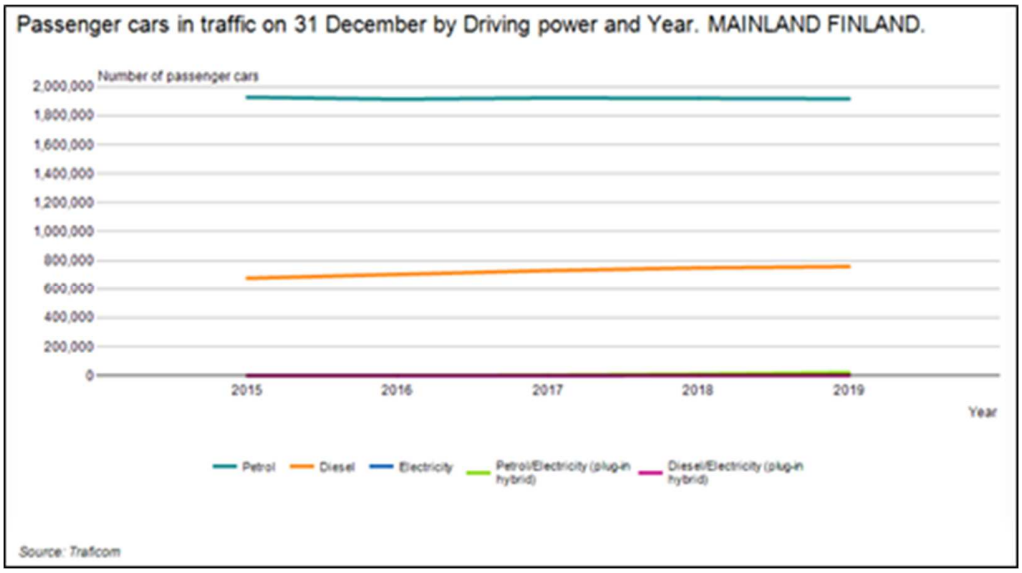

Figure 20 Passenger cars, Finland

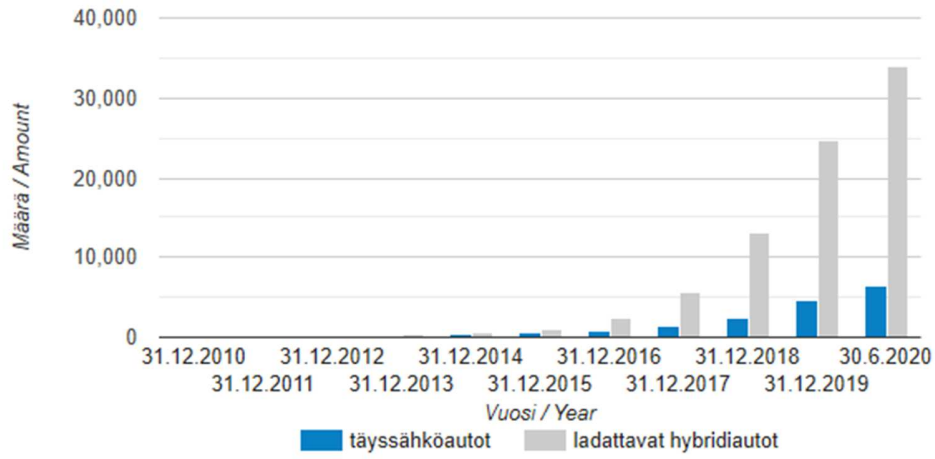

Figure 21 Passenger cars; PHEVs and BEVs, Finland. HEVs' not illustrated

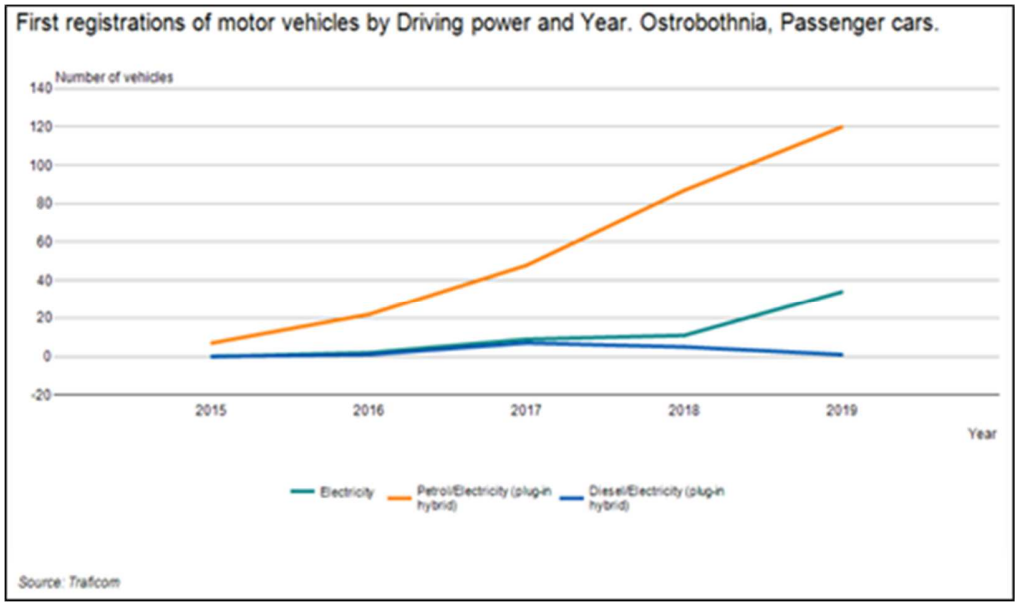

Figure 22 Passenger cars in Vaasa region (Ostrobothnia), electric and hybrid

Ambitions

Although 2nd life batteries for stationary applications are not currently, nor in near future viable for Vaasa, such energy storage solutions do present an opportunity for Vaasa region subsequently.

Planning of replication activities

No plans exist currently to replicate activities with second-life batteries. More investigation on the subject is required, and some conditions need to be in place, for this activity to develop.

Barriers and drivers

- Political
  - Driver: National and regional policies and goals support measures striving for energy efficiency, use of sustainable energy sources and solutions for energy storing.
- Economical
  - Driver/Barrier: The use of 2nd life batteries should be cheap. The expenses of the batteries largely concern the batteries' "first life". However, the LH city Utrecht's demonstration on utilizing 2nd life batteries revealed, that at the moment it is indeed more expensive to use 2nd life batteries than new ones, largely due to the lack of 2nd life battery market and experience of different solutions of utilization.
  - Driver: The utilization of the 2nd life batteries adds more length and value for the life cycle of a battery, which can benefit the battery manufacturer, grid operator and the battery owner.
  - Barrier: Investments in 2nd life batteries are not yet economically viable. Without subsidies, there are no business models for 2nd life batteries' applications. Legal and financial circumstances need to be changed.
- Sociological
  - Barrier: Knowledge of utilization of 2nd life batteries is limited and may cause prejudice.
- Technological
  - Driver: There are several potential and researched ways of utilizing 2nd life batteries: in buildings, mobility and ancillary services for the local power grid.
  - Driver/Barrier: The technology exists. However, the utilization of 2nd life battery solutions may require more investigation and research, depending on the case.
  - Barrier: The market is not mature yet for 2nd life batteries' usage in most countries. More time has to pass for EVs to increase their share of vehicles in use.
- Legal / Regulatory framework
  - Driver/Barrier: More regulatory framework is needed in the utilization and trade of 2nd life batteries, not only in national level but internationally as well. Existing regulation does not support enough the commercialization of 2nd life batteries in wider perspective.
- Environmental
  - Driver: 2nd life batteries have 8-10 years of capacity left and are environmentally safe and sustainable energy storage/source, if handled correctly. Recycling a battery after its first life is expensive, and disposal is non-environmentally friendly way.

Implementation plan

None currently, TBA. As the penetration of battery electric vehicles develops more strongly, and eventually the supply of 2nd life batteries will increase substantially from the current level, then an implementation plan will be called for.

Financial Schemes and opportunities

None currently, TBA.

5.9. Conclusions on ambitions and planning of activities for TT#2 Smart Energy Management and Storage for Energy Grid Flexibility

Vaasan Sähkö Oy will implement low-temperature district heating (DH) in the Ravilaakso district. The system is based on separate local network. The DH will be based on heat power from the waste incineration of Westenergy Oy's plant, and heat power from the Vaskiluoto's heat storage. The charging and discharging capacity of the thermal energy storage is 100 megawatts. The amount of energy stored is between 7.000 and 9.000 megawatt hours.

A local storage, or a mid-level borehole system, will be designed, when the construction of the area has proceeded enough, and there are sufficient number of residents and high enough level of consumption to make the investment feasible.

6. Transition track #3: Smart e-Mobility sector

6.1. TT#3 Replication in a nutshell

- IS-3.1: Smart solar V2G EVs charging:

Currently, there are no activities related to V2G solutions in Vaasa.

For Ravilaakso district, the new near-zero energy district discussed in IS-1.2 and IS-2.2, a fleet of vehicles for sharable use has been planned. It has been calculated, that one shared car in the district would replace six to eight personal cars (in some estimates even as many as 12-15 cars). Smart Charging is expected to play a major role in the near future, i.e., when the EV penetration rate will reach the level, where the local grid sizing and related constrains will need the adoption of more developed management system, thus avoiding negative impacts on the local, but potentially also national, grid operation.

- IS-3.2: Innovative mobility services for the Citizens:

Mobility as a Service development (EVs, public transport, cycling, walking, car sharing), and Ravilaakso district's mobility schemes.

Please see more in Annex 1 for the LH cities demonstrations, which contributed to the City of Vaasa's replication plan.

6.2. Selection process

Selection process has largely benefited from two previous projects related to mobility; Sustainable Mobility Plan for Vaasa (2019), and the Transition Arena workshop, focusing on future mobility in Vaasa.

Vehicle-to-grid (V2G) solution's analysis is carried out by The City of Vaasa, Vaasan Sähkö Oy and Vaasan Sähköverkko Oy.

During the Transition Arena, drivers, challenges and uncertainties were identified, and vision defined, focusing on four specific targets. Transition pathways were developed to achieve the set targets. Twenty-six immediate actions were identified.

Integrated solutions are studied based on their suitability for immediate actions, and possible replication in Ravilaakso area.

Figure 23. *Ravilaakso replication area shown in red.*

The Sustainable Mobility Plan determines the goals for the activities, which the City of Vaasa will implement according to available funding from the City budget, or by external funding. The activities will be planned separately and approved by the City Council, and are not presented in this report. However, the IRIS project raises possibilities for future replication, and enhances learning process.

6.3. Mapping of stakeholders

The main stakeholders for TT#3.1 are the local energy company Vaasan Sähkö Oy and the electricity grid owner Vaasan Sähköverkko Oy, being responsible for the technical infrastructure and services related to V2G solutions. In addition, a possible manufacturer of EVs, and e-vehicle owners belong to the key stakeholders. At the moment, only few vehicle manufacturers allow V2G application.

The stakeholders within TT#3 IS3.2 were identified during the Transition Arena workshop, with participants from the City of Vaasa (civil servants and board members), the University of Vaasa, NOVIA University of Applied Sciences, Regional Development Company VASEK, and Technology Centre Merinova. Smart Mobility Services are considered as an opportunity to develop new concepts, especially in densely populated urban areas, and the development will involve citizens and service providers.

The Sustainable Mobility Plan's focus is largely on activities that are the responsibility of the City of Vaasa. However, stakeholders include citizens and enterprises - the users of the infrastructure.

6.4. Identified knowledge gaps

TT#3.1's main knowledge gaps are related to consumer behavior, sustainability and economic feasibility of solutions. Even if it is possible to identify available EV stock in the region, it is not possible to identify how many of the EV owners could use the V2G service, and how the system would affect to the durability of the batteries, and for example on the guarantee provided by the manufacturer. Additionally, there is not enough knowledge about the benefits for the EV owners.

For EC2B replication (Gothenburg), the main knowledge gaps are related to the sustainability of the business model and the uncertainty of human behavior. The system is also based on complex agreements between different third parties (housing developer, platform developer and vehicle provider).

6.5. Capacity building and knowledge transfer

For TT#3.1 there is a need to improve the knowledge of the development of the V2G solutions, and what are the financing options for developing services, where customer base is very low compared to the infrastructure required. There is also need to gain more knowledge about customer behavior concerning V2G solutions.

For EC2B, the Lighthouse partner Trivector (Gothenburg) is required to take active role, to build capacity and knowledge with possible replication partners in Vaasa.

6.6. IS-3.1: Smart solar V2G EVs charging

Baseline

Vehicle-to-grid (V2G) and Smart Solar Charging solutions are closely linked to Transition Track #2, Flexible Energy Management and Storage.

Currently, there are no activities related to V2G solutions in Vaasa.

There are 18 public e-charging stations at the moment in Vaasa. Several operators exist, and the number of charging stations will be raised mainly by private operators.

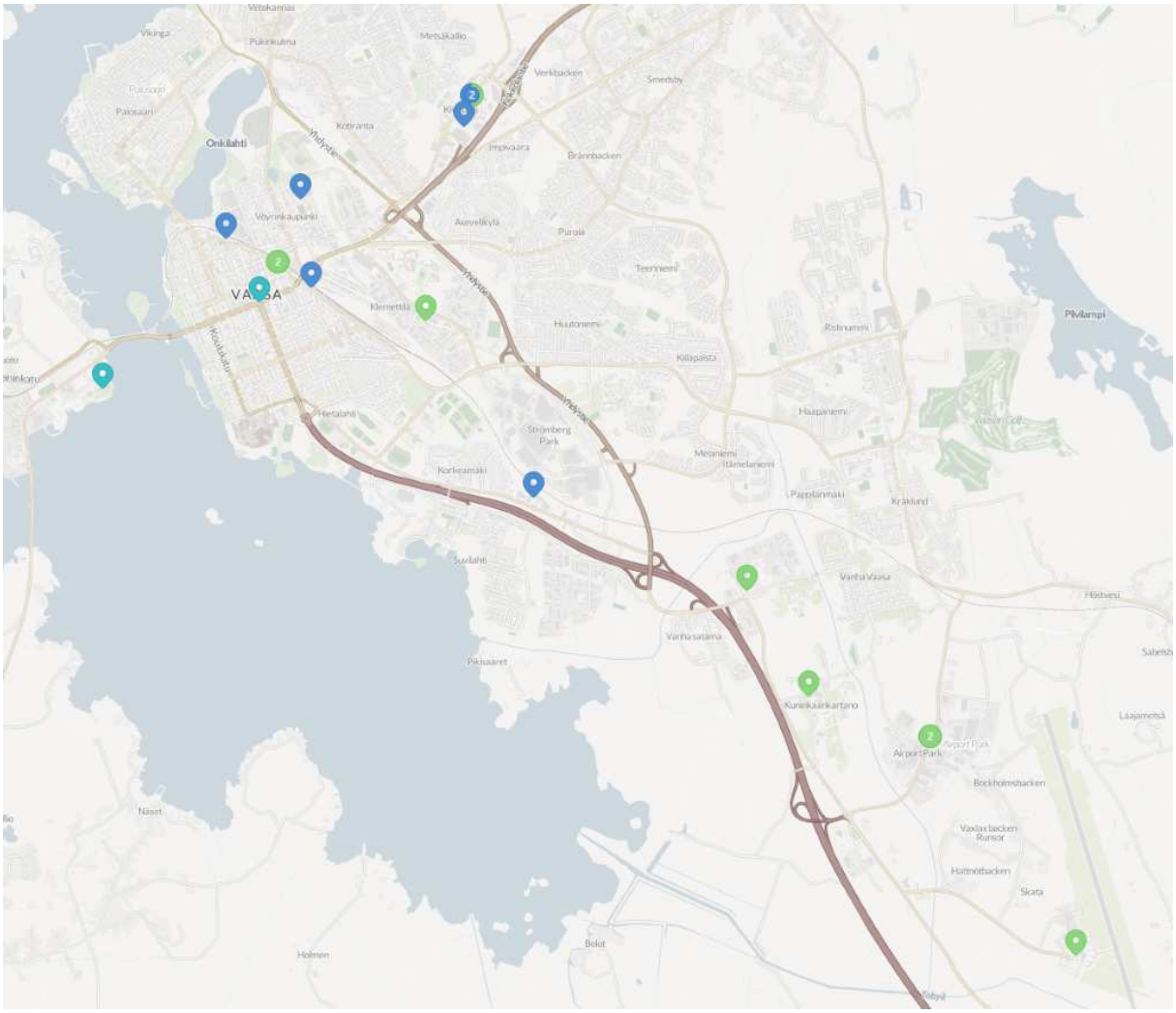

Figure 24 Location of e-charging stations in Vaasa (www.latauskartta.fi)

Ambitions

For Ravilaakso district, the new near-zero energy district discussed in IS-1.2 and IS-2.2, a fleet of vehicles for sharable use has been planned. It has been calculated, that one shared car in the district would replace six to eight personal cars (in some estimates even as many as 12-15 cars). It is still uncertain, whether the vehicles will be EVs, although there is a good possibility for it.

Smart Charging is expected to play a major role in the near future, i.e., when the EV penetration rate will reach the level, where the local grid sizing and related constrains will need the adoption of more developed management system, thus avoiding negative impacts on the local, but potentially also national, grid operation.

The following graphs illustrate the development of photovoltaic generation connected to the distribution network of Vaasa Sähköverkko Oy. It can be assumed, that the PV generation capacity can exceed the minimum electricity demand in the grid even before 2030. According to the same estimation, the total

capacity of PV generation will be approximately 60 MWp, while the minimum average hourly capacity of the network has been about 50 MW in the current situation. However, not all production facilities are likely to produce their full capacity at the same time.

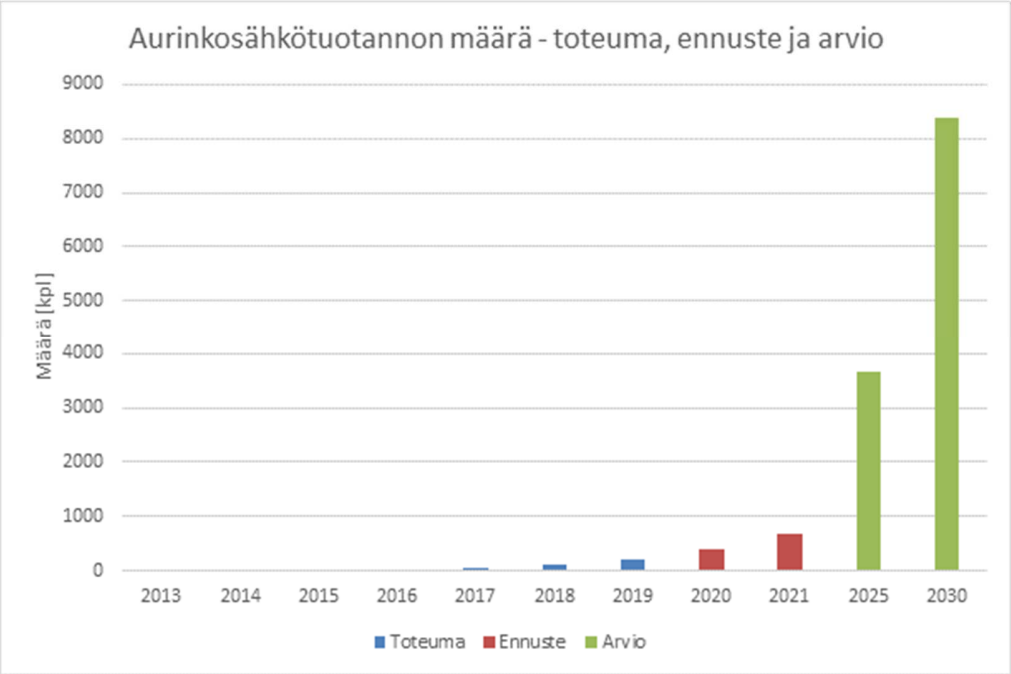

Figure 25 Photovoltaic production quantity: actual, forecast and estimate

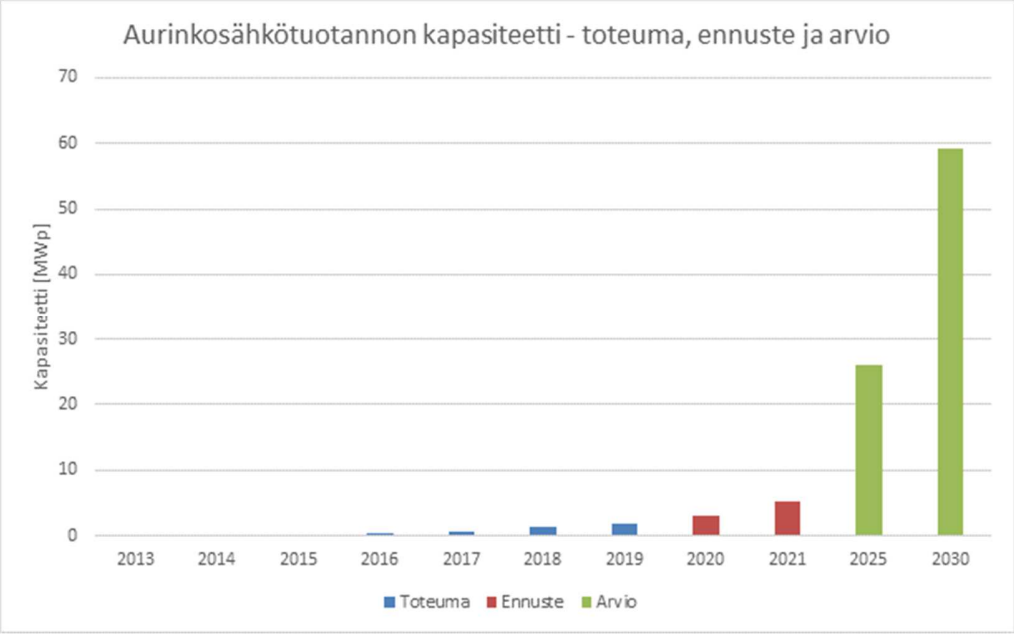

Figure 26 Photovoltaic production capacity: actual, forecast and estimate

Planning of replication activities

Currently the are no plans to implement IS3.1, due to the fact that the demand for smart solar V2G EVs' charging is negligible in Finland in general, and there is no service available for shared e-vehicles. However, when viable business model/-s shall eventually emerge, planning of the V2G replication can continue. Demonstration in Gothenburg, related to e-buses and their charging system (V2G), could be replicated later after the project period, if the City of Vaasa will invest in e-buses.

Barriers and drivers

- Political
  - Driver/Barrier: EU expresses a strong political commitment towards electrifying transportation. However, the City of Vaasa has already made an investment in biogas buses, and required infrastructure for local bio fuel production.
- Economical
  - Driver: V2G enables attractive mean for economical profitability, concerning the grid operator, aggregators and service operators, and the EV owner.
  - Driver/Barrier: In order to utilize EV batteries in the existing energy system, a new implementable and lucrative business model has to emerge. This could be in the form of price bonuses, instead of the conventional EV charging tariffs.
  - Barrier: Electric vehicles are more expensive than IC and diesel-powered vehicles. E-buses demand charging infrastructure, for example fast charging stations at each endpoints of the route. These stations can be very expensive, requiring smaller size/volume of batteries with very high storage capacity. Well-functioning, effective and full electrification of the city bus fleet, requires fast charging infrastructure manageable in size as well.
  - Driver/Barrier: The investment cost of a bidirectional adjustable charging system is higher than G2V system. However, it is the most cost-effective and economically profitable alternative once utilizing V2G in full extent becomes widespread.
- Sociological
  - Barrier: User acceptance of smart charging still this day, can prove to be a barrier. For many of the end-users such a service, and their awareness of its full potential, requirements and effects, can be relatively limited. To increase this awareness is highly important for citizen engagement.
- Technological
  - Driver: In general, no major technical barriers are to be expected, since the technology is already available.
  - Driver: V2G operating model enables EVs to be utilized as distributed storage system for the grid, and in various ancillary services, e.g. peak shaving, load shifting, voltage and frequency control, energy arbitrage etc., providing more flexibility for the power grid.
  - Driver/Barrier: As the number of EVs increases, it is important that the charging activity and infrastructure are controlled intelligently, to avoid power peaks, and the need for additional power caused by charging. Components for implementing smart charging at the property level already exist, but at the higher grid network levels. Smart charging has not yet been demonstrated in public use in Finland.

- Barrier: However, for V2G solutions, only a few vehicle manufacturers exist currently, who allow the use of EV batteries in the V2G operating model. Many of the available EV models, and charging infrastructure models, have too low technical performance and capacity, to manage detailed V2G schemes.
- Barrier: The main identified technical barriers are related to the power infrastructure required to be in place for electric charging stations, compatibility of the charging stations with local power network, and availability of power in the local network.

- Legal / Regulatory framework
  - Barrier: More defined, detailed and well-constructed regulatory framework is required, and will be done as V2G schemes become more current.
- Environmental
  - Driver: The rising number of EVs and reduction of fossil fuel driven car in the traffic, lead to reduction of CO_2 emissions, improvement of local air quality, and reduction of noise levels.
  - Driver: The contribution EVs have to the reduction of air-pollution, might convince citizens to favor the adoption of e-mobility and shared transportation, such as shared EVs.

Citizen engagement

The main challenge is to stimulate citizens to change their habits of using private cars, and start actively promoting and utilizing a smart car sharing system instead. Private car ownership and private car commuting are very common in Vaasa. The replication of IS-3.1 should be combined with the replication of IS-5.1 “Community building by change agents”, further described in section 8.1.

Impact assessment

Electric vehicles and Mobility as a Service (MaaS) reduce consumers' carbon footprint and offer new types of business opportunities. The energy storage system provided by e-cars’ and e-buses’ V2G solution, combined with smart energy and charging management, have the potential to aid, or even optimize the energy self-consumption of buildings, reduce grid stress, and unlock the financial value of grid flexibility.

Implementation plan

A plan will be prepared, after the development of proper V2G systems becomes clearer, and enough information about suitable business models and technical requirements are available. Even for a local pilot project to be made, more research is required.

6.7. IS-3.2: Innovative Mobility services for the Citizens

Baseline

The Finnish government has set a national target to reduce emissions from traffic by 50 % by 2030 from the 2005 level. Based on national policies, the City of Vaasa decided on the Sustainable Mobility Program in 2019. It reviews the City’s strategies related to transportation, mobility and related infrastructure. The program aims to develop guidelines and solutions for modes of everyday sustainable transport in Vaasa and clarify the measures to be taken with traffic, so that Vaasa can achieve carbon neutrality before 2030. The program was developed in close cooperation with stakeholders (WSP Finland Oy & Traficom), and it has strong focus on citizen engagement.

The Sustainable Mobility Plan defines the vision, objectives, interventions and reporting system for mobility in Vaasa, thus providing vital information about which, how and when the IRIS solutions could be replicated in Vaasa. The development of the Sustainable Mobility Plan was preceded by Transition Arena workshop, which concentrated on mobility issues in Vaasa region. The workshop was carried out by BothniaTM project, funded by the European Regional Development Fund (ERDF), the City of Vaasa and the University of Vaasa. One objective of the BothniaTM project was to identify stakeholder and citizen engagement's importance, who can act as "change agents" for the community, and being part of the Transition Arena workshop as well. This activity can be referred to the IRIS integrated solution "Community Building by Change Agents" demonstrated in Utrecht.

The baseline is defined before any interventions has been made, which again make it possible for any measures of the impacts of the interventions to be made. Assessment of the baseline is a very important step in any project or transformation process, since without it, it is not possible to determine where and what improvements are needed, and what level of improvements or transformation have been achieved as a result of the intervention.

Each of the transition tracks' baseline include descriptions of the practice prior to the interventions. In some cases, if there is no prior state (e.g., in the case of a new building), reference data (e.g., average values for existing buildings, or values stipulated by law, regulations, standards or city databases with statistics of demo area) will be used.

Traffic is the second biggest source of CO_2 emissions in Vaasa, consisting of 29% of emissions outside the trading sector. The other two main CO_2 sources are district heating 50% and consumer energy consumption 13%. In the close future, traffic will be the biggest source for CO_2 emissions, when the political decision to ban fossil fuels in heating will come fully into effect, and the energy efficiency of living will increase. To achieve a dramatic reduction of traffic related CO_2 emissions, various new methods of technology and emission mitigation are required.

Some of Vaasa's challenges are that the number of vehicles per person is high (630 vehicles per 1000 persons) and the share of vehicles using alternative fuels or powering technology is too low. However, several positive steps have been taken. New biogas buses, and rising number of charging stations enabling the growth of EVs' share in traffic, have been put to use. The City of Vaasa has built an ecosystem for local biogas production and purchased 12 biogas buses for the city's internal transportation service. Additionally, new bus routes have been developed, in collaboration with Vaasa region's biggest employing companies, and not forgetting engaging the citizens.

Public Transport

Vaasa's internal public transport is been organized by diesel and biogas buses. Currently, approximately 1.2 million trips are done in Vaasa by public transport annually. Based on the BothniaTM project, this amount is planned to be doubled by 2025 and quadrupled by 2035.

Cycling and E-scooters

The share of cycling in Vaasa is only 12%, but there is a huge potential to increase it, since distances are short, the terrain is relatively flat, and the number of students, who utilize bicycles a lot, is approximately 13000. Nearly 80% of the citizens of Vaasa live within cycling distance, which is maximum of 5 km from

the city's center. In 2018, a bike sharing system was tested in the city center and on the Vaasa University's campus area with positive results. Additionally, one can rent an electric scooter in Vaasa. This service was introduced in 2020, and it has quickly gained popularity.

(Rekola bikesharing: https://www.rekola.eu/finland/about)

(TIER Electric Scooters: https://www.tier.app/fi/)

Coordination of activities

Unfortunately, a lack of common, integrated approach and strategy, aiming to achieve low-carbon mobility exists in Vaasa. There are several overlapping strategies, policies, programs, projects, studies, and activities related to mobility and transport without proper coordination, prepared by the City, local Universities and private organizations, which proves to be a challenge. However, there are good examples as well. The City of Vaasa, Vaasa Region Development Company VASEK, the University of Vaasa, and the Center for Economic Development, Transport and the Environment (ELY) implemented MoveIT, *Low Carbon Dioxide Transport Services in the Vaasa Region by 2030* project in 2019. The project was funded by *Pohjanmaan liitto* through EAKR-funding and local ELY, the City of Vaasa and the Municipality of Mustasaari. The project prepared an analysis of the current situation, and vision for the public transport and other mobility solutions in the Vaasa region. The focus of the report is Mobility as a Service, and the development of the mobility chains in the Vaasa region. The report provides a baseline for most of the issues related to in IRIS Transition Track 3, Smart e-Mobility sector.

A research about technical view of the mobility and transportation, *Sustainable Mobility Plan in Vaasa Region,* is carried out in collaboration with the University of Vaasa and Technology Centre Merinova.

Ambitions

Organizing a market based public transport in Finland is challenging, due long distances and the difference in the sizes of the cities. Smart mobility services are considered as an opportunity to develop new concepts, especially in densely populated urban areas.

Vaasa is aiming to improve the service level in the mobility sector, mainly in public transport, improving the cost and resource efficiency. The target is to receive cheaper unit cost for the services and better utilization degree most efficiently. One of the main objectives is shared transport system, which also includes the use of bicycles and e-scooters. For shared transport system, the main tool is system monitoring on data and devices connected to the transport service system. Further development of e-mobility and use of biogas buses in the local city transport are also main the objectives for the Vaasa´s logistic plan.

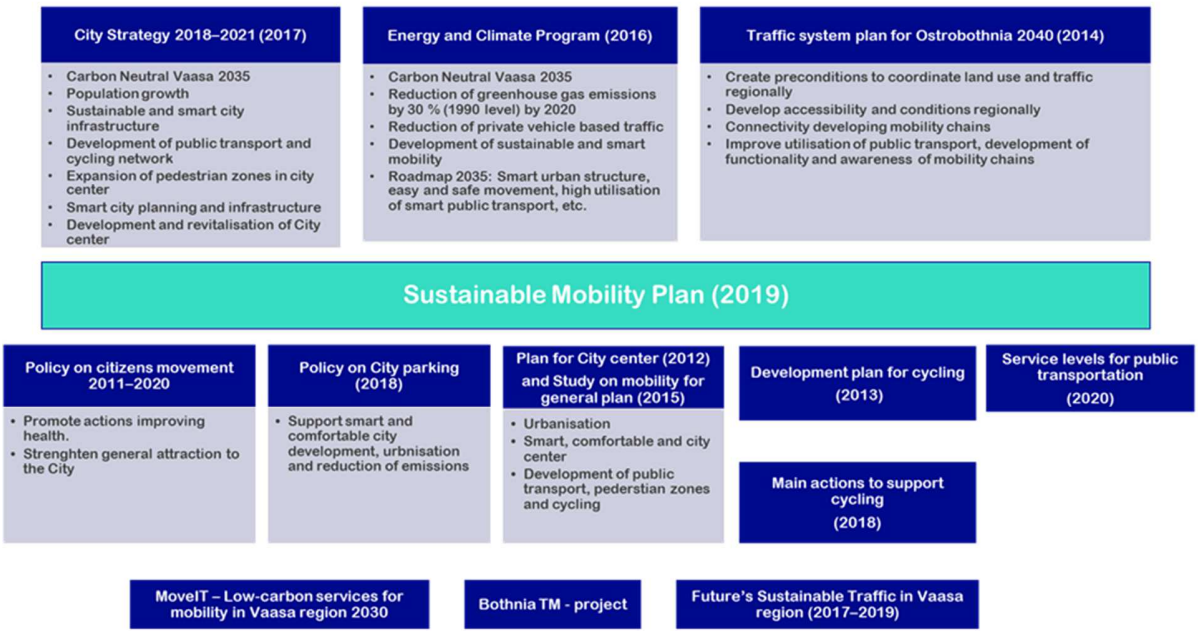

Figure 27. *Vaasa's strategies, policies, plans and programs related to carbon neutrality goals and sustainable transport.*

The BothniaTM project, funded by EU, the City of Vaasa and the University of Vaasa, has held series of workshops during 2018 and 2019, about the future mobility. As a result, the Vaasa Transition Arena workshop delivered the following key messages about the city's, users' and citizen's needs:

1. Public transport ridership should be quadrupled until 2035.
2. The cycling modal share should be tripled until 2035.
3. Traffic emissions should be reduced by 90% until 2035.
4. Coordination of planning should be taken to a new level.
5. Increase the energy capital visibility in Vaasa's daily life.
6. Give low-carbon solutions the highest priority in infrastructure development.
7. Put sustainable commuting/mobility on organizations' agenda.
8. Use Transition management methods and tools to larger extent.
9. Reduce the number of cars in public space and reduce the number of km driven.
10. Increase the utilization rate of a shared car and public transport and increase revenues.
11. Reduce CO_2 emissions.
12. Reduce the need to build expensive underground parking spaces.

Planning of replication activities

The Sustainable Mobility Plan includes over 20 activities for years 2019-2022, related to improving infrastructure for cyclist, pedestrians, public transport etc., that are outside the IRIS implementation and replication. However, more than ten activities are linked to the IRIS demonstrations, and possible replication or lessons learned from Lighthouse cities, which can be re-evaluated during planning or implementation.

Table 11 Plans for replication activities (TT#3)

Activity	Implementation planned	Description	Possible replication
Plan to develop mobility hubs	2019-2020	Development of hub for mobility services and connections to districts	
Sustainable Mobility Plan	2019	Strategic document based on City Strategy	
Development of the city centre for pedestrians	2019-2021	Support innovative initiatives. Increasing pedestrian zones in the city centre	
Data collection	2019	Data collection and system available on city web-site	Data platform TT#4
Specific budget for cycling	2020	Financing plan mobility	
Development of parking facility plan for cycling	2020-2021	Plan on parking facilities	
More efficient and flexible use of public spaces	2020	Co-operation and easy access to public spaces. Shared parking places	Co-creation and citizen engagement TT#5
Improving public image of public transport	2020	Co-creation with citizens, service provides	Co-creation and citizen engagement TT#5
Improve conditions during winter season for cycling paths and pedestrian zones	2020-2021	Service levels and main network for cycling and pedestrians	
Develop use of public spaces	2020	Safety, co-creation and quality definitions for public spaces	
Annual plan for communication on sustainable mobility	2020	Plan for communication, goals, stakeholders, KPIs, budget	Co-creation and citizen engagement TT#5
Project to improve existing cycling paths	2020-2030	Improvement of existing cycling paths	
Digital services for mobility	2020-2021	Real time service on public transport, piloting platform for different applications, payment systems and services related to mobility	Services for smart mobility TT#3, Data platform TT#4
Improve awareness of healt and environmental aspects	2021	Communication on activities and impacts	Co-creation and citizen engagement TT#5
City train connection between harbour - Vaasa city centre -	2021	Facilitate connection and required investment	

airport - City of Seinäjoki			
Procurement or subsidies to e- or biogas buses	2021	Implement EU decisions on procurement	TT#3 IS3.1 E-buses and charging systems
Development of public transport	2021	Improve services, smart solutions, quick connections etc.	
Planning of new cycling routes and priorities	2021 - 2022	Update city centre plan, pilot for new cycling path in city centre, planning and implementation plan	Co-creation and citizen engagement TT#5
Vierasvene laituri (connection to the archipelago)	2021	Improve connections to Vaasa archipelago for small boats	
Participatory planning and budgeting	2021-2022	Co-creation and engagement of citizens for planning and budgeting	Co-creation and citizen engagement TT#5
Awareness of smart energy and mobility solutions	2022	Subsidies and guidance to housing associations on sustainable mobility and energy efficiency (e-vehicles, charging systems, shared vehicles, e-bikes, mobility services).	Services for smart mobility TT#3
Pilot on public-private partnership in new housing construction projects	2022-2027	Improve quality of housing areas and related outdoor spaces, e-vehicles, shared vehicles, e-bikes, charging systems, mobility services. Model to measure benefits	TT#2, TT#3, TT#5
Awareness for employers and private enterprises for sustainable mobility	2022	Awareness, co-creation and engagement to facilitate mobility plans for private sector employers	Co-creation and citizen engagement TT#5
Development of safety, accessibility and quality related to pedestrian zones and cycling paths	2022	Functioning network including green zones	

Replication from LH Gothenburg VivaBf/EC2B demonstration is under more detailed scrutiny, to be utilized for a new housing construction in Ravilaakso district. This planned project is part of activity described in Sustainable Mobility Plan's "Pilot on public-private partnership in new housing construction

projects". EC2B platform model could also be used in other new housing construction projects, as well as, in other housing associations, and public housing companies.

Organization of work

Most of the activities related to the Sustainable Mobility Plan are the responsibility of the City of Vaasa. However, local citizens and biggest employers have to be included in the planning of activities and replication.

Public-Private partnership project is a collaborative project with, e.g., Yrjö and Hanna Foundation (social housing), construction company, Software/Platform provider Trivector, a company providing shareable e-vehicles, e-bikes facilitator, electricity grid owner Vaasan sähköverkko Oy (charging stations) and the City of Vaasa. The concept can be replicated to other construction project.

Data collection and management

Table 12 KPIs based on the on the Sustainable Mobility Plan

KPI	Source	Baseline	Goal
CO_2 emissions (kt CO_2-ekv)	CO_2 report	66,8 (2019)	Reduce CO_2 emissions, carbon neutrality
Vehicles according to sustainable fuel sources	Traficom statistic	1,2% (9/2019)	Reduce CO_2 emissions, carbon neutrality
Usage of local public transport (1 million travellers/a)	Ticketing system	1,229 (2018)	Improve the service of public transport, increase the number of travellers
Number of cyclist (total annual)	Automatic calculation points	-	Improve cycling activity and conditions
Citizen approval	Questionnaire		Citizen engagement
Air quality NO2 amount annual average (microgr/m3)	TEA-indicator	74 (2019)	Improve air quality
Low-carbon fleet in public transport (%)	The City of Vaasa	50 % (2019)	Improve public transport and reduce CO_2 emissions

Barriers and drivers

Table 13. *Possible challenges/risks and their relevance.*

Challenge/Risks	Relevance	Mitigation measures
Decision-making involves different stakeholders, public and private actors	High	Integration of activities
Easy use of private vehicles	High	Improve knowledge, engagement
Operations/Functionality of local public transport	High	Improve knowledge, engagement
Lack of common vision	High	Improve knowledge, engagement
Public opinions	High	Improve knowledge, engagement
Funding for investments	High	
Safety and accessibility for cycling and pedestrians	Medium	Improve knowledge, engagement
Direction of technical development and impact on behavior	Medium	Accessibility, engagement
Long-term continuity of political commitment	Low	Improve knowledge, engagement
Role of local city administration	Low	Improve knowledge, engagement
Equality and education	Low	Integration of activities, citizens engagement and co-creation, co-operations with schools etc.

- **Political**
  - Driver: The City of Vaasa is committed to reach carbon neutrality by 2030. The aim set earlier for 2020, was to reduce CO_2 emissions by 30% compared to 1990 level. Vaasa's population is growing steadily, setting requirements for future's accommodation needs. Large part of this growth needs to be accommodated within the current city boundaries. This will be carried out through more compact building, increasing the number of homes per km2. Simultaneously, the city center is required to stay attractive and comfortable, and to be developed to meet the needs of the growing number of inhabitants.
  - Driver: The City of Vaasa is also working proactively, to promote the development of Mobility as a Service (MaaS) concept. The City will apply lower parking norm in new development areas, where property developers are able to make new arrangements for mobility services, such as vehicle and bike sharing.
  - Barrier: Curtailing private car ownership, or private car mobility, are sensitive political issues. Hence, politicians may try to delay or avoid of making such potentially unpopular decisions.
- **Economical**
  - Driver: MaaS connected to accommodation can reduce costs for property developers, as it might reduce the number of parking lots they need to provide, or building expensive underground parking garages. It can also lower mobility costs for users, if ownership of a car becomes unnecessary. For mobility service providers, it might attract new customers.

  - Barrier: It is challenging to find a business model that viable for all actors involved in MaaS solution. Developing and maintaining the digital platform requires investments and capital. For some mobility-service providers it may prove to be difficult to find sufficient amount of capital to fund planned sturdy MaaS solution on all levels.
- **Sociological**
  - Barrier: To stimulate citizens to change their habits of using private cars, and start actively promoting and utilizing car sharing system or public transport instead, or switching from IC powered cast to EVs. One's ability to own and use one's own car is often considered as an ideological right.
  - Barrier: As the service to be developed in this case (Maas and EC2B) is primarily aimed at newly built housing projects, it is mainly offered to economically privileged groups.
- **Technological**
  - No technological barriers are to be expected, since technology is already available.
- **Legal / Regulatory framework**
  - Driver: For new construction areas, the City of Vaasa will apply lower parking norm, e.g., parking-spaces that need to be reserved per dwelling. The city is preparing pilots projects on how to actively stimulate the development of MaaS concepts, by reducing parking places, which will be required if MaaS concept is utilized. However, the urban plans and building regulations define how many parking lots are required in different buildings areas. Any exceptions are decided during the permitting process.
- **Environmental**
  - Driver: Improved services should lead to reduction of the CO_2 emissions, improvement of local air quality and reduction of noise levels.

Specifications

The Yrjö and Hanna Foundation is a non-profit party that is responsible of designing ARA rental apartments (2 apartment buildings) for seniors in the Ravilaakso welfare city block. Car sharing is part of the plan, and the Foundation is aiming for 1-2 e-vehicles for the welfare block. Y&H will act as the landlord, the owner of the block, and a total of 103 apartments will be built on the block, guaranteeing good conditions for shared vehicle use. Additionally, Y&H Foundation will provide a number of e-bikes for its block. The provider of the EVs and e-bikes is Y&H Foundation's decision.

Ravilaakso district has big ambitions for shared cars in general. The City of Vaasa has negotiated one block with Lakea Oy, a constructor and construction project developer, which also intends to acquire a few shareable cars for the area. They may be located in a parking facility in the area.

Citizen engagement

For EC2B replication, Yrjö & Hanna Foundation (*Säätiö*) will engage its residents in early stages, via marketing and advising the use of services available when residents are in the process of moving into the district. The replication of IS-3.2 should be combined with the replication of IS-5.1 "Community building by change agents", further described in section 8.1.

Business model

The business model for EC2B in Ravilaakso has not yet been settled in detail. However, the housing foundation will need to construct less parking places than normally required by the building regulation. In

average, one parking place can cost from several thousands to tens of thousands of euros. In addition, the inhabitants can get more services related to concept developed, e.g. e-bikes, e-scooters, phone application. This platform can also be used for managing and booking other shared resources. The application and platform developer will get access to new markets for its products, and possibility to further develop its business. Raavilaakso districts mobility plan also requires providing shared vehicles, e.g. cars, bikes, e-scooters etc., generating profit for the service providers. Additionally, the City will benefit financially from increased utilization of public transport, from ticket sales.

Most of the other possible replication activities related to the Sustainable Mobility Plan are done by the City, and are dependent on the local budget.

Governance

The project is based in EC2B service, which involves several actors, users and providers; end-users, housing foundations, mobility service providers etc., to develop high quality and more sustainable mobility services.

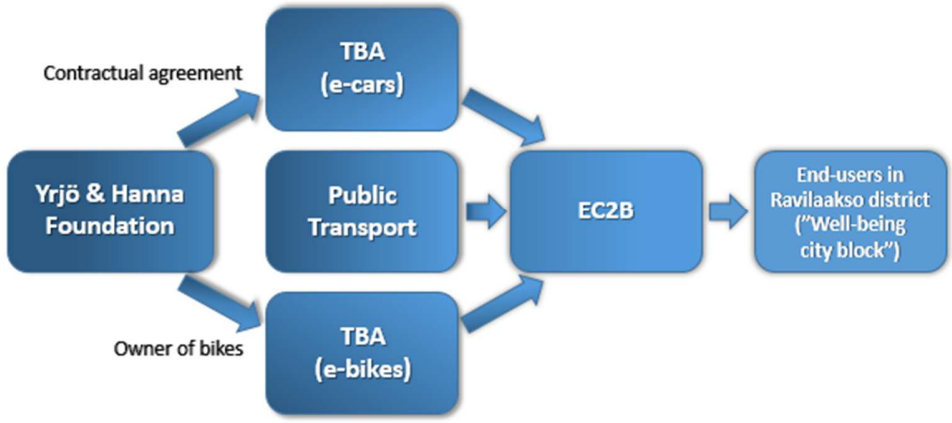

Figure 28. *EC2B governance.*

Most of the other possible replication activities related to Sustainable Mobility Plan are done and implemented by the City of Vaasa.

Impact assessment

EC2B enables housing development, where one doesn't have to take into account, that the inhabitants would be owning cars. This is done through the packaging of flexible mobility services, counselling and a community for sharing concept.

EC2B helps real estate developers, who want to offer the market a modern and urban housing concept, with lesser number of cars in the district, through a package solution of sustainable and flexible mobility, that is attractive to both customers (residents) and authorities (the municipality).

EC2B benefits mobility service providers, who want to reach large and affluent market for their sustainable mobility services. It will form part of a comprehensive service for sustainable mobility, easily available at home.

EC2B advances cities' ability to create a more attractive urban environment and sustainable development with fewer cars and a significantly more efficient land use.

Implementation plan

The implementation of EC2B's replication will follow the following steps.

1. **Evaluation** of Gothenburg's demonstration in collaboration with Yrjö & Hanna Foundation, Trivector and the City of Vaasa.
2. **Feasibility study** of the EC2B to be developed. Identification of providers of shared resources and content of the platform and services.
3. **Risk analysis** includes risk identification and description of their mitigation activities.
4. **Financial analysis** includes the investigation of financing schemes from each partners' business case. At this stage, the city is expected to decide, how it will act to referred required parking norm and number of used shared vehicles.
5. **Detailed design documents**. The Yrjö & Hanna Foundation with main stakeholders will develop the technical documents required for implementation.
6. **Agreements**. Depending on project definition there is need to prepare agreements between different partners of the implementation, to define responsibilities and business models. If part of the implementation is outsourced, the public procurement is done according to the national legislation.
7. **Project implementation.** The development of required services and applications for the platform, and construction phase of required infrastructure, including construction works and equipment installation etc.
8. **Commissioning**. Before operation, the commissioning step is recognized as of increased importance, due to the innovative and complex nature of the designed measures.

For activities under the Sustainable Mobility Plan, a separate document that will made, to be approved by the City Council together with annual budget plans.

WBS – Work Breakdown Structure & Gantt chart

Financing schemes and opportunities

National funding

- The Government of Finland:
  - https://julkaisut.valtioneuvosto.fi/handle/10024/160721

- https://tem.fi/en/transport-sector-growth-programme
- The Finnish Innovation Fund SITRA:
  - https://www.sitra.fi/en/projects/public-private-mobility-services-offered-side-side/
  - https://www.sitra.fi/en/topics/project-funding/
- Motiva Ltd. - Sustainable Development Company:
  - https://www.motiva.fi/en/public_sector
- Business Finland for public and private projects:
  - https://www.businessfinland.fi/en/for-finnish-customers/home
- Regional level funding sources, e.g., *Pohjanmaan liitto*:
  - http://2019.pohjanmaa.fi/frontpage/)

EU funding

Table 14. *Relevance of EU-level financial instrument for TT#3.*

Transition Track est. relevance		Project Size	Risk	Time-span	Info
EIB 4.1 European Investment Bank	Medium	Medium to large	Low risk	Long to mid term	Applicants/partners will undergo the EIB Due-Diligence process
EIF 4.2 European Investment Fund	Medium	Large and mid sized	Low to medium	Long to mid term	Applicants/partners will undergo the EIB Due-Diligence process with EIF or Intermediary partner
GB/CAB 4.3 Green /Clim. Awareness/ Bonds	High	Small to large projects.	Low risk	Long to mid-term	financing for sustainable projects and activities that promote transition to climate resilient growth.
PPP 4.4 Public Private Partnership	High	Medium to large	Risk-sharing managed in PA	Long to very long	Initiated to enable private capital in infra-structural city investments
4P 4.5 Public Private People Partnership	High	Medium to large	Risk-sharing managed in PA	Long to very long	Enabling citizen participation and public/ private cooperation in development projects
PF4EE 4.6 Priv. Finance for En. Efficiency	High	Large and mid-sized	Low to medium risk	Medium to long	Facilitating access to affordable financing for investments with strong energy-efficiency focus
EEEF 4.7 European Energy Efficiency Fund	High	Medium	Low to medium risk	Medium to long	Initiated to bring public and private partner-ship capital into climate change mitigation
EFSI 4.8 European Fund for Strategic Inv	High	Micro, small and mid size	Medium to high risk	Medium to long	Launched to help overcome the current investment gap in the EU
CF 4.9 Crowd Funding	Medium	Small projects	Medium to high risk	Short to mid-term	By EU-commission described as an under-developed source of funding and financing

6.8. Conclusions on ambitions and planning of activities for TT #3 Smart e-Mobility Sector

The City of Vaasa has approached the replication of the TT#3 activities with wide perspective, including e.g., biogas buses, cycling, pedestrian areas, and route planning. Electric cars themselves will not solve

the basic problems of high level of private car ownership, increment in traffic flows and congestion. Any incentives promoting EV growth must not conflict with the objectives of public transport development.

The ambition is to achieve functional and economically viable public transport system, that will be smart and include combination of different services and means of transportation. Smart Mobility can function as an opportunity to develop new market-based mobility services in an urban area, to complement public transport and the sustainable mobility chain.

The Sustainable Mobility Plan sets up activities that will be implemented by the City of Vaasa, and a separate implementation will be approved by the City Council and annual budgeting.

In addition, market-based smart solutions can complement the activities described in the Sustainable Mobility Plan. In such case, the Yrjö & Hanna Foundation, Trivector and the City of Vaasa will study and decide, whether replication can be possible, and what conditions is needed to be fulfilled, in order to enable the replication activities.

7. Transition track #4: City Innovation Platform (CIP)

7.1. TT#4 Replication in a nutshell

A collaboration project between the City of Vaasa, Vaasan Sähkö Oy, Wärtsilä Oyj and TietoEVRY Oyj, is aiming to build a pioneer solution to help any city to reach carbon neutrality. The experiment helps Vaasa's fight against climate change, and achieve carbon neutrality by 2030.

The project combines all the data from the three biggest carbon emission sources – traffic, heating and electricity consumption – enabling the parties involved carefully scrutinize the impacts of different actions on emission levels. With the help of the new tool, it's possible to demonstrate where and how the City's emissions are generated, which allows the efficiency of different measures to be simulated and verified. In the first phase, the experiment includes approximately 30% of the City's carbon emission sources.

Collaboration between all parties is a quintessential part of the project. The companies and the City are committed to share information and offer access to data, that has not been accessible before to outside parties. In addition to the interface itself, building a collaborative model for the parties involved, plays a crucial role.

High-quality and collaborative data on the environment and the City's operations can also act as an engine of development. The City needs a lot of quantitative data to develop its own operations, so that it can identify potential problems or deficiencies in its own operations or infrastructure. The Finnish Data Management Act also requires, that information systems used by cities have an interface through which information can be shared with other authorities.

Please see more in Annex 1 for the LH cities demonstrations, which contributed to the City of Vaasa's replication plan.

7.2. Selection process

The City of Vaasa is developing and implementing the following projects within this transition track:

- An open data project that aims to publish all public information in a specific format for free use by researchers and developers. The aim is to utilize Fiware and valid national data models.
- Implementation of traffic management and monitoring system: including not only traffic volume monitoring, but also information on means of transport. The aim is to enrich the data with environmental information and to use this in the planning of operations.
- The description of the information and the overall architecture (operation, information, system, technology) required by the Data Management Act, and later on within transition periods. All key systems will be built with the necessary interfaces or functionalities that enable the transfer and opening of data as open data.

7.3. Mapping of stakeholders

The main stakeholders involved in the replication process of all integrated solutions within this transition track are:

- The City of Vaasa
- Wärtsilä Oyj
- TietoEvry Oyj
- Technology Centre Merinova
- VASEK
- The University of Vaasa
- Huld Oy
- The citizens of Vaasa
- Equipment/materials/services suppliers

7.4. Identified knowledge gaps

The main knowledge gaps identified within this transition track refer to:

- Development and implementation of digital platform at the City level, including data from different city sectors, e.g., transportation, energy, services. The problem identified by The City of Vaasa representatives, referring to the availability of data from different stakeholders, e.g., occasionally there are private stakeholders (e.g., local telecom company), who are not willing to share data, or there is no technological capability to share data.
- Some old information systems have never been investigated before, in which case data models and the interpretation of information can be problematic. It is possible that even the manufacturer no longer has the know-how to interpret the data of old systems, or there are shortcomings in the documentation.

All these knowledge gaps can be, and some of them have already been, addressed within IRIS project through different capacity building and knowledge transfer activities.

7.5. Capacity building and knowledge transfer

The problem of 'access to data' is a well-known problem, that affects the entire Finnish public sector extensively. The legislation contributes to supporting development by obliging municipalities to publish public information and build infrastructure so, that the disclosure of information is possible.

The City of Vaasa aims to promote open data by building a data warehouse/data vault with partners, which serves as a tool for internal reporting and data management, as well as an open data portal for other parties.

All these knowledge gaps can be, and some of them have already been, addressed within IRIS project through different capacity building and knowledge transfer activities.

Due to the Covid19 pandemic, during 2020 no site visits have been possible to realize, webinars and peer-to-peer meetings have been the only options. Concerning the City Innovation Platform, the first webinar/peer-to-peer session took place on 12.8.2020 between Utrecht and the City of Vaasa.

7.6. IS-4.1: Services for Urban Monitoring

Baseline

At the moment, there are no regular monitoring tools and a centralised data reserve in Vaasa, where data would be collected. Solutions are "point solutions" for specific needs that may not be more widely exploitable.

Ambitions

Monitoring the City of Vaasa's activities through connected objects. In an ideal future version of CIM, all City assets are apart, also the connected IoT objects. Through visualization of the connected IoT objects, the City of Vaasa can for instance see, which assets need maintenance or replacements.

There are preliminary plans for large-scale use of modelling in the development and management of traffic in Vaasa. This would contribute to the achievement of Carbon Neutral Vaasa 202X project's targets. It is important to be able to accurately determine how much emissions traffic produces at any time, and in real time. The operating model will be based on a static traffic model (e.g., *Brutus* by Ramboll Group), which takes all modes of transport into account. The operating model takes into account real-time traffic calculation, including e.g., car traffic at traffic lights, light traffic camera counters, public transport passengers from the payment system, and vehicle traffic emissions (from the Trafi database based on the registration plate).

Modelling of previously mentioned data will contribute to the determination of targeted measures to reduce transport emissions, increase its fluidity and develop new operating models (means of vehicles' power, car sharing, safety etc.). In addition, modelling helps in the planning of cycling and walking routes, as well as in the development of transport services, e.g., public transport (line, frequency, speed, price) and in citizen engagement (information sharing). Thus, an operational programme for the various modes of transport is possible, and an impact assessment of the measures concerning the different modes of transport can be carried out using a static transport model.

Planning of replication activities

The City of Vaasa has started the mapping of IT assets, and the description of work required by the Information Management Act. The aim is to identify critical data resources and data exploitability. Deficiencies identified in the utilization of data resources:

- Ageing technology and systems (life cycle).
- Insufficient support from the supplier for older systems.
- Contract technical matters.
- Lack of interfaces.
- Missing standardized data model and interpretation of data.

Other factors that influence the utilization of the City's information and the design of municipal technology:

- Changes in traffic.
- Changes in means of transport.

The main goals of the project are listed below:

- Data vault.
- Standardized data model at national and EU level (applicable model).
- Interfaces for key information systems, enabling the transfer of data to a centralized data pool.
- Publish data from a centralized data pool (open data).

Central data pool:

- The City builds a centralized data pool and user interface in Microsoft Azure.
- Public information is published as open data.
- PowerBI builds a reporting and visualization layer on top of the data.

Organization of work

Most of the mobility related subjects are the responsibility of the public sector. However, when planning of activities and replication, local citizens and key employers have to be included.

The City of Vaasa is carrying out development projects with the suppliers and development partners of the current information systems. The development partner is Atea Finland Oy.

Data collection and management

Integration tools, Microsoft Azure and PowerBI tools.

Barriers and drivers

- Political
  - Barrier: There is sometimes reluctance from politicians to open up access to data, due to fear of its misuse.
- Economical
  - Driver: The City Information Model could potentially save huge sums of money for the City of Vaasa, thanks to improved quality of planning with the help of comprehensive data from a district.
  - The long time period between the investment and the visible benefits.
- Sociological
  - Driver: From the social point of view there were no barriers to be identified. The social advantages of implementation of this project constitute of improving the quality of life (QoL) of the citizens of Vaasa. There should also be mentioned that through this project implementation, new jobs can be created in Vaasa.
- Technological
  - Driver: Open data trend pushing the CIP development.
  - Driver/Barrier: Increasing amounts of data is generated by and within buildings (BIM). A multitude of different systems exist to control climate, lighting, access control etc., not to mention all the new data sources, emerging from IoT devices, all of which generate data.

    - Driver/Barrier: The current open urban data platform contains mainly static databases. For meaningful services real-time or near real-time data must be shared in a safe, accessible and reliable manner.
- Legal / Regulatory framework
    - Barrier: Lack of standardization for data collections.
- Environmental
    - Driver: The implementation of a City Information Model promises huge environmental benefits, due to improved planning and greater efficiency in execution, for instance, improved logistics when building new houses or infrastructure.
    - Driver: All measures proposed within this integrated solution can lead to reduction of pollutant emissions, thus reducing environmental impact.

Specifications

To define the administrative model, tools, data model used, and establish principles and practices for the use of data.

Citizen engagement

The information provided is intended for developers and designers. The challenge is that the data is not utilised in the applications that residents use, thus the goals are not fully realised.

Business model

The City of Vaasa provides all public information as open information to all those who need it. The goal is to provide "fuel" to developers who can create applications that interest users.

Governance

The City of Vaasa manages the information and is responsible for the service.

Impact assessment

High-quality information is available.

Implementation plan

- Identifying groups of data that are of interest.
- Identify interfaces of information systems and the information obtained through them.
- Setting up data models.
- Get tracking devices and any modifications to the interfaces of information systems.
- Specify the processing and life cycle of the data, e.g., whether the data must be anonymized before it can be exported to a centralised strain.
- Export the data to a centralized data pool and publish it as open data.

WBS – Work Breakdown Structure & Gantt chart

The project plan has not yet been made at the work assignment level. Work will begin in 2021. (Please see more in Annex 2)

Activity	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.Obtaining financing																								
2. Technical project																								
3. Acquisition																								
4. Implementation																								
5. Project reception																								

Figure 29 -WBS - Services for Urban Monitoring

Financing plan

In the first phase, the City of Vaasa will finance the development activities, but partners and external funding sources will be sought for the follow-up.

7.7. IS-4.2: Services for City Management and Planning

Baseline

The city already has a spatial feedback system, but the goal is to proactively collect information about operations and the environment, so that it is possible to react better already at the planning stage. People's behavior is changing rapidly, and the challenge is the long-life cycle of the structures implemented.

Ambitions

The aim is to collect information that assists planning, and describe trends and changes in the city's structures and human behavior. Trends can be confirmed with the collected data.

Planning of replication activities

The aim is to create analyses and visualizations of the collected data, to illustrate changes and needs in the city.

Organisation of work

Most of the mobility related subjects are the responsibility of the public sector. However, when planning of activities and replication, local citizens and key employers have to be included.

Data collection and management

The collected data is used in urban planning and development. The city manages the data itself, and is responsible for reporting and data content.

Barriers and drivers

- Political
  - Barrier: There is sometimes a reluctance from politicians to open up access to data for fear of its misuse.
- Economical
  - Driver: The City Information Model could potentially save huge sums of money for the City of Vaasa, due to improved quality of planning, with the help of comprehensive data from a district.
  - Barrier: The long time period between the investment and the visible benefits.
- Sociological
  - Driver: Open city management and planning will facilitate both citizen engagement and political involvement by reducing bureaucracy and paperwork for new projects, additionally, increasing transparency and encouraging innovation activities.
- Technological
  - Driver: Open data trend pushing the CIP development.
  - Driver/Barrier: Increasing amounts of data is generated by and within buildings. A multitude of different systems exist to control climate, lighting, access control etc., not to mention all the new data sources, emerging from IoT devices, all of which generate data.
  - Driver/Barrier: The current open urban data platform contains mainly static databases. For meaningful services, real-time or near real-time data must be shared in a safe, accessible and reliable manner.
- Legal / Regulatory framework
  - Barrier: Lack of standardization for data collections.
- Environmental
  - Driver: The implementation of a City Information Model promises huge environmental benefits, due to improved planning and greater efficiency in execution, for instance, improved logistics when building new houses or infrastructure.

Specifications

Identify data needs and create report conditions to support planning. The aim is to standardize reporting, making monitoring a common value.

Citizen engagement

The aim is to involve the residents in the planning.

Business model

The activities are part of normal city development and planning. The aim is not to commercialize the model.

Governance

The City of Vaasa manages the operations.

Impact assessment

The aim is to increase the ability to identify weak signals and react to trends.

Implementation plan

- Identify the information needs of planning and development at the task and knowledge level.
- Identify dependencies and stakeholders, as well as any new user groups.
- A reporting and visual layer will be built on top of the collected data in Microsoft Azure.
- Develop reporting models and visualization.

WBS – Work Breakdown Structure & Gantt chart

The project plan has not yet been made at the work assignment level. Work will begin in 2021.

Activity	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.Obtaining financing																								
2. Technical project																								
3. Acquisition																								
4. Implementation																								
5. Project reception																								

Figure 30 WBS -Services for City Management and Planning

Financing schemes and opportunities

In the first phase, the City of Vaasa will finance the development activities, however partners and external funding sources will be sought for further development.

7.8. IS-4.3: Services for Mobility

Baseline

The City of Vaasa has decided to achieve carbon neutrality by 2030. This goal set the framework for The Carbon Neutral Vaasa 202X roadmap designed together with the local business community, universities and public bodies.

Ambitions

Key goals are combining data from different sources for cities to plan their actions in order to manage their carbon emissions, and measuring the effects of their actions. To accelerate decarbonization, the best actors and solution providers are put together. Additionally, machine learning and advanced analytics aid in proactive measures on predictive patterns.

Planning of replication activities

The goal is to identify, collect, analyze and visualize relevant data, in the data management tool. The aim is to use the information in various use cases, from planning to decision-making.

Organization of work

The goal requires a broad network of cooperation, in which the City of Vaasa plays a guiding role. Implementation will take place through projects.

Data collection and management

The Carbon Neutral Vaasa 202X project has built a POC model (proof of concept) that also includes a model for data collection and further processing. The aim is to compile the relevant data into a common repository, the analysis tools of which provide the information needed to support decision-making. The aim is to open up data resources by acquiring the necessary interfaces or by gradually renewing systems (at least as far as the City is concerned).

Barriers and drivers

- Political
  - Barrier: There is sometimes a reluctance from politicians to open up access to data for fear of its misuse.
- Economical
  - Driver: The City Information Model could potentially save huge sums of money for the City of Vaasa, due to improved quality of planning, with the help of comprehensive data from a district.
  - The long time period between the investment and the visible benefits.
- Sociological
  - Driver: Supports social sustainability and QoL.
- Technological
  - Driver: Open data trend pushing the CIP development.
  - Driver/Barrier: The current open urban data platform contains mainly static databases. For meaningful services real-time or near real-time data must be shared in a safe, accessible and reliable manner.
- Legal / Regulatory framework
  - Barrier: Lack of standardization for data collections.
- Environmental
  - Driver: The implementation of a City Information Model promises huge environmental benefits, due to improved planning and greater efficiency in execution, for instance, improved logistics when building new houses or infrastructure.

Specifications

The Carbon Neutral Vaasa 202X project aims to define more precisely the relevant data, data models and tools.

Citizen engagement

The aim is to involve the residents in the planning and give behavior changing information.

Business model

The aim is to create tools and relevant information for the cooperation network to support planning and decision-making. The goal is to create a model of good practice and KPI indicators that can be shared at national and EU level.

Governance

The development takes place via an extensive cooperation network. Project activities are directed by steering groups and other working groups defined on a case-by-case basis.

Impact assessment

High-quality information is available to support planning and decision-making. Information can be combined and enriched.

Implementation plan

The project plan has not yet been made at the work assignment level. Work will begin in 2021.

WBS – Work Breakdown Structure & Gantt chart

In the first phase, the City of Vaasa will finance the development activities, but partners and external funding sources will be sought for the follow-up.

Financing schemes and opportunities

In the first phase, the City of Vaasa will finance the development activities, however partners and external funding sources will be sought for further development.

7.9. IS-4.4: Services for Grid Flexibility

Baseline

The City of Vaasa currently has no specific plans to promote Services for Grid Flexibility, but the case relates to The Carbon Neutral Vaasa 202X project, the project plan of which is currently being designed. The good practices and solutions identified in the IRIS project will be applied in The Carbon Neutral Vaasa 202X project.

Additionally, since the grid flexibility services, e.g. peak shaving, load balancing, energy arbitrage, voltage and frequency control etc., can include various RES, EV and e-bus, V2G, smart charging, BESS and 2nd life battery schemes and ancillary services, smart energy management, smart house and smart metering solutions, different services for grid flexibility will become relevant in Vaasa in the near future. In other words in the development of the new Ravilaakso district and in the retrofitting activity. However, these are yet to be determined and carefully planned.

7.10. Conclusions on ambitions and planning of activities for TT #4 City Innovation Platform (CIP)

The conclusions on ambitions and planning of integrated solutions related to city innovation platform are the following:

- Identify data pools and their data models, from which data is collected in a centralized data pool.
- The interface of the systems is mapped, and if necessary, modifications are acquired, that enable the disclosure of data according to the data model. Large investments will be put on the development map and projected.
- A centralised data reserve, where information on the city's environment and operations is being collected, is still in the planning process, and the commissioning takes place in stages, one use case at a time. The City of Vaasa has implemented a few development applications that have collected user experiences from the use and visualisation of the data pool.
- Traffic monitoring equipment will be acquired to pilot the monitoring of traffic volumes and types of means of transport. Subsequently, broader experiments and established activities will be put on the development map and promoted as investments.
- Technical documentation will be prepared during the project.
- The aim is, for the collection and publication of information related to the IRIS project to begin in 2021.

8. Transition track #5: Citizen engagement

8.1. TT#5 Replication in a nutshell

The City of Vaasa has a tradition of involving citizens in the city development and decision-making processes. The City of Vaasa was awarded by The Finnish Institute for Health and Welfare in 2019, for promoting the participation of citizens. On a strategic level, this work has been visible in Vaasa's participation program 2017-2020. The program was developed in close collaboration with citizens, in order to improve the opportunities for citizens to participate and influence directly, in addition to representative democracy. The program offers models for this direct influence of citizens. Essential actions of the participation program are:

- Measures for improved collaboration between the city organization and Vaasa's residential area associations, as well as the city organization and the third sector.
- Mayor's discussions on a regular basis with the councils, including the Youth Council as well as the City Council's discussions with citizens on a regular basis.
- Activities of parents' associations in schools and kindergartens.
- Measures for improved collaboration between the City organization and students.

In addition to this, several pilots with citizen engagement focus in mind have been carried out during the last years, e.g.:

- Digitalization support – personal support for citizens regarding electronic services.
- Citizens as developers – citizens participate in the planning and development of the City services or activities.
- Participatory integration - in collaboration with the City organization, associations, companies, and others to generate ideas, for events promoting integration of citizens receiving residence permits.
- The development of Vaasa's sustainable urban mobility plan, as well as the identification of change agents, and the implementation of a transition arena within mobility in the BothniaTM project.

Monitoring and continuous improvement are key elements of Vaasa's participation program. The current program is valid until the end of 2020. Development of a new participation program for the next three years, and IRIS Vaasa replication plan regarding citizen engagement, are to take place in autumn 2020. Securing a strong connection between the replication plan and the City's participation program is an essential part of the development.

For the IRIS transition track #5 Vaasa aims at replicating the following four integrated solutions:

- IS-5.1: Changing everyday energy use
- IS-5.2: Participatory modelling
- IS-5.3: Living labs

- IS-5.4: Behavior changing information

Please see more in Annex 1 for the LH cities demonstrations, which contributed to the City of Vaasa's replication plan.

8.2. Selection process

In order to select the most suitable IRIS solutions for replication with regard to citizen engagement, it has been important to become familiar with the demonstrations of the IRIS Lighthouse cities through careful reading of documentations, via presentations held by the demonstrators, and during on-sight visits in Utrecht, Gothenburg and Nice. In addition, it has been important to take into consideration what citizen engagement processes, projects and activities have been, or are currently been carried out in the City of Vaasa, as well as relevant related programs on strategic level within the City. Regarding the latter part, the City of Vaasa is implementing its participation program of 2017-2020, which is currently being developed for the period of the coming three years 2021-2024. In the selection process, both current activities and strategic level programs, as well as those under development have been taken into account.

Based on the familiarization with the IRIS Lighthouse cities' demonstrations, and the past, current and planned future activities, projects and strategies within the City of Vaasa, the following integrated solutions and the specific measures of interest have been identified as the most relevant with regard to replication:

- **IS-5.1: Changing everyday energy use**
  - Community building by Change agents (Utrecht)
- **IS-5.2: Participatory City Modelling**
  - Min Stad as a tool for citizen engagement (Gothenburg)
- **IS-5.3: Living labs**
  - Co-creation in Local Innovation Hub (Utrecht)
- **IS-5.4: Behavior changing information**
  - Campaign District School Involvement (Utrecht)
  - Public Awareness Campaign Energy – School & College; Youth & Family (Nice)

8.3. Mapping of stakeholders

Vaasa relies on strong cooperation between different actors, when it comes to how business is conducted, projects are planned and implemented etc. Depending on the case, involved actors can range from the City of Vaasa and surrounding municipalities to companies, higher education institutions and non-profit organizations, and further to citizens and other potential actors within the region. Hence, the mapping of stakeholders is an integral part of both city and regional development. The IRIS replication in Vaasa is following this existing model, and there is a continuously ongoing mapping of relevant stakeholders, besides those directly involved in the IRIS project, with regard to the chosen integrated solutions. With regard to citizen engagement, this process is strongly linked to the ongoing participation program by the

City of Vaasa. In general, citizens are the main stakeholder group, however, under each integrated solution there are more specific groups of citizens, which can be identified and involved.

For each solution, the following stakeholders have been identified:

IS-5.1: Changing everyday energy use:

- Citizens of certain districts
  - Ristinummi
  - The Olympia-block
  - Other districts TBA
- Residents' associations
- District councils
- The City of Vaasa
- The universities in Vaasa (The University of Vaasa, Vaasa University of Applied Sciences, and NOVIA – University of Applied Sciences)
- Third sector actors such as *Vaasan Setlementti* association

IS-5.2: Participatory city modelling:

- Citizens
- The City of Vaasa

IS-5.3: Living labs:

- Citizens of certain districts
  - Ristinummi district
  - The Olympia-block
- Residents' associations
- District councils
- The City of Vaasa
- The universities in Vaasa (The University of Vaasa, Vaasa University of Applied Sciences, and NOVIA – University of Applied Sciences
- Third sector actors such as Vaasan Setlementti association

IS-5.4: Behaviour changing information:

- Pupils and students in Vaasa and their families
- Teachers and school/university staff members
- The City of Vaasa
- Companies of the Vaasa Energy cluster

8.4. Identified knowledge gaps

Considering previous activities carried out in Vaasa, there is an extensive experience in conducting citizen engagement in IRL settings via e.g., workshops and other face-to-face meetings. With regard to the use of digital solutions for citizen engagement, the City of Vaasa has a feedback channel on its webpages,

allowing citizens to give feedback regarding issues managed by the City. However, in the ongoing COVID-19 situation many of the engagement activities usually conducted in IRL, will have to be moved to digital settings. This more extensive use of digital/virtual tools and techniques is recognized as a knowledge gap.

8.5. Capacity building and knowledge transfer

In order to build capacity and transfer knowledge, relevant stakeholder representatives have participated in workshops and peer-to-peer digital and face-to-face meetings, organized by lighthouse city representatives. Besides this, active participation in workshops and meetings, material from the workshops and meetings together with other documentation (e.g., webpages) have been used to get more information about the chosen integrated solutions. In addition, there have been visits to lighthouse cities where the solutions have been acquainted with in more detail.

Considering future capacity building and knowledge transfer, a lot of potential can be expected in the peer-to-peer meetings held either IRL or virtually. To maximize the outcomes of these meetings, it is vital to gather key stakeholder representatives in Vaasa as participants in the meetings, together with key representatives from the lighthouse cities, sharing their knowledge on a specific solution.

8.6. IS-5.1: Changing everyday energy use

Baseline

In the framework of some previous projects, the City of Vaasa has carried out citizen engagement activities in different city districts and related to different topics in line with the outlining of Vaasa's participation program. Two of these previous projects successfully implemented in Vaasa in the last years included activities closely connected to the measure *Community building by Change agents* demonstrated within the IRIS project. The first of these projects is "BothniaTM –Transition Management for Accelerating Ostrobothnian Sustainable Development" (https://www.univaasa.fi/en/sites/bothniatm/) funded by the European Regional Development Fund (ERDF) in the years 2017-2019 by the University of Vaasa in close cooperation with the City of Vaasa. The aim of the project was to introduce the transition management approach in region of Vaasa and to implement the approach by carrying out a transition arena related to future mobility. The transition arena was formed by identifying and activating a network of change agents promoting future sustainable mobility in Vaasa. In this way, the project provided experiences regarding community building based on a change agents perspective, which can be utilised in the replication of the IS-5.1.

The second project is the project OSAT carried out 2017-2020 and funded by the European Regional Development Fund (ERDF) / European Social Fund (ESF). The City of Vaasa carried out this project in cooperation with several other actors, such as the Vaasa Evangelical Lutheran Church, including also third sector actors, such as the organization *Setlementti*. The main project aim was to develop the (working) capacities of inhabitants at risk of social exclusion by activating them in communities and thus improve the social inclusion and prevent social exclusion and poverty. Within the OSAT project, a step model including four steps was developed. One of the actions related to the step model was to identify key actors of networks and communities in Vaasa's districts. The experiences gained and networks established within this action can be utilized in the replication of the IS-5.1.

Ambitions

The IS-5.1 Community building by Change agents will be replicated in order to support the replication of the following integrated solutions in various districts of Vaasa: IS-1.2 Near zero energy retrofit district, IS-3.1 Smart solar V2G EVs charging, and IS-3.2 Innovative mobility services for citizens. The ambitions of the replication are in line with the ambitions of the demonstration in the Lighthouse city Utrecht, i.e., to design and demonstrate feedback mechanisms and inclusive services for citizens to achieve that citizens are motivated to change their behavior in relation to the integrated solutions the measure is supporting.

Planning of replication activities

The planning of the replication activities will be specified in parallel with the specification of the replication activities, which the change agents would support (IS-1.2, IS-3.1, IS-3.2).

Organization of work

The City of Vaasa would lead the work and would cooperate with actors involved in the replication of IS-1.2, IS-3.1, IS-3.2 (the local student housing association VOAS, the City owned Kiinteistö Oy Pikipruukki Fastighets Ab etc.) actors with experience from other citizen engagement activities, such as the University of Vaasa.

Data collection and management

No detailed plan is currently available.

Barriers and drivers

- Political
  - Driver: -
  - Barrier: -
- Economical
  - Driver: The IS-5.1 is closely connected to IS-1.2, IS-3.1, and IS-3.2 and the financing of the IS-5.1 activities can therefore be supported from different funding sources.
  - Barrier: The economic situation of the city due to covid-19 might become a barrier due to potential limitations of resources.
- Sociological:
  - Driver: Previous successful projects have demonstrated the efficiency of activities based on a change agents perspective (BothniaTM, OSAT).
  - Barrier: Activities are focused on citizen segments characterized by the risk of societal exclusion. This risk is presumably further increased in the ongoing COVID-19 situation, which may influence the possibility to engage the target groups.
- Technological
  - Driver: -
  - Barrier: In the ongoing COVID-19 situation many of the engagement activities usually conducted in IRL will have to be moved to digital settings. This might cause a challenge for reaching out to more vulnerable citizen groups due to restricted access to and/or knowledge about technological solutions.
- Legal / Regulatory framework

- Driver: -
- Barrier: -

- Environmental
  - Driver: -
  - Barrier: -

Governance

The City of Vaasa would have the lead and coordinate the actions in close cooperation with actors involved in the demonstrations of the integrated solutions as well as experienced actors within citizen engagement.

Impact assessment

Impact assessment measures have not been specified yet.

Implementation plan

In line with the demonstration in Utrecht, the replication of the measure will be implemented via the steps below. Related to topics and districts where the change agents perspective has been implemented before, the implementation is not starting from step 1, but flexibly from step 2 or 3 onwards.

1. Perform a first mapping exercise identifying key formal and informal influencers
2. Contact the identified actors and apply the snowball method for identifying further key actors
3. Involve the key actors in the preparation of the engagement process
4. Consult the formed group of change agents on a regular basis
5. Extend the group for next citizen engagement activities when needed

WBS – Work Breakdown Structure & Gantt chart

No detailed plan is currently available.

Financing schemes and opportunities

The funding of IS-5.1 activities should be taken into consideration as a part of the funding for IS-1.2, IS-3.1, and IS-3.2. Thus, the funding opportunities are in line with the descriptions in respective sections of this replication plan.

8.7. IS-5.2: Participatory city modelling

Baseline

In Finland, participatory governance has been seen as complementary to representative democracy. It has been introduced as a new kind of civil activity in the field of political participation and a new type of governance policies. The main-focus has been on citizens' involvement in local policy-making, suburb and neighborhood development included. Much attention is paid to people's opportunities to participate in debate and influence political decision-making in different fields of governance, particularly in welfare issues in the local context. In Vaasa's context, this approach is implemented in the city of Vaasa's participation program. This approach requires constant efforts from city officials to find suitable and genuine ways to engage and utilize the empirical knowledge of the people.

Related to the replication of IS-5.2, citizen engagement is currently carried out in Vaasa, for instance, in accordance with the MRL in zoning and street planning projects. Currently, the City of Vaasa utilizes the Maptionnaire tool (https://app.maptionnaire.com/fi/9697/) to conduct map-based surveys of various projects. The surveys are compiled and published separately on the City's website and all background material is communicated to the designers.

Ambitions

Within the IRIS project, the City of Vaasa will further investigate the possibilities of online participatory tools. There is a need to develop Vaasa's feedback system into a more interactive direction. In addition, online enquiries (including map-based tools), online workshops and question times will be developed as well as further ways to utilize and communicate the information gained via these tools.

There is also need to develop a holistic online system; a user interface to the services of the city, based on strong electronic identification.

These ambitions will be developed simultaneously. This will be carried out by taking into account especially the ambitions, aims and experiences of the "Min Stad" (My City) demonstration in the Lighthouse city Gothenburg. In Gothenburg, the purpose is to involve the citizens in order to increase involvement in urban development issues, increase knowledge of urban planning and to create and open debate via "Min Stad".

Planning of replication activities

The City of Vaasa is keen on interacting with other IRIS partners in order to explore best practices concerning participatory online-tools and holistic user interfaces to city services using strong identification. We will especially spotlight the usability and technical functionality of the existing methods and tools, particularly Min Stad, and focus on how citizens have been involved in the development work of the systems.

Organization of work

The team from the City of Vaasa includes professionals from several fields: IT management, citizen participation, civil engineering, and e.g., experts from culture and sports department. Best practices from other cities, needs of different city departments as well as the user experience of the citizens will be explored in collaboration, and suitable digital solutions will be developed.

Data collection and management

Data from city departments ads users will be gathered in workshops and via electronic enquiries. The work will be conducted by Vaasa's IT management and citizen participation officials.

Barriers and drivers

- Political
    - Driver: Strong governmental encouragement participatory city modelling.
    - Barrier: -
- Economical
    - Driver: Vast variety of long-term economic benefits can be expected.
    - Barrier: Required tools and methods demand at least some investments.

- Sociological
  - Driver: Participatory city modeling advances quality of life.
  - Barrier: -
- Technological
  - Driver: Required technology and tools exist.
  - Barrier: -
- Legal / Regulatory framework
  - Driver: -
  - Barrier: -
- Environmental
  - Driver: -
  - Barrier: -

Specifications

More specific details of the ways to conduct the work, and the setting of the specific goals and impact assessments will be done in a later stage.

Business model

Requires further investigation, to be specified later.

Governance

Requires further investigation, to be specified later.

Impact assessment

Requires further investigation, to be specified later.

Implementation plan

Requires further investigation, to be specified later.

WBS – Work Breakdown Structure & Gantt chart

Requires further investigation, to be specified later.

Financing schemes and opportunities

National and international financing possibilities will be further investigated and applied for in an appropriate time.

8.8. IS-5.3: Living labs

Baseline

In the framework of some previous projects, the City of Vaasa has carried out citizen engagement activities in different city districts and living areas in line with the outlining of Vaasa's participation program. One recent successful project was the project OSAT carried out 2017-2020 and funded by the European Regional Development Fund (ERDF) / European Social Fund (ESF). The City of Vaasa carried out this project

in cooperation with several other actors, such as the Vaasa Evangelical Lutheran Church, including also third sector actors, such as the organization Setlementti. The main project aim was to improve the (working) capacities of inhabitants at risk of social exclusion by activating them in communities and thus improve the social inclusion and prevent social exclusion and poverty. Within the OSAT project, a step model including four steps was developed. The steps of the model are containing actions such as identifying key actors of networks and communities in Vaasa's districts and developing paths for individuals and communities supporting social inclusion.

Even though the OSAT project focused on and developed citizen engagement activities with the aim of improving social inclusion and preventing social exclusion and poverty, the knowledge and experiences gained and the networks established within the OSAT project can be utilized for the replication of the IRIS project focusing on smart cities and energy transition related issues. Based on the experiences gained and lessons learned in the IRIS project, the City of Vaasa will use a broader and more open starting point for the replication of the living labs, meaning that the living lab methodology will be the primarily focus of the replication activities. As a starting point, the activities within the living labs are not strictly restricted to only smart cities and energy transition issues, but the activities will whenever possible, be linked to these topics.

Ambitions

The City of Vaasa has a strong interest in developing living labs in order to support citizen engagement in different city districts. This is very much in line with the participation program of the City of Vaasa. The replication will start in the city districts Olympia and Ristinummi. Although the development of these districts are different in many respects, they are currently facing similar challenges due to risks of societal exclusion and poverty. Within the project *LähiöInno* (2020-2022), which has been funded by the Finnish Ministry of Environment, living labs (Community Urban Planning Labs, CUPL) will be established in these two city districts in order to engage the citizens in user innovation activities supporting district development and preventing segregation. In the Ristinummi district, the activities will be further supported by the project *Ristinummi district development plan* (2020-2022), which has also been funded by the Finnish Ministry of Environment. The aim of this project is to prevent segregation in the district and to increase the well-being and inclusion of the residents in order to support the vitality of the district. In addition, the aim is to diversify housing services and to develop other services provided in the district.

Planning of replication activities

The LähiöInno project will be carried out 1.9.2020–31.12.2022 and the Ristinummi city district development plan will be implemented 2020–2022. Based on the experiences gained in these projects, further replication activities will be planned.

Organisation of work

The University of Vaasa is leading the LähiöInno project. The project is carried out in close cooperation with the City of Vaasa, leading the implementation of the Ristinummi city district development plan, and the following local actors: the local student housing association VOAS, the City owned Kiinteistö Oy Pikipruukki Fastighets Ab, and the digital support Digituki funded by the Regional Council of Ostrobothnia.

Data collection and management

Data will be collected via interviews, surveys and in the events organized in the established livings labs. The data will be managed by the University of Vaasa, according to the data management principles, specified in the LähiöInno project.

Barriers and drivers

- Political
  - Driver: There is a strong national support for similar kind of initiatives supporting city district development in order to prevent social exclusion.
  - Barrier: -
- Economical
  - Driver: Two projects have gained external funding.
  - Barrier: The economic situation of the city due to covid-19 might become a barrier due to potential limitations of resources.
- Sociological:
  - Driver: -
  - Barrier: Activities are focused on citizen segments characterized by the risk of societal exclusion. This risk is presumably further increased in the ongoing COVID-19 situation, which may influence the possibility to engage the target groups.
- Technological
  - Driver: Digital support for citizens in the LähiöInno project is enhanced by the Digituki initiative funded by Regional Council of Ostrobothnia.
  - Barrier: In the ongoing COVID-19 situation many of the engagement activities usually conducted in IRL will have to be moved to digital settings. This might cause a challenge for reaching out to more vulnerable citizen groups due to restricted access to and/or knowledge about technological solutions.
- Legal / Regulatory framework
  - Driver: -
  - Barrier: -
- Environmental
  - Driver: -
  - Barrier: -

Governance

The University of Vaasa is leading the LähiöInno project. The City of Vaasa is leading the implementation of the Ristinummi district development plan.

Impact assessment

Impact assessment measures have not been specified yet.

Implementation plan

The project LähiöInno will be implemented in the following steps:

1. **Project kickoff and establishment of living labs** including the setup of feedback channels for the residents of the districts involved. Specifications of the theoretical framework of the project.
2. **Follow-up events in the established living labs** including analysis of the data collected and preparation of the next event round. Deepening the theoretical framework of the project.
3. **Second round of sessions in the living labs** including analysis of the data collected from the events and via the feedback channels for the residents of the districts involved. Engaging discussion and social debate about the project topics.
4. **Follow-up events of the second round of sessions in the living labs** including analysis of all collected data, formulating results and first conclusions. Summarizing user innovation ideas and discussions with the City of Vaasa on how to develop the ideas further.
5. **Finalizing project results and publishing of the project report**. The project results can serve as a basis for the preparation of policy recommendations.

WBS – Work Breakdown Structure & Gantt chart

	2020		2021				2022			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WBS 5.3 Implementation of living labs in the project LähiöInno										
Task 5.3.1 Project kickoff and establishment of living labs										
Task 5.3.2 Follow-up events in the established living labs										
Task 5.3.3 Second round of sessions in the living labs										
Task 5.3.4 Follow-up events of the second round of sessions in the living labs										
Task 5.3.5 Finalizing project results and publishing of the project report										

Figure 31 WBS – Living Labs

Financing schemes and opportunities

The two projects described above have received funding from the Finnish Ministry of Environment. The total budget of the project LähiöInno is about 285 000 euro, out of which the amount of funding from the Ministry is about 230 000 euro. The total budget of the Ristinummi city district development plan is 2,5 Million Euro, out of which about 900 000 euro is funding from the Ministry. For further replication activities to be planned national (e.g., Finnish Ministry of Environment) and European regional and social funding schemes (e.g., ERDF / ESF) provide future possibilities.

8.9. IS-5.4: Behavior changing information

Baseline

Concerning the use of information to change citizen behavior, the City of Vaasa has experience in educating energy-related issues. Vaasa is known as the energy capital of the Nordic countries with its Energy Vaasa Cluster. In line with this, the Energy Education Path (www.energiapolku.fi) has been carried out since 2017. The path begins from the early childhood education and continues all the way to university education. In other words, it includes basic education, vocational education, upper secondary school education, and polytechnic education. Each step of the path has its own particular focus areas and tools. The main goal with the Energy Education Path is to increase pupils' and students' awareness and competence in energy-related issues. Although this primarily concerns pupils and students, the effects are likely to involve the social context of each actor as well, e.g., friends and family. Raising awareness is emphasized throughout the path, since energy is a core theme and a natural part of the educational

content on all levels. This goal is linked to IS-5.4 “Behavior changing information” and resembles what has been conducted in Nice (Public awareness campaign Energy – School & Collège; Youth & Family) and in Utrecht (Campaign District School Involvement).

Importantly, the intention is to raise interest and foster participation already from early childhood education, and more specialized knowledge and skills are added throughout the education path. In addition to the teaching held by the teachers, invited experts are visiting the schools and the pupils make site visits. To enhance the energy competence within schools in Vaasa, there is a particular need for competent teachers. The project strives to support and motivate teachers by offering the Energy Education Path program as a framework and education for the teachers. This is facilitated through virtual and physical learning environments, and together the teachers form a network of energy teachers enabling interaction and experience exchange.

Besides raising awareness and competence among pupils and students as well as teachers, the project has some further goals. Through this project, the participating learners can gain knowledge, skills, and abilities for future working life. Finally, there is an aim to familiarize learners with the studying and career opportunities within the Vaasa energy cluster, which is achieved through active interaction between schools and working life. The awareness raising regarding opportunities and securing skilled workforce is facilitated through various means as exemplified in **Figure 32** below.

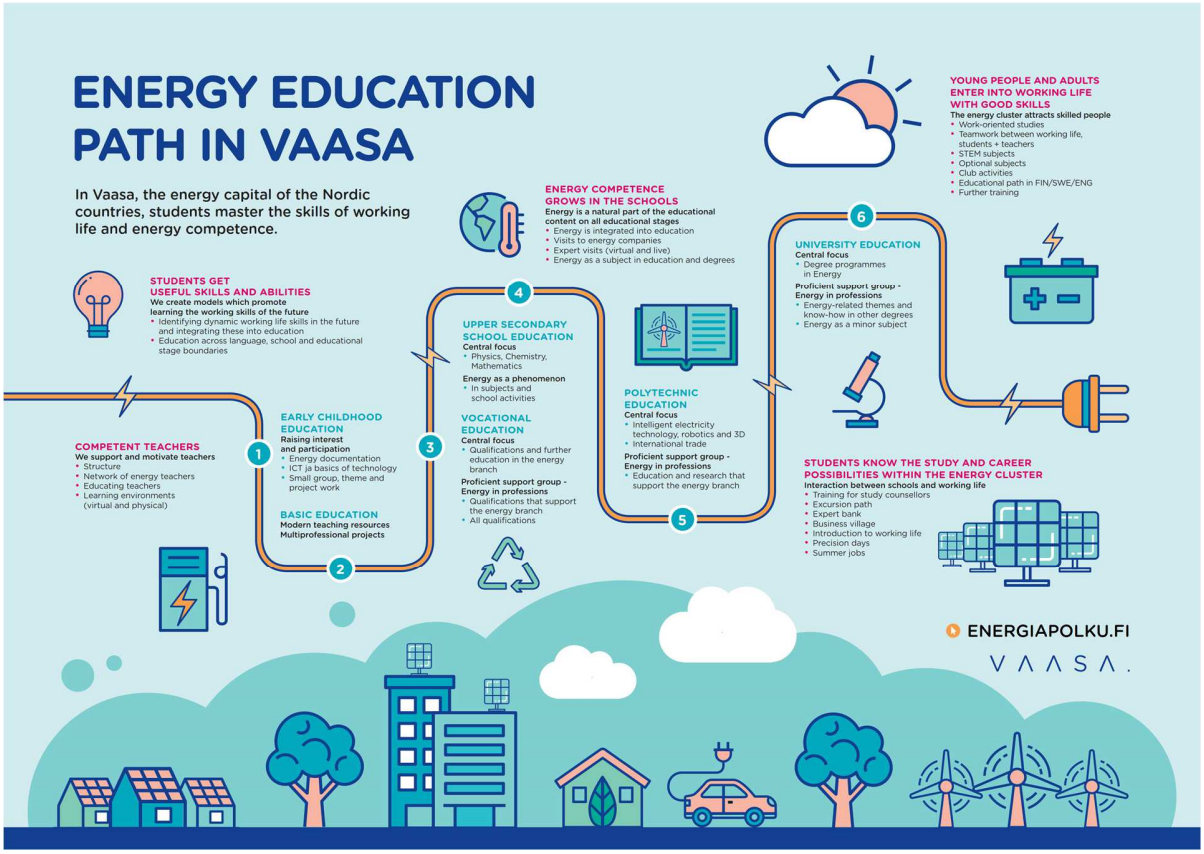

Figure 32. *Overview of the Energy Education Path in Vaasa.*

Ambitions

As discussed in the baseline, the City of Vaasa is strongly motivated to raise the awareness and competence among citizens, particularly in the school-world, in energy-related matters. This becomes evident particularly in the Energy Education Path in Vaasa. With multiple purposes, the aim of the project is to increase competency among teachers who subsequently "transfer" this knowledge and these skills to the pupils and students. The intention is not only to raise awareness, but also to evoke interest and motivation among citizens to deal with issues concerning energy and change behavior. Moreover, the project also serves the purpose of ensuring that there is a skilled workforce available now and in the future. This is important for the pivotal energy cluster found in Vaasa, but also at large for the ability to strive towards a more sustainable future in the energy area. This is an ongoing process, and in order to meet the various goals of the existing Energy Education Path, there is a need for continuous development based on e.g., insights from the demonstrations in the lighthouse cities Nice and Utrecht.

Planning of replication activities

Regarding this solution, the replication builds upon the existing Energy Education Path. Replication is about drawing insights from what has been conducted in the lighthouse cities of Nice and Utrecht related to raising citizen awareness on energy-related matters (Nice) and campaign district school involvement (Utrecht).

Organization of work

The Energy Education Path in Vaasa is managed by a working group, coordinating the activities in regular meetings and annually revising and updating the plan. The plan is put into practice by the schools at the different educational levels. These levels are:

- Early childhood education
- Basic education
- Vocational education
- Upper secondary school education
- Polytechnic education
- University education

Within the schools at each level, teachers are educated as "energy teachers" with relevant knowledge and skills to educate the pupils and students. Together, they form a network of energy teachers. In addition to the teachers, also other staff members, such as study counsellors, are involved in the process.

In addition to the school world, the working sector and particularly Vaasa's energy cluster is highly involved in this process. Representatives from the various firms within the energy cluster participate in educating the pupils and students by, for instance, hosting site visits and visiting schools. These companies are often future employers for students and graduates from the path. Moreover, the Energy Education Path is linked to other projects, such as the learning environment *Yrityskylä* ("Business Village"), which is an award-winning learning concept, where pupils in grades six and nine gain positive experiences of working life, the economy and society, and the project also encourages to entrepreneurship (www.yrityskyla.fi/en).

The Energy Education Path consists of a plethora of activities, subjects, projects etc. at the various educational stages, which means that there are also several actors involved. However, the main actor responsible for the coordination is the working group, and the teaching practicalities are carried out by school staff in the various schools and the energy cluster companies' representatives, while pupils and students are the ones learning.

The replication will be organized by utilizing the already existing organization structure for the Energy Education Path. The structure will be continuously updated based on recognized needs and insights gained via the demonstrations in the lighthouse cities.

Data collection and management

No detailed plan is currently available.

Barriers and drivers

- Political:
  - Driver: Local political system supports the existing Energy Education Path program since it is a strategic priority in the City of Vaasa.
  - Barrier: -
- Economical:
  - Driver: The existing Energy Education Path program is integrated in the schools' educational programs, hence financed via normal school resources (city or governmental funding). Thus, it is not dependent on external funding resources.
  - Driver / Barrier: The economical basis for enabling the activities is depending on all involved educational institutions' decisions.
- Sociological:
  - Driver: The existing Energy Education Path program is carried out on all educational levels ranging from kindergarten to university level. Since the Finnish school system is based on the principle of integrated schools, all pupils independently of their backgrounds are involved in the program activities.
  - Barrier: -
- Technological:
  - Driver: The energy industry (energy cluster) in the Vaasa region is focused on innovative technology. Digitalization is an integrated part of this.
  - Barrier: -
- Legal / Regulatory framework:
  - Driver: Within the Finnish legislation, educational institutions have the freedom to emphasize different topics within the degrees and curricula. The legislation does not limit this precisely. Curricula on various educational levels have the topic energy and sustainable development as a natural part of the required contents.
  - Barrier: -
- Environmental:
  - Driver: Energy and sustainable development, including environmental aspects, are very closely connected, and there are courses on the various educational levels combining these topics.
  - Barrier: -

Business model

The existing Energy Education Path program is integrated in the schools' educational programs, hence financed via normal school resources.

Governance

The Energy Education Path program is led by the City of Vaasa.

Impact assessment

The impact is assessed via the continuous measurement of pupils and students involved in the activities. The impact of the program on the energy cluster in terms of providing skilled workforce to the companies is also assessed regularly.

Implementation plan

The existing Energy Education Program is an ongoing program, which is continuously updated.

WBS – Work Breakdown Structure & Gantt chart

No detailed plan is currently available.

Financing schemes and opportunities

No detailed plan is currently available.

8.10. Conclusions on ambitions and planning of activities for TT #5 Citizen Engagement and Co-creation

TT#5 differs from the other Transition Tracks since it is, besides being an own Transition Track, integrated into all the other Transition Tracks and thus included not only in this section, but also in the previous sections of the replication plan. The city of Vaasa plans to replicate all four Integrated Solutions within TT#5. The aim of all citizen engagement activities within replication is to ensure that citizens are motivated to change their behavior in relation to the replicated Integrated Solutions. The replication of the four Integrated Solutions described above differs in terms of their current state and nature:

- IS-5.1 is to be specified in parallel with the specification of related replication of Integrated Solutions from TT#1 and TT#3. The specifications can be built upon knowledge and experiences from previous Vaasa projects.
- IS-5.2 is to be further planned and specified taking into consideration best practices from other cities and especially the experiences from the "Min Stad" demonstration in the Lighthouse city Gothenburg.
- IS-5.3 has started within the project LähiöInno and will be closely connected to the Living Lab demonstration of the Lighthouse city Utrecht.

- IS-5.4 is building upon the existing Energy Education Path program in Vaasa. The replication will utilize experiences and knowledge gained in the Lighthouse cities Utrecht and Nice, and will connect the established Vaasa network to the IRIS network.

The citizen engagement activities in Vaasa are in general supported by the participation program of the city. The current participation program is still valid for the year 2020, and the program for the period of the coming three years, 2021-2024, is currently being developed.

9. Summary of Follower City use cases and measures

Transitions Tracks	Integrated Solutions	Vaasa		
		R	Project name	Status
#1 Smart renewables and closed-loop energy positive districts	**IS-1.1:** Positive Energy Buildings	R	Wasa Station	
	IS-1.2: Near zero energy retrofit district	R	Several: Olympia, Ristinummi	
	IS-1.3: Symbiotic waste heat networks	R	Vaskiluoto heat storage	
#2 Smart Energy Management and Storage for Energy Grid Flexibility	**IS-2.1:** Flexible electricity grid networks	R	**Smart Grid (Sundom)**	
	IS-2.2: Smart multi-sourced low temperat	R	Suvilahti self-sufficient district & Ravilaakso low temperature DH	
	IS-2.3: Utilizing 2nd life batteries	-	**TBA**	
#3 Smart e-Mobility Sector	**IS-3.1:** Smart Solar V2G EVs charging	-	**TBA**	
	IS-3.2: Innovative Mobility Services	R	EC2B Ravilaakso	
#4 City Innovation Platform (CIP)	**IS-4.1:** Services for Urban Monitoring	R	**TBA**	
	IS-4.2: Services for City Management	R	**TBA**	
	IS4.3: Services for Mobility	R	**TBA**	
	IS-4.4: Services for Grid Flexibility	R	**TBA**	
#5 Citizen engagement and Co-creation	**IS-5.1:** Co-creating the energy transition	R	**Ristinummi district, Olympia**	
	IS-5.2: Participatory city modelling	R	**TBA**	
	IS-5.3: Living labs	R	LähiöInno	
	IS-5.4: Apps and interfaces	R	Energy Education Path	

Colour	Description
	Design of replication projects started
	Replication objects identified
	Replication projects to be investigated

10. Output to other work packages

Please see 1.3. Relation to other activities

11. Conclusions

Vaasa's City Council set a target for the City in December 2019, to achieve carbon neutrality by 2030. This decision also determined the framework for the *Carbon Neutral Vaasa 202X* roadmap designed together with the local business community, universities and public bodies, securing collaboration and committed involvement from all key stakeholders to fight against climate change, and to reach the carbon neutrality goal in time. The Carbon Neutral Vaasa 202X program strives to create the most credible path for fast and profitable transition to carbon neutrality, by facilitating the energy transition away from non-renewables, and developing export concepts for complete carbon neutral city solutions. Additionally, the City of Vaasa has committed to the Covenant Mayors program in 2016, which requires Sustainable Energy Action Plan (SEAP).

The IRIS Smart Cities project is a perfect enabler for the City of Vaasa to accomplish the climate objectives and plans mentioned before. Being part of the IRIS project provides Vaasa a vast variety of innovative and effective smart energy related solutions, demonstrated by the Lighthouse Cities, which are replicable and best suited for Vaasa. With these replicable solutions the City of Vaasa can better achieve carbon neutrality, and gain long-term value and well-being for its citizens and businesses.

The City of Vaasa strives constantly to find new means to further sustainable development on all levels, thus ensuring the well-being of its citizens, growth of the city's population, and to increase employment rates and the economic growth. The transition process to carbon neutrality requires fast action and determination, while looking after the performance of the businesses and the economy. To achieve this, new innovations and joint export concepts are needed. The City of Vaasa launched its Energy and Climate Program in 2016 prioritizing in five main goals:

- Improving energy efficiency by saving energy and intensifying its use.
- Adding renewable energy sources: solar, hydro, wind, wave, geothermal and bio energy.
- Developing energy services for neighborhoods, constructors and renovators.
- Reducing CO_2 emissions by 30% by 2020 from 1990 level.
- Buying only green electricity for public buildings.

The IRIS Smart Cities project aid also to achieve these goals.

The main objective of this Deliverable is to provide a planning template, a roadmap, for potential replication actions and development projects for the Vaasa ecosystem. This replication report focuses on removing obstacles from investments, by providing visibility and technical assistance. It also provides knowledge, technical assistance and visibility for replication in wider perspective, and makes intelligent use of the latest and established financial resources.

Some of the integrated solutions presented in this Replication plan are lacking precise financial and funding schemes, due to the early stage of the solutions in question. These financial plans will be concretized later on.

The secondary objectives of this Deliverable are:

- Prioritizing the replication activities of integrated solutions in Vaasa ecosystem.
- Describing the risks and the mitigation plan concerning the replication activities.

- Providing implementation of KPIs monitoring plan.

The desired end-result is, that at least some of the IRIS integrated solutions will be implemented in Vaasa ecosystem, in the near future. For rest of the IRIS integrated solutions presented in this report, the investigation of their potential and planning of their possible replication continues.

Solutions to be replicated and their status:

Green: Design of replication projects started

Orange: Replication objects identified

White: Replication projects to be investigated

Transition Tracks	Integrated solutions	Follower Cities	
		Vaasa	Status
#1 Smart renewables and closed-loop energy positive districts	IS-1.1: Positive energy buildings	R	
	IS-1.2: Near zero energy retrofit district	R	
	IS-1.3: Symbiotic waste heat networks	R	
#2 Smart energy management and storage for energy grid flexibility	IS-2.1: Flexible electricity grid networks	R	
	IS-2.2: Smart multi-sourced low temperature	R	
	IS-2.3: Utilizing 2nd life batteries for smart large scale storage schemes	-	
#3 Smart e-mobility sector	IS-3.1: Smart Solar V2G EVs charging	-	
	IS-3.2: Innovative mobility services for the citizens	R	
#4 City innovation platform (CIP)	IS-4.1: Services for urban monitoring	R	
	IS-4.2: Services for city management and planning	R	
	IS-4.3: Services for mobility	R	
	IS-4.4: Services for grid flexibility	R	
#5 Citizen engagement	IS-5.1: Chnaging everyday energy use	R	
	IS-5.2: Participatory city modeling	R	
	IS-5.3: Living labs	R	
	IS-5.4: Behaviour changing information	R	

12. References

[1] Sustainable Energy Action plan, City of Vaasa / Covenant of Mayors / https://mycovenant.eumayors.eu/docs/seap/21324_1455174727.pdf

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[3] **City strategy / City of Vaasa 9.12.2019 https://issuu.com/graafisetpalvelut_vaasa/docs/vaasa_-_kaupunkistrategia-2020-2021?fr=sMDc0ZjczNTQ3MQ**

[4] **Sustainable Mobility plan** / City of Vaasa / https://www.vaasa.fi/en/living/traffic-and-streets/sustainable-mobility/

[5] Data https://www.vaasa.fi/en/news/data-helps-the-city-of-vaasa-go-carbon-neutral/

Annex 1

TT#1 Replication in a nutshell

Lighthouse	Demonstration activity
Utrecht	The demonstration activities of TT#1 on Smart renewables and near zero energy district in LH Utrecht comprise of the integration of a set of solutions integrated and deployed in 12 four-storey apartment buildings of social housing corporation Bo-Ex (8 buildings with gas-infra; 4 with DH-infra, 644 apartments in total).
	• District-scale integrated PV-system installed on 12 apartment buildings, leading to a high share of locally produced and consumed renewable power at district scale making PV profitable without subsidies.
	• RES and LT district heating, to be demonstrated in 4 apartment buildings
	• Energy savings towards NZEB by refurbishment of 12 apartment buildings from energy label E/F to A
	• Installation of innovative HEMS (home EMS TOON) in all 644 apartments, providing feedback on energy consumption, the PV-system, hybrid E/G heating and ventilation and facilitating citizen engagement.
	• A smart hybrid heat pump in four apartment buildings, connected with the existing gas heating device, to provide heat and hot tap water.
	• Energy savings thanks to a small-scale pilot of eight apartment dwellings where a partly DC network in the dwellings is realized.
	• Medium-scale demonstration of smart street lighting, providing district WiFi, dynamic and energy efficient lighting, powered by renewable energy.
	• Installing performance testing and measurement equipment.
Nice	The main objective of Transition Track #1 (TT#1) is the integration and demonstration of different Renewable Energy Sources (RES) based technologies and energy saving measures at building and at district scale including the symbiotic networks alongside with smart energy management systems (SEMS), in order to: a. increase the share of locally produced and consumed renewable energy (self-consumption) for electricity, but also for heating and cooling purposes; b. maximize the energy savings at building and district level reducing the citizen's energy bill and c. define and evaluate the value-adding role of humans and of renewable energy-based solutions at the ecological system contributing to the reduction of air pollution, while at the same time the citizens benefit by increasing their comfort level and the quality of life.

	Collective self-consumption at building scale is a new concept for commercial and residential customers in France while only a small number of projects have been done in Europe so far. This concept will be implemented and tested in Nice Méridia on two positive energy buildings under construction (PALAZZO MERIDIA and IMREDD buildings).
	A new smart control system will be implemented and tested in Les Moulins on two degraded high-rise buildings (132 apartments) enabling to adjust the heat supply to the individual demand in each apartment. An innovative commissioning process will be tested to measure the real energy savings induced by this smart control system.
	An urban scale Local Energy Management Dashboard will be implemented and tested in Grand Arénas on a waste heat recovery system allowing near real-time measuring, failure tracking and energy management at home, building and district level, facilitating the efficient operation among various energy resources and evaluating any potential optimization actions.
Gothenburg	Gothenburg will demonstrate a positive energy sub-district consisting of 6 buildings (132 apartments). These buildings will be connected to a further 55 buildings on the Chalmers campus for trading surplus heating and cooling solar PV. Gothenburg will also demonstrate how building integrated solar cells on the facade and roof of HSB Living Lab can be used within the renovation process. Six different BIPV facilities were installed at the HSB Living Lab to be able to compare and evaluate from a technical and economic point of view.
	• Demonstration of at least 200 kWh electricity storage in 2nd life automotive (bus) batteries powered by 140kW local PV
	• Demonstration of heating from geo energy with heat pumps (2-300 m deep boreholes),
	• Demonstration of cooling from geo energy without chillers
	• Demonstration of local energy storages consisting of water buffer tanks, structural (thermal inertia of the building) storage and long-term storage in boreholes
	• Demonstration of seasonal energy trading (cooling in summer season) with adjacent office block
	• Development and demonstration of advanced Energy Management System to integrate PV, DH, grid and all abovementioned storage options to achieve peak shaving and minimal environmental impact
	• Demonstration of how Building Integrated Photovoltaics (BIPV) can be used in façade renovation process.

TT#2 Replication in a nutshell

Utrecht	In a nutshell
Measure 1: Solar V2G charging points for e-cars	Brief summary: 18 smart solar V2G chargers in the district, at district scale interconnected with the PV-systems
	Expected impact: This measure has already led to city-wide scale-up of V2G-chargers, solar PV-systems and district energy management. This bi-directional ecosystem had its world premiere in May 2019 in the presence of King Willem-Alexander of the Netherlands and top executives of Groupe Renault. The bi-directional charging / discharging stations will provide the infrastructure for the ambition to integrate smart energy management, combining sustainable transport with maximising self-consumption and reducing grid stress, and unlocking the financial value of grid flexibility. This is necessary infrastructure to demonstrate in the selected demonstration areas the opportunities for flexibility creation through district scale storage, combining the batteries from V2G e-cars and V2G e-buses with stationary batteries, supported by open ICT for interconnection, performance monitoring and new information services for aggregators, grid operators, municipality and citizens. The bidirectional charging/discharging stations are installed in a demand-driven pace.
Measure 2: Solar V2G charging points for e-buses	Brief summary: 10 smart solar/wind V2G charging spots for e-buses in Westraven
	Expected impact: The e-bus charging stations will provide monitoring and research data for the ambition to integrate smart energy management, as well as an interesting case of how the large charging powers can best be connected to the grid.
Measure 3: Stationary storage in apartment buildings	Brief summary: District-wide additional stationary storage in 12 apartment buildings, including 2nd life batteries, interconnected to primary V2G-storage and PV-systems by green ICT
	Expected impact: The battery will make an important contribution to making the grid more stable and resilient, as well as provide an important component for the city-wide 'virtual power / storage plant' which will provide sustainable energy, emission-less mobility as well as flexibility services on low and medium tension levels.
Measure 4: Smart energy management system	Brief summary: District EMS, the district ICT platform providing interconnection and monitoring at district scale, allowing deployment of the Universal Smart Energy Framework (USEF, fundament of the business model 'Value of Flexibility)
	Expected impact: The USEF/Gopacs smart energy management system will for the first time assess the value to the TSO as well as to the DSO, of flexibility delivered at low / medium tension grids.

Nice	In a nutshell
#1 IS 2.1 - Flexible electricity grid networks (PV // batteries // lighting network)	Brief summary: integration of local vRES (variable Renewable Energy Sources), decentralized battery storage and public/private EV charging infrastructure under a common Local Energy Management System. Objective is the testing of different operation strategies of such connected assets, towards the delivery of flexibility services to the electric grid. The demonstration is organised among different service layers, starting from the management of single assets towards the district scale and further, achieve the interfacing with energy service markets via aggregation.
	Expected impact: to be "pilots" for the industry and serve as model for further developments and replication. Provide contribution in terms of return-of-experience and results, to the complex debate concerning smart local energy management systems and thus, be integrated into the dissemination, communication and replication activities.
#2 IS 2.2 - Smart multi-sourced low temperature district heating with innovative storage solutions (excess heat from buildings equipment // heat pumps // thermal storage // decision and citizens apps)	Brief summary: The demonstration aims at assessing the potential convergence of operational strategies for integrating the management of heating, cooling and power at district scale, thanks to the supervision system to be deployed. The objective is the optimisation of the exploitation of a geothermal sourced district heating and cooling network, via the integration of different storage solutions, accompanied by an enhanced energy management system.
	Expected impact: As previous demonstrator, however focused not on the electric grid, but on the optimisation of thermal grids.
#3 IS 2.3 - Utilizing 2nd life batteries for smart large-scale storage schemes (PV // EVs // V2G)	Brief summary: aim is the cross-comparison of the use of 1st and 2nd life BESS (Battery Energy Storage Systems) for similar applications within the building sector. In other words, both batteries (1st life BESS in the EV, via a V2G charging pole, and the 2nd life BESS stack) will be used for providing stationary BESS based energy services within the IMREDD building. By using similar BESS capacities, performances and their temporal behaviour will be more easily made comparable.
	Expected impact: be the first of a kind implementation within the French context, which should serve as model for further developments and replication. Provide confidence to related stakeholder and decision makers and promote the further development of such solutions. Part the assessments scope is the testing of the performances of these single technologies, in providing building and grid relevant services (i.e. the

	optimization of self-consumption projects, PV valorisation and curtailment reduction). This should lead to a better assessment for they integration path into the energy system.

Gothenburg	In a nutshell
#1 Demonstration of A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage	Brief summary: In this demonstration Akademiska hus together with IRIS demonstrate how DC system can give advantages when local electricity is produced with (PV) and stored in battery systems.
	Expected impact: The batteries are primarily expected to provide peak power shaving, as well as storing locally produced PV electricity. Secondarily, they can be used to buy and store electricity from the grid to use or sell later. The DC system will provide secure supply and in an energy efficient way.
#2 Demonstration of a low temperature DH 45/30 system for six buildings	Brief summary: This measure considers connecting the buildings in Viva with a low temperature heat transport network.
	Expected impact: A heating system with steady service, providing high comfort with a low amount of purchased energy.
#3 Demonstration of A 1700 kWh PCM (Phase Change Material) cooling storage.	Brief summary: The purpose of PCM Cold Storage is to reduce the peak cooling power demand by storing cooling energy in Phase Change Materials (PCM) in a Thermal Energy Storage (TES).
	Expected impact: The PCM storage are primarily expected to provide peak power shaving in the AWL building. It can also reduce the peak power in the campus cooling system KB0 system in the way that AWL building will have lower power demand.
#4 Demonstration of integration and evaluation of a 200kWh energy storage	Brief summary: This measure explores the re-usefulness of vehicle batteries in stationary applications.
	Expected impact: The batteries are primarily expected to provide peak power shaving, as well as storing locally produced PV electricity. Secondarily, they can be used to buy and store electricity from the grid to use or sell later.

TT#3 Replication in a nutshell

Utrecht	In a nutshell
Measure 1: V2G E-cars	Brief summary: The MaaS “We Drive Solar” car sharing system will be demonstrated in the LH demo district by means of 14 solar powered V2G e-

	cars delivered by Renault. Also, Bo-Ex will procure 4 e-vans to replace its existing vans for maintenance and service use.
	Expected impact: The IRIS Utrecht demonstration is serving as a living lab and a catalyst for fast upscaling of smart energy and mobility management for the whole city of Utrecht. LomboXnet is rolling out the technology in the whole city and even in the region around Utrecht city. This bi-directional ecosystem had its world premiere in May 2019 in the presence of King Willem-Alexander of the Netherlands and top executives of Groupe Renault; at the same event the new open standard for V2G charging was launched by ElaadNL and the Open Charge Alliance. The shared e-cars will provide a green alternative mode of transport for the IRIS district residence, reducing NOx, fine particular matter, carbon monoxide and carbon dioxide emissions. At the same time their batteries contribute to smart energy management, combining sustainable transport with maximising self-consumption and reducing grid stress, and unlocking the financial value of grid flexibility.
Measure 2: V2G e-buses	Brief summary: 10 smart solar V2G e-buses by QBuzz
	Expected impact: The e-buses and charging stations will provide not only a green mode of public transport for the IRIS district residents and reduce emissions, but also generate large amounts of monitoring and research data for the ambition to integrate smart energy management, as well as an interesting case of how the large charging powers can best be connected to the grid.

Nice	In a nutshell
#1 Smart - Solar - V2G EVs charging	Brief summary: Measure #1 addresses the deployment of a smart charging infrastructure (hardware and software). Smart charging is a charging system where electric vehicles, charging stations and charging operators share data connections. It aims to monitor, manage, and restrict the use of charging devices to optimize energy consumption. By monitoring a large pool of charging stations equipped with fast charging points, belonging to both public and private networks, it is expected to provide more flexibility to the public electricity grid not only by implementing power shaving and shifting (V1G) but also other energy services as i.e., primary or tertiary reserves (V2G). The smart integration of such strategies should lead to the optimization of the total energy consumption, and possibly generate a new income stream for EVCI operators and owners.
	Expected impact: equivalent CO2 from gas CHP plant saved [tCO2eq/MWh] - Flexible volume/power of electricity [MWh - MW] (depending on the targeted energy service)

#2 Innovative Mobility Services for the Citizens	Brief summary: Measure #2 addresses the optimization of the operation of a shared EV fleet by coupling the booking and forecasting of the use of EVs to a smart charging management of the EVCI. The benefits are a higher utilization rate of shared EVs, thus an increased turnover of vehicles, a consequent reduction of the ratio between the number of required charging stations and the number of EVs. It is expected that such an enhanced car sharing exploitation system should favour the implementation of smart charging services in a more reliable and/or efficient manner.
	Expected impact: Vehicle utilization rate (# travel/day) – avg. battery load after trip (kWh) – avg. number of trips before charging (# trip/EV)

Gothenburg	In a nutshell
#1 EC2B for tenants in Brf Viva	Brief summary: The MaaS concept EC2B offers customers an attractive alternative to owning their own car, allowing easy access to a variety of transport modes (as e-cars, e-bikes or public transport) in connection to where customers live or work. In demonstrator #1 EC2B is implemented for tenants in the 132 apartments in Brf Viva in Gothenburg, where no private car parking is available.
	Expected impact: Providing a mobility service instead of car parking means tenants are nudged towards more sustainable transport habits, using a car only when they need one.
#2 EC2B for employees on Campus Johanneberg	Brief summary: In demonstrator #2, the EC2B concept is adjusted to cater for the needs of employees in the campus area of Johanneberg. In addition to providing easy access to a wide range of transport options, a function will be developed within the EC2B app which allows employees to send receipts of their travel expenses (as car rental fees or public transport tickets) directly from the app to their employer's financial department in order to reduce administrative procedures.
	Expected impact: Through offering attractive options for local business travel, employees will be less dependent on driving their own car to work to be able to use it for business trips during the day, resulting in more sustainable transport habits and less traffic in the campus area. An added benefit is a reduced administrative burden for handling travel expenses.

TT#4 Replication in a nutshell

Utrecht	In a nutshell
Measure 1: Monitoring EMobility with LoRa network	Brief summary: So far, the pilot is developing successfully. Cooperation between involved IRIS project partners Municipality of Utrecht, WeDriveSolar and Civity is established, leading to task and budget assignment and planning. Also, procurement of equipment (parking sensors) and cooperation with Communithings is established. The first sensors are put into place and monitoring starts further conclusions can be drawn.
	Expected impact: A data service will contribute to a more efficient use of the charging infrastructure in Utrecht and beyond. Thereby contributing to lowering the costs for charging infrastructure and optimizing charging services for e-drivers.
Measure 2: Smart Street Lighting with multisensory	Brief summary: In two co-creation workshops functional specifications for a smart pedestrian crossing have been set. Technical specification of the crossing and lamppost has been done. Early 2020 the smart street lighting and the crossing will be put into place. A second track has been opened in this measure. The municipality of Utrecht is currently facing the procurement for replacement of 60.000 lamp posts within the city. A tender will be put into the market. The municipality of Utrecht wants sensor and connectivity services to be a part of this procurement. The city aims at deriving lessons from the IRIS project to put a successful tender into the market for the 60.000 lampposts.
	Expected impact: Data collected through these sensors should be used to enhance data driven district policies aimed at reducing/minimizing problems faced by the citizens in public space. Future connectivity services promise a new business model for the operation of street lighting.
Measure 3: 3D Utrecht City Innovation Model	Brief summary: A '3D City Information Model application' for the Kanaleneiland district in Utrecht has been developed. This model is a data-based 3D representation of the district and provides insight into the energy performance in Kanaleneiland. The app “Mijn Woonwijk” was developed. The app is aimed at increasing the involvement of citizens in the changes and new projects in their neighbourhood. The app was developed and tested among a limited number of users.
	Expected impact: 3D visualization that potentially can support integrated city planning and promote the involvement of citizens. Experience shows that participation leads to better projects, better considerations and decision-making and more support for finally selected solutions.

Measure 4: Monitoring Grid Flexibility	Brief summary: For the implementation of Grid Flexibility Services the assets need to be installed. The energy storage battery will be installed Q1 2020 meaning services will start summer 2020. Progress so far has been implementing the necessary data connections
	Expected impact: The potential of flex services is reducing effect on peak loads in the grid and in the future avoiding heavy grid investments, optimization of the use of local renewable energy and thereby reduce climate impact.
Measure 5: Fighting Energy Poverty	Brief summary: A challenge/tender for Energy Poverty Services has been put into market. The challenge didn't deliver a satisfying solution. A different approach using the smart in home energy manager TOON (TT1) will be developed together with Eneco.
	Expected impact: The objective is to develop a data service for tenants of housing corporation Bo-Ex, which gives them control over and/or better understanding of their energy bills, resulting in reduced energy bills and increased disposable income of tenants.

Nice	In a nutshell
Measure#1: Sensors data collection in air quality	Brief summary: Measure#1 "Sensors data collection in air quality" will enable to improve air quality data and support citizen engagement. Air data will be retrieved thanks to sensors and stations measurements; traffic data collected on the CIP and on other sources. The AZUR data model will integrate all these data to strengthen the accuracy of its future hourly output. These correlated data will be converted into innovative pedagogical tools co-designed with the Metropole NCA, relevant stakeholders and citizens.
	Expected impact: Measure#1 will enable to take advantage of collecting data in order to generate citizens' engagement. On the one hand benefits are expected for the air quality evaluation (upgrade AZUR accuracy output, additional local traffic and air quality data, integration of sensors data within a data model). On the other hand, this measure will support citizen engagement. The data collected will be converted into pedagogical tools to raise awareness, enhance behavioral change, improve the quality of urban life etc.
Measure#2: BIM/CIM data display	Brief summary: The Nice Côte d'Azur Metropolis wants to demonstrate the capacity of the multi-scale BIM from the perspective of the City Information Platform (CIP) deployed in the IRIS project and the ability to integrate real-time "hot" data at the urban and scale Buildings.
	Expected impact: The main goal is to improve the various stakeholders' global understanding of the urban future of Nice Meridia district in terms of development of physical accommodations and of main activities performed by this area.

Measure#3: Services for mobility	Brief summary: The demonstration on how smart charging can be used to provide flexibility for the electric distribution grid based on a dynamic management of a shared EVs fleet to offer V1G and V2G energy services to the energy market while optimizing the turnover of vehicles and their availability to the end-users by an advanced forecasting and a dynamic management of EV battery charging.
	Expected impact: Providing flexibility services based on smart charging to reduce the local grid imbalances and, beyond, to contribute to the energy market. Providing an efficient car sharing service based on electric cars to foster the electric mobility market by reducing the barriers to EV adoption.
Measure#4: Services for grid flexibility	Brief summary: This system, which is connected to local VRES (variable renewable energy sources), decentralized battery storage and public/private EV charging infrastructure, aims to test different scenarios in order to provide flexibility services to the power grid.
	Expected impact: The new tool will allow us to see in real time the impacts of the different energy scenarios on the elements of the building, will also play an educational role and will make it possible to raise the awareness of the various actors of the territory to energy (production of renewable energy, self-consumption, storage ...) which is a major stake in the territory.

Gothenburg	In a nutshell
Measure#1: CIM Pilot	Brief summary: Gothenburg is in the middle of a major transformation in the City's central areas, and many large construction projects take place at the same time. Such big changes within urban areas will affect many people's lives and force a higher degree of coordination between many actors and organizations. It also requires better information and communication. To meet the challenge, the City of Gothenburg wish to establish a CIM (City Information Model), an information model where City information is stored and can easily be accessed. To test the concept of CIM, the City of Gothenburg in the IRIS project demonstrates a pilot of CIM (City Information Model). One objective for the CIM pilot is to demonstrate the value of automating the process of collecting BIM data from building projects for different phases in the building process. A project using BIM creates a lot of valuable information from the analysis phase through to the design, construction and finishing phases. The idea is that when the collection of this data is automated, and the BIM data is saved in a structured and well-defined way, the data can easier be used to get citizens engaged in projects. It can also easier be used by current and future city building projects in the close by area. They could reuse the data already produced by another project for instance to check for collisions or to find results from earlier investigations etcetera. In the CIM pilot the idea is to provide BIM data from reference project as open or shared data in combination with other geospatial City data. This data could then be downloaded and consumed in applications for visualization or in project design tools. The tool will be demonstrated to upload, validate and save BIM data. Also, it will be demonstrated

	Expected impact: In Gothenburg City, the CIM pilot is expected to contribute to improved planning management, control and maintenance for better energy and transport services for citizens and businesses. It should also contribute to Citizen engagement in urban development and growth. The CIM pilot is expected to contribute to the creation of the real CIM for Gothenburg and to contribute to the development of third-party applications. The CIM pilot is also expected to save resources by reusage of data, which would contribute to increased sustainability.
Measure#2: Energy cloud	Brief summary: The Energy Cloud will collect, structure, store and share energy data from buildings on the Chalmers University of Technology campus in Gothenburg, including micro-production, EV-charging, building control systems, smart meters and tenants using the RealEstateCore ontology.
	Expected impact: The overall ambition with the Energy Cloud is to reduce energy consumption in buildings - first at Chalmers Campus of Johanneberg and Gothenburg city, then Sweden and Europe. This will be achieved by targeting one of biggest bottlenecks for data driven energy savings - access to structured energy data. With the Energy Cloud and its standardized energy data structure, property owners will be able to quickly scale local energy efficiency projects to their entire portfolio. Digital energy services and applications such as visualizing to tenants, building energy management systems (BEMS), energy optimization service and advanced energy research projects can also use the Energy Cloud to replicate and scale faster and at lower cost.

TT#5 Replication in a nutshell

Utrecht	In a nutshell
#1 Community Building by Change Agents	Brief summary: The main objective is to inform the community and tenants of the apartment buildings about the measures of the IRIS project and their purpose. Secondary objective is to create a network of engaged citizens, that can act as change agents for the rest of the community.
	Expected impact: Change agents from the district are not distrusted by the others and can influence tenants and citizens without liability.
#2 Campaign District School Involvement	Brief summary: The main objective is to involve parents through the primary schools' (Kaleidoscoop, Da Costaschool and Schatkamer) children. Professional school MBO Utrecht will be involved by providing training and possibly jobs to youngsters living in the district, while installing and maintaining the integrated smart solutions in the demo district.
	Expected impact: More acquaintance by children with the subject of sustainability, a positive vibe within youngsters about the IRIS-initiatives who will involve and help their parents.

#3 Evaluation and co-creation	Brief summary: The main objectives are to create an innovation hub within the district of Kanaleneiland-Zuid and to develop a personal interface of HEMS and/or apps.
	Expected impact: More fame and a better reputation of the local innovation hub, and a HEMS with an appropriate interface for the tenants of Bo-Ex.
#4 Campaign smart street lighting	Brief summary: The main objective is to organize a process of co-creation where people can think about and work on feasible solutions for smart street lighting.
	Expected impact: A high level of co-creation which results in a warm welcomed product which is adopted by the district involved.
#5 Virtual Reality Platform	Brief summary: This activity focuses on a virtual reality platform for apartment buildings to other new buildings so households can experience their future 'new' home, including infotainment and interactive training about the new smart energy and mobility services they may expect.
	Expected impact: With a better view on the future situation, tenants are equipped better to make their choice and support the plans of the refurbishment.

Nice	In a nutshell
#1 Public awareness campaign Air Quality	Brief summary: Three solutions will be implemented: urban awareness campaign, students training project and commuting to work by air quality measurement to develop car-sharing.
	Expected impact: Raise the awareness of various targets about the air quality: general audience, white collars, and young people to change the habits of mobility.
#2 Public awareness campaign Energy – School & Collège; Youth & Family	Brief summary: The objective is to increase general knowledge of the world of energy and/or their environment in order to raise the awareness of different audiences and encourage them to change their behaviour.
	Expected impact: More acquaintance by children with the subject of sustainability, a positive vibe within youngsters about the IRIS-initiatives who will involve and help their parents.
#3 Citizens individual engagement – IOT	Brief summary: Integrate in the same IOT application the energy consumption of each tenant from different sources and deliver relevant messages related to their behaviour.

	Expected impact: Increase understanding of the link between individual behaviour and its impact on personal energy bills.

Gothenburg	In a nutshell
1) **Minecraft as a dialogue tool for citizen engagement** Activity Minecraft: 1a) Minecraft in the planning process	Brief summary: The activity investigates whether and how the digital platform Minecraft can be used as a tool for collecting information and knowledge from children within the work of a detail plan for city development.
	Expected impact: To be able to summarize experiences and success factors for using Minecraft as a tool for child dialogue in the planning process. By extension, the activity itself can arouse children's interest in planning and urban development in general, which is a positive side effect. Another side effect: The City Planning Office has a need to study, test and evaluate methods for citizen dialogues with children, something that is not fully accommodated in the ordinary planning process. Implementing this within the IRIS project provides an opportunity to get a much-needed work done.
Minecraft as a dialogue tool for citizen engagement Activity Minecraft: 1b) Minecraft summer camp in Gothenburg City Triennal, 2021	Brief summary: In the summer of 2021 Gothenburg turns 400 years. This will be manifested in an urban exhibition by the Jubilee park in the city development area Frihamnen and the new bridge over the river. The IRIS project will collaborate with the Gothenburg City Triennial 2021 to create a summer camp where 3-4th graders can participate for a week to rebuild Gothenburg in Minecraft and physically build parts of the suggestions as part of the urban exhibition.
	Expected impact: The test will provide information on how Minecraft can be used as a tool for citizen engagement in combination with traditional physical construction work for citizen engagement in site building activity for children and young people.
2) Min Stad as a dialogue tool for citizen engagement Activity Min Stad 2a) The citizenship engagement model (ME-model)	Brief summary: ME-model will provide a starting point for the planned activities within this WP and all the activities will, in turn, contribute to the knowledge about what rights and obligations citizens have in the different types of commitment in each phase. Within the IRIS project the Engagement Ladder is used as a reference tool to determine the possibilities for citizens to influence decision-making, articulating their needs, challenges and problems.
	Expected impact: The ME model constitutes the basis for learning and knowledge generation about citizens' involvement and commitment to further development of the Min Stad Platform. The ME model will also provide the basis for discussing what kind of organization and facilitation the different types of citizenship require.

Min Stad as a dialogue tool for citizen engagement Activity Min Stad 2b) Smart City Hub	Brief summary: The Smart City Hub is an idea of tool that compiles, and filters information based on specified rules and a geographic context. The information that such a tool consumes should be open data provided by the City. For example, data describing ongoing plans, ongoing street work, planned events or documents, and information stating political decisions, all geocoded to a geographic location or area.
	Expected impact: To investigate the need and possibilities for a platform / tool that compiles, and filters information / selects specific geographical contexts. Identification of opportunities and challenges in continued work on the development of Min Stad 2.0.
Min Stad as a dialogue tool for citizen engagement Activity Min Stad: 2c) Continous Dialogue	Brief summary: 'Continuous Dialogue' aims to study and analyse how the established forms of citizen dialogue works and how they can be developed. A fundamental question is what the urban building processes would look like if we opened up to citizen influence during the entire planning process and how it could be done with the help of the digital platform Min Stad (My City). The activity aims to broaden the concept of dialogue to emphasize how the city can receive comments from citizens and the channels to respond to them. The activity is carried out through a number of workshops with representatives from the city building office and the city's various administrations and Chalmers.
	Expected impact: An analysis of how the established forms of citizen dialogue works and how they can be developed.
Min Stad as a dialogue tool for citizen engagement Activity Min Stad: 2d) Inclusive Life Challenge	Brief summary: Students at Chalmers university of Technology enrolled in the master's course "Leading in a digital world", will be engaged in Gothenburg Smart City Challenge based on the city's open data. The incentive for The City's contribution is to fulfil the vision of becoming a Smart City which is circular and sustainable.
	Expected impact: The course will lead to innovations on the area of smart and sustainable cities as well as citizen dialogue / citizen engagement and will be an opportunity for The City Building Office's Geodata department to get new open data innovatively tested and evaluated.
Min Stad as a dialogue tool for citizen engagement Activity Min Stad 2e) Interview Survey	Brief summary: This is an interview study on digital platforms for citizen engagement and innovation. The study is to be carried out in Gothenburg and is about how to encourage greater citizen participation through further developing Min Stad as a dialogue tool, particularly in line with the goals of Jämlikt Göteborg (Equal Gothenburg).1 The main task is to create an interview guide, conduct about 30 interviews with citizens around the digital platform Min Stad and suggest some ideas for development of the platform. The project is to be carried out during the autumn 2020.
	Expected impact: The project will contribute to the overall research aims of: • disseminating information more efficiently in a new digital channel, reaching new user groups and • improving the dialogue between the municipality and citizens as much as possible within the constraints of the current legislative framework.

3) 3D - VR/AR visualisation of BIM and sensor data	Brief summary: JSP will demonstrate a BIM (Building Information Modelling) based 3D Augmented Reality/Virtual Reality Environment. This demonstrator will be housed in the office building "A Working Lab", where the innovative environment and extensive sensor network will provide relevant information to the demonstrator. The AR/VR BIM demonstrator will virtually immerse users in the inner workings and properties of a building, providing deeper understanding and involvement in the building's processes.
	Expected impact: Thanks to the intuitive and simple user interface, a number of new stakeholders that have previously not been involved or asked will be able to engage themselves in these matters. All this, in turn, will enable a greater understanding of and a momentum towards how buildings should be designed and operated for increased sustainability, accessibility and comfort.
4) Personal Threshold Application (PET)	Brief summary: Within the PET project an app was developed that to monitor energy usage and giving feedback to users regarding their energy consumption. The ERO application was designed for a smart home system in mind that could balance the energy demand and supply. The app has a function called Personal Energy Threshold (PET), a momentary power level showing when there is plenty and short of energy in relation to the household's energy consumption.
	Expected impact: The expected impact was to develop a deeper understanding of the tenants' energy consumption at individual level, and let each individual choose what type of energy source to be used and when. Through the developed application ERO the aim was to nudge individuals to choose "green" energy such as energy from the installed PVs (façade and roof).