BOOKLET OF POSITIVE ENERGY DISTRICTS IN EUROPE

PREVIEW

A compilation of projects towards sustainable urbanization and the energy transition

The booklet has been collected and edited by the PED Programme Management of JPI Urban Europe – Christoph Gollner, Robert Hinterberger, Margit Noll, Susanne Meyer and Hans-Günther Schwarz

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Interested in joining the European Positive Energy Cities network? Get in contact with us!

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The Strategic Energy Technology (SET) Plan

The SET-Plan, adopted by the European Union in 2008 and revised in 2015, is a first step to establish an energy technology policy for Europe, with a goal of accelerating knowledge development, technology transfer and up-take in order to achieve Energy and Climate Change goals.

The SET Plan focuses on 10 key actions fields, of which **action 3.2 on "Smart Cities and Communities"** aims to **support the planning, deployment and replication of 100 Positive Energy Districts by 2025 for sustainable urbanisation.**

https://setis.ec.europa.eu/

The Joint Programming Initiative (JPI) Urban Europe

JPI Urban Europe's vision is to be the **European platform to create and make available knowledge and robust evidence for sustainable urban development.**

Twenty European countries participate in the initiative, 70+ projects have been funded with approx. 100 million Euro public investment spent for joint calls. JPI Urban Europe has established cooperation schemes with Belmont Forum and China.

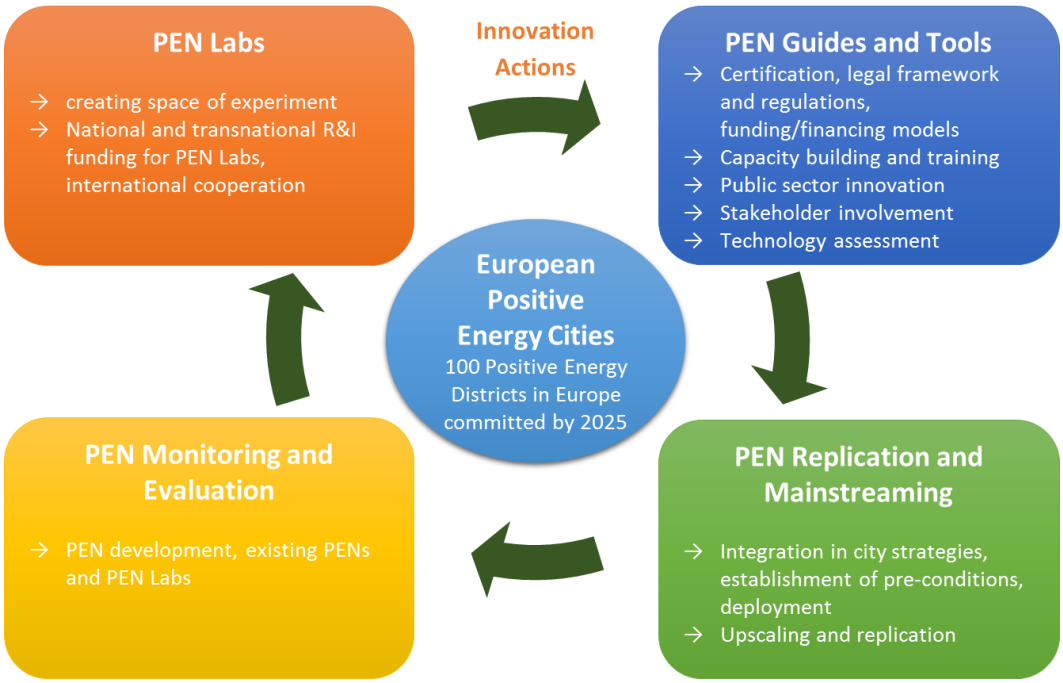
https://jpi-urbaneurope.eu/

PREAMBLE

The **Programme on Positive Energy Districts and Neighbourhoods (PED Programme)** has the ambition to support the planning, deployment and replication of 100 'Positive Energy Districts' across Europe by 2025 for urban transition and sustainable urbanisation. Positive Energy Districts will raise the quality of life in European cities, contribute to reaching the COP21 targets and enhancing European capacities and knowledge to become a global role model.

The Programme on Positive Energy Districts and Neighbourhoods has been established in 2018 by the Action 3.2 on Smart Cities and Communities of the European Strategic Energy Technology Plan. The transnational Joint Programming Initiative (JPI) Urban Europe provides a well-established Programme Management Structure for the PED Programme.

Solid understanding and consideration of cities' strategies towards PEDs, experiences and support needs serve as the base of developing and designing the programme. This is why the PED programme aims at a strong engagement of city authorities, research organisation, public utility provider and industry and citizens organisation in the programme implementation.



PED Programme implementation pathways, Source: SET-Plan ACTION n°3.2 Implementation Plan

The **PED Programme Cities Workshop (3 April 2019, Vienna)** therefore invited cities to co-create the PED Programme in a highly interactive setting and lay the basis for further cooperation. As a preparation for the workshop, the participating cities have been asked about their PED-related project experience. The cases are collected in this booklet. Project descriptions are ordered according to the project status, from "implemented/in operation" to "planning stage". Each project is presented in four sub-sections:

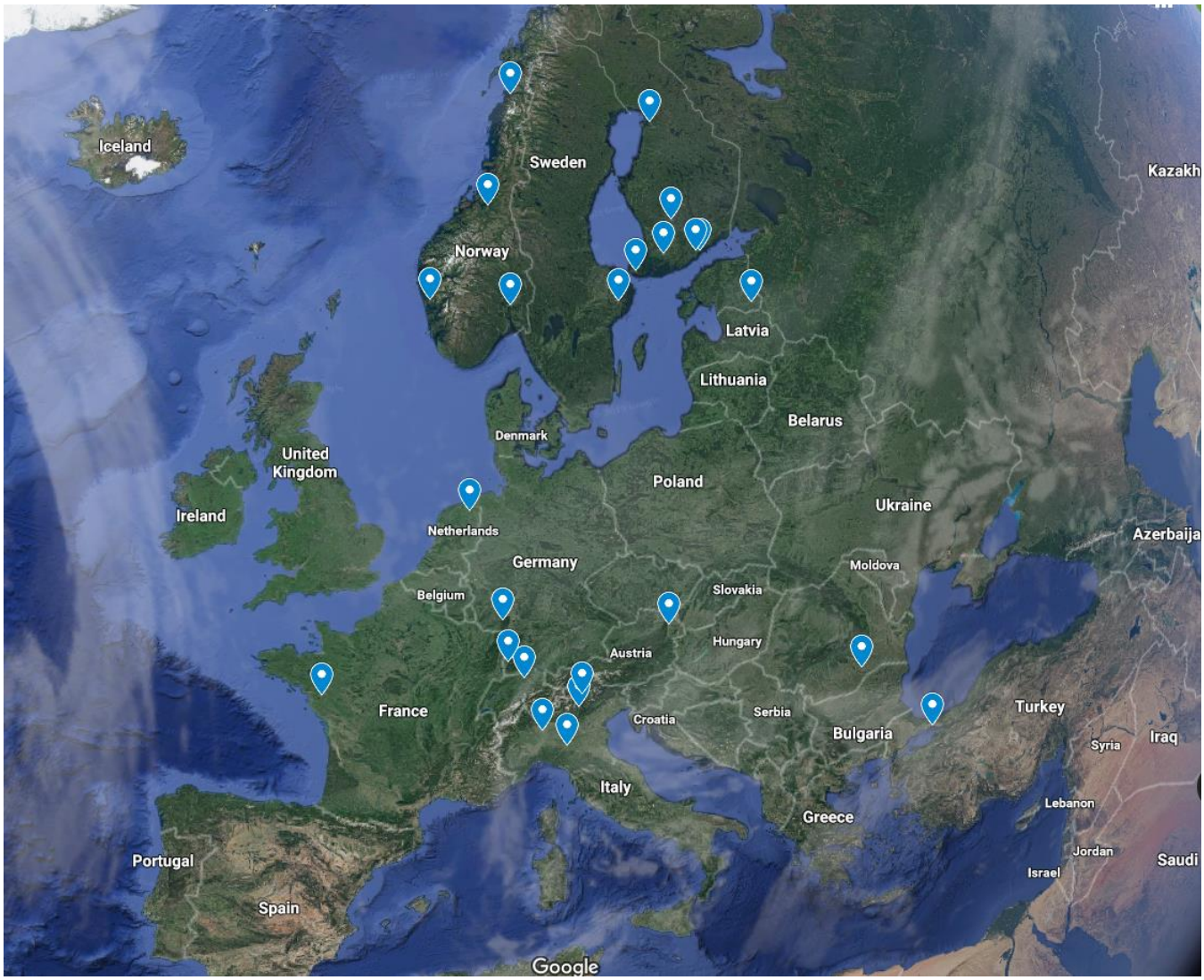
1. General information
2. Overview and description of the project
3. Strategies
4. Success factors and challenges/barriers

An **outlook on the PED Programme** reveals that the workshop findings on support needs of cities will be analysed and turned into

1) a strategic input for a transnational PED Call Programme supported by many European countries starting in winter 2019/2020 and
2) lessons learnt for the design of a Positive Energy Districts Network with dedicated exchange and mutual learning formats.

Many thanks to all contributers! Of course, this compilation is far from complete and must be seen as work in progress, content will be updated regularly and systematic analysis will be conducted.

Cities/projects (as of 12-04-2019)



Source: google maps (12.4.2019)

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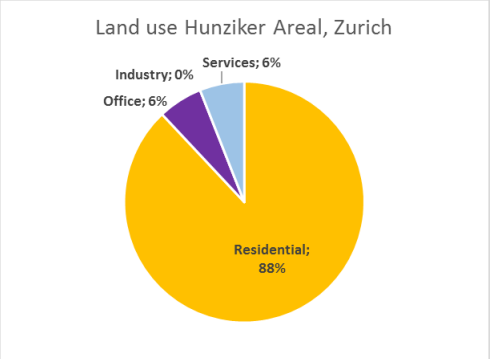
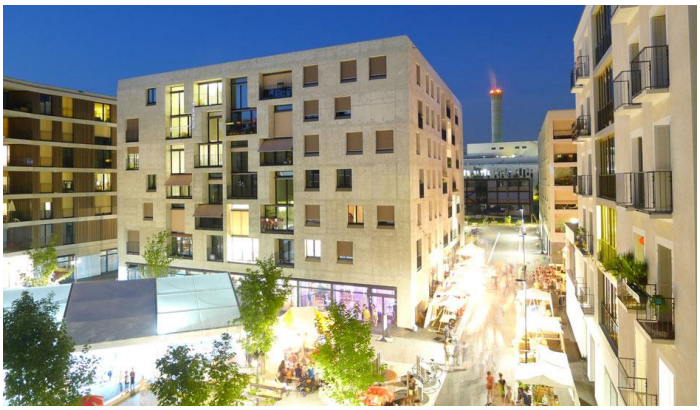
General information	
City	**Zürich, Switzerland**
Project name	**Hunziker Areal**
Project status	planned ☐ under construction ☐ **realized** ☒ **in operation** ☒
Project start – end	2007 – 2017
Contact	Project contact «mehr als wohnen» Example presented for PED Programme Cities Workshop (3 April, Vienna): Swiss Federal Office of Energy Ricardo Bandli Federal Department of the Environment, Transport, Energy and Communications (DETEC)
Project website	https://www.mehralswohnen.ch/
Size of project area	4.1 ha
Building structure	**Newly built** ☒ Existing neighbourhood ☐ Mixed ☐
Land use	- Residential: 88 % - Office: 6 % - Industry: / - Other: Business & restaurant 6 % 
Financing	Private cooperative "mehr als wohnen"

Overview description of the project
Several dozen smaller cooperatives in the city of Zurich founded in 2007 the cooperative "mehr als wohnen" (more than living) with the idea to develop new forms of living and structural innovations. In 2010, the cooperative was able to buy the 41 000 m2 large site of the former “Hunziker concrete factory” from the City of Zurich. Since the beginning of 2015, the Hunziker site in the north of Zurich provides living space for 1200 people and about 150 jobs. 370 residential units offer various typologies for different needs and budgets. The broad range from studios to cluster apartments with spacious communal areas enables a high mixing. The apartments are subject to occupancy regulations and residents should refrain from using private cars. The Participation of the residents is central to active coexistence instead of an anonymous neighbourhood. This is made possible by numerous public ground floor uses and open spaces on the Hunziker site. There they can celebrate parties together, having workshops or plant vegetables. With incentives to combine living and working, attractive business, participatory processes and a variety of living realities, a socially sustainable and lively quarter is priority.

The Hunziker site is operated according to the principles of the 2000-watt society. The buildings meet the Minergie-P standard (energy efficiency and sustainable materials) and are heated with waste heat from the neighbouring municipal computer centre. The photovoltaic systems on the roofs cover 20 percent of the electricity consumption.

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Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ **Energy efficient** ☒ Carbon-free ☐ **Climate neutral** ☒ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒ Other: According to the **goals of 2000-Watt-Society** *(includes CO2 emissions max. 1 tonne per person per year)* https://www.2000watt.swiss/english.html
Indicators/expected impact	- Environmental - Social - Spatial
Overall strategies of city/municipality connected with the project	Smart City Strategies https://www.stadt-zuerich.ch/portal/de/index/politik_u_recht/stadtrat/weitere-politikfelder/smartcity/strategie/publikationstrategie.html Urban Renewal Strategies & Energy Masterplanning https://www.stadt-zuerich.ch/gud/de/index/umwelt_energie/2000-watt-gesellschaft/publikationen/roadmap.html (English)
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ Refurbishment ☐ Sustainable production ☐ **Sustainable consumption** ☒ (Local) Governance ☐ Legal framework ☐ Business models ☐
Innovative stakeholder involvement strategies	- Citizens - Research Pilot, demonstration and flagship projects programme of the Federal office of energy https://www.bfe.admin.ch/bfe/en/home/research-and-cleantech/research-and-development/pilot--demonstration-and-flagship-projects-programme.html

Typology of energy supply	Heating and hot water: District heating plant with server waste heat of the urban Data centre The regulation of the heating of the thirteen houses is based on a system solution which works predictively and self-optimizing. For this purpose, the temperature and relative humidity of all use units are measured on the site and transmitted online to a server. The temperature and humidity data can then be visualized per house. A big advantage is the measurement of room temperatures in the apartments. This information helped to more systematically address and address the problems of regulatory intervention Electricity consumption and production The electricity consumption of the residents and users is crucial for optimizing the total energy consumption of the area. The local businesses account for one third of the total land use. Efficient kitchen appliances, central freezers and laundry rooms, as well as sufficient residents contribute to the economical use of electricity on the site. In addition to Stromverrauch also the production data were evaluated. A quarter of the power consumption can be produced directly on site. The self-consumption share of the entire area is 92%. Say only 8% of the electricity produced is reflected in the annual balance in the network

Success factors	**Challenges/barriers**
n/s	n/s

2 Fleuraye, Carquefou/Nantes, France

General information	
City	**Carquefou (which is one of the 24 cites of Nantes Metropole), France**
Project name	**Fleuraye west**
Project status	planned ☐ under construction ☐ **realized** ☐ **in operation** ☒
Project start – end	1995 – 2022
Contact	Nantes Metropole, Benoit Cuvelier
Project website	**https://biit.l//2Fsdcq8; http://www.quarterlafleuria/e.fr/**
Size of project area	37 ha - Fleuriaye West project
Building structure	**Newly built** ☒ Existing neighbourhood ☐ Mixed ☐
Land use	For both Fleuraye Est and West projects **Surfaces** - Waterproof area 320 000 m² - Vegetated surface (roof included) 700 000 m² - Area of public spaces: 510,000 m² **Built surfaces** - Office floor area 50 000 m² - Floor area shops 5000 m² - Floor surface Public facilities: 40 000 m² - Floor area of houses: 100,000 m² - Number of accommodations: 1,600 (of which 620 for Fleuriaye West project) - Number of social housing units: 350 - Green spaces / habi 233.33 m² / liv - Public spaces / habi 170 m² / living space

Financing	Total investment cost 270 M € excluding taxes (for both Fleuriayre West and East project)
	- Of which for Fleuriayre West : 123 M€ of which 100 M€ pour buildings, 20 M€ for public space, 3 M€ for renewable energ/
	- Total grants: € 168,000 excluding taxes
	  ○ for Fleuriayre West: Communicating R & D, Passive Design, Communicating Terminal, Project Engineering.
	  ○ for Fleuriayre East: Collective self-consumption study, project engineering.

Overview description of the project

NANTES METROPOLE / CITY OF CARQUEFOU CASE

The district of La Fleuriaye, in the City of Carquefou, (which is part of Nantes Metropole) was developed in two phases:

I. The district is composed of two sub districts:

1. The Fleuriaye East district is 65 Hectares, built between 1995 and 2010. Compositon of the district on the eastern part: 120 tertiary companies over 55,000 m², 1000 dwellings, a theater, a University Institute of Technology (IUT), a music school, cultural actvites.

2. The **Fleuriaye West** district of 37 Hectares, under construction since 2013. Compositon of the district on the western part: 600 housing units (320 delivered toda/); 10,000 m² of tertiary and service, an equestrian center, a Medical-Educational Institute (EMI)

II. Objectves of the district

- to provide a living environment and comfort of use in order to guarantee the good health of the inhabitants. It is for this purpose that all of the new housing units in the neighbourhood have been built following the Passivhaus label, thus extending the objectives of urban development (living environment, comfort, health) within very qualitatve housing.

- The second major axis is to be able to propose on La Fleuriaye West a neutral impact assessment in energy and environment. It is made possible by:
  - specific work on biodiversity, water and landscape,
  - the construction of passive housing very sober energetically,
  - a renewable energy production equal to or greater than the consumption of the district thanks to the generalization of solar photovoltaic on all of the south roofs.
  - At the end, on La Fleuriaye West part, the district will reach a renewable energy coverage rate greater than 100% and about 42% on the entre perimeter (Fleuriaye Est and West projects).
  - Concerning La Fleuriaye Est, an objective of controlling energy consumption and renewable energy production is also being developed as an extension of the actions initiated on La Fleuriaye West, notably with the future realization of collective self-consumption projects.

- The third axis concerns the implementation of a transposable economic model, limiting the use of public funding.

The Fleuriaye West district : a positive energy district

La Fleuriaye West is aiming for the goal of 100% renewable energy. To do this it is primarily a question of reducing the general consumption of the district, THEN to compensate the totality of the consumptions by a coherent set of production of renewable energies. On the whole programming, it was decided to generalize the passive standard reconciling minimization of consumption, maximizing summer and winter thermal comfort and real air quality. It concerns:

- 620 homes ranging from single-family homes to community buildings
- 10,000 m² of tertiary sector and activity,

Which will make it the most important passive district of France.

L'extension ouest du quartier de La Fleuriaye (à gauche) vient parachever un bassin de vie de 102 ha avec une mixité harmonieuse de fonctions.

Look at the district by drone: https://www.youtube.com/watch?v=h-MuQgKqWWs

More information (in French) on https://www.construction21.org/france/city/fr/quartier-de-la-fleuriaye-a-carquefou.html

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ Climate neutral ☐ Sustainable neighbourhood ☐ Social aspects/affordability ☐ **Preserving biodiversity** This is one of the essential components of the western extension of La Fleuriaye: preservation and enhancement of existing landscape heritage, spontaneous flora, edges bordering hedges, preservation of fauna and flora migration corridors with a very innovative passage to open sky on which vehicles will roll. Special care was also taken in the collection of runoff water through a network of valleys and ponds. **Energy** The optimal orientations of the buildings on La Fleuriaye Ouest, coupled with the passive envelope, make it possible to obtain a temperature of 20° C in dwellings in winter without heating while allowing in the summer, a real comfort without overheating thanks to the good management of the solar contributions and a ventilation system double flow, very effective to cool the houses by means of the nocturnal ventilation. All passive housing also includes quality equipment in order to limit consumption related to "specific" uses (office automation, household appliances, etc.), which represents a significant share of consumption in housing, all the more when the very important energy performance of the latter makes it possible to reduce other consumption items such as heating, domestic hot water ...

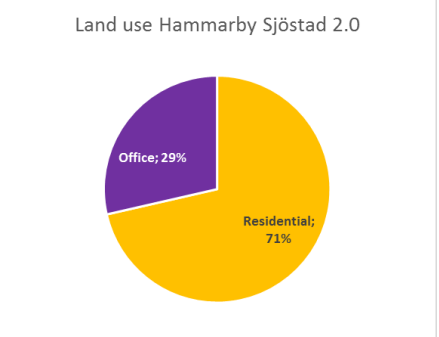
	To conclude, beyond the technical system and the performance of the building, the major player in the management of the resources remains the inhabitant, that is why meetings of sensitization with the good practices were carried out in order to inform the inhabitants and fight against any misconceptions. Moreover all the buildings are instrumented with digital energy meters allowing a good interpretation of the consumption by the users and encouraging the control of these. Following the same principle, the TOTEM which will be installed in the center of La Fleuriaye West and which will indicate the consumptions and productions of the district will have a real pedagogic impact with the whole of the users. **Social** 68 social passive house with no extra costs
Indicators/expected impact	Indicator 1: proportion of certified batiments passivhaus ➔ 100% of buildings certified with passive label Indicator 2: Neighbourhood Renewable Energy Coverage Rate ➔ Renewable energy coverage rate > 100% Indicator 3: Carbon footprint of buildings Indicator 4: Investment cost of buildings by typology Indicator 5: Evolution of the distribution of competences by function (command / control / production / use) in the production of a sustainable city. Indicator 6: Level of perception and implication of the users of the sustainable city Indicator 7: Number of barriers identified and raised to achieve objectives Indicator 8: Effectiveness of the organization process and the level of communication of the project with regard to the results achieved
Overall strategies of city/municipality connected with the project	- Urban Renewal Strategies - Energy and environnement strategies
Which factors have been included in implementation strategies?	Local (renewable) resources ☐ Regional energy system ☐ Mobility ☐ Buildings ☐ Materials ☐ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ (Local) Governance ☐ Legal framework ☐ Business models ☐ **<u>Local renewable resources</u>** The **Fleuriaye West district** project aims for a neutral energy balance with a renewable energy contribution equivalent to all-purpose consumption. To do this it will be at the end more than 2.3 MWp which will be installed on the buildings of the Fleuriaye West. By the end of 2018, there was about 1.2 MWp connected to the Fleuriaye West, representing a renewable energy coverage rate of more than 100% for a self-consumption rate close to 55%. Numerous projects on individual homes in La Fleuriaye West also provide for the use of biomass through the wood stove that allows the use of another form of renewable energy and contributes to achieving our goal 100% renewable energy. **Concerning La Fleuriaye Est**, Two self-consumption projects are in development involving private and public partners and totaling 200 kWp of solar photovoltaic production capacity for collective

	self-consumption. These operations are associated with a search for the reduction of energy consumption with first tracks that can lead to up to 30% decrease in consumption on average **Buildings** Regarding the buildings o**f La Fleuriaye West**, the entire neighborhood targets the label Passivhaus, all buildings will produce as much renewable energy than they will consume energy. Today the delivery of the first 320 housing units has positioned the area as the largest positive energy Passivhaus district in France. With the delivery of 300 additional dwellings by 2022 on different typologies (individual housing, small collective) the district will consolidate even more its innovative character. **Soft mobility** Pedestrian paths are present on the whole district. The Renaudières alley also offers the opportunity to cross the site quickly as it crosses from east to west to join the nautical base of Carquefou at the edge of the Erdre 800m to the west. In order to promote soft mobility and the achievement of the neighborhood's environmental objectives, the Loire-Atlantique Développement-SELA developer, who is also the DIVD pilot, offers, as part of the marketing of free lots, a high-end electric assistance bicycle for any buyer achieving the ambitious environmental goals of the neighborhood. It should allow residents to make the most of this type of vehicle to reach the town center of Carquefou 2 km or reach the city center of Nantes 30 minutes. **Materials and circular economy:** The mobilization of local sectors in the choice of equipment was a priority on the operation. A close link was made to all passive projects between real estate operators and equipment suppliers, particularly in the following areas: • Exterior wood furnishings, • Double flow ventilation systems, especially in the individual house, • Local photovoltaic solar generator. On the waste side, a specialized service provider is mobilized to rationalize the recovery of all waste generated by individual housing projects. The plants come from local nurseries in the Loire Atlantique and Maine et Loire.
Innovative stakeholder involvement strategies	**Involvement of stakeholders and citizens** - The project involves a consortiium of 18 partners bringing together the entire value chain: o Nantes Métropole: Decision-making local authority o City of Carquefou: Territory hosting the demonstrator, co-decision o Loire-Atlantique Development SELA: Urban Developer, Energy Developer and General Pilot of demonstrator o ENEDIS: Electricity Distribution Network Manager o Armorgreen: expert in renewable energies o The Fleuriaye Technopôle: Group of Economic Interest of La Fleuriaye o AMOCITE: Surveyor Legal Expert o ENERGELIO: Passive designer o MAGNUM: Architect o PELLEGRINO ASSOCIES DESIGN WORKSHOP: Architect o SAMO: Social housing company o Vilogia: Social housing company o ARTELIA: Infrastructure and Smart Grid Study Office o AUP: Urban planner o EIFFAGE CONSTRUCTION: General contractor o Claude FIGUREAU: Ecologist - Albdo: Bureau of Energy Studies of the Building o LEGRAND: Developer of electrical optimization solutions

	- In order to have competent professionals both in collective housing and individual homes, as well as the tertiary sector in the passive sector, we have put construction professionals and specialized trainers in contact with one another so that they can acquire the sharp technical bases induced by passivehaus buildings. - A special collaboration with the Distribution Grid Manager ENEDIS has also been set up in order to optimize the electrical infrastructure as much as possible and to promote the strong control of consumption in their dimensioning. - In order to make the users aware of the objective "neutral energy" a communicating terminal will also display consumption and production of the neighborhood in near real time. - Concerning the existing part of the district (East part) , a strong mobilization was necessary with the 100 companies of the perimeter, of the University of Nantes through its IUT, of the city of Carquefou through the theater, the school of music ... in the goal of launching operations aimed at the development of collective self-consumption - Social housing and promoters have been put in place accompanying measures for residents to sensitize them to the particularities passive housing and provide them tips to guarantee optimum comfort
Typology of energy supply	**At the end 15 000 m² of photovoltaic panels** – currently 8,000 m² of panels cover the south roofs of collective buildings.

Success factors	Challenges/barriers
Involvement of stakeholders towards collaboration and replicability Each actor in the construction chain has taken responsibility for limiting the cost of construction and the cost of housing management. - The developer: by defining the sizes of critical operations to make real estate operators benefit from scale effects, - The planner: by defining parcels limiting the effects of masks and optimizing the free solar capture by their orientation and a form of roof predefined from the specifications - Donor and developer real estate operators: by comparing a wide variety of construction systems and technical equipment; by using design / build arrangements; by making their roof available to solar investors without a fee, - The consulting firms that are experts in passive design or biodiversity directly associated with the urban project management or the buildings, at the request of the developer, - The unique photovoltaic system to offer solar investors economies of scale, - Condominium trustees and specialized surveyors, associated upstream to estimate their fair value for future common expenses and help guide the choices to be made during the design phase	**Legal and tax challenges** - to improve the economic value of renewable energy produced locally - to facilitate the development of collective self consumption PV projects **Raising competences** - to upgrade skills of building companies and other staff related to passivhaus works and design **Business models** - how to make the construction of passive or positive energy buildings more economical and more replicable - How to optimize the production of renewable energy while reducing costs

3 Hammarby Sjöstad 2.0, Stockholm, Sweden

General information	
City	**Hammarby Sjöstad (City district in Stockholm), Sweden**
Project name	**Hammarby Sjöstad 2.0**
Project status	planned ☐ under construction ☐ **realized** ☒ **in operation** ☒
Project start – end	2014-2030
Contact	Jorgen Loof
Project website	http://hammarbysjostad20.se//
Size of project area	2 km²
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	- Residential:25,000m² - Office: 10,000m² - Industry: n/a 
Financing	Public-private Research funding

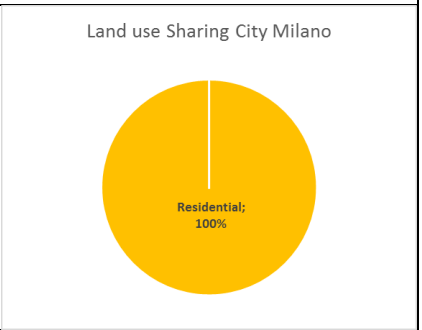
Overview description of the project
The **ElectriCITY's** mission is to transfer the city district of Hammarby Sjöstad into the Paris climate deal 2050 already 2030. We also have a mission to be global leaders in sustainable developments and to inspire other. We will do this through research, innovation and business. As it is a citzen-driven initiative the key is to develop solutions that is adapted quickly by the citizens. Hammarby Sjöstad, means the lake city of Hammarby. It is situated approximately 5 km south from the city center of Stockholm. The district is still under construction today with 25' inhabitants (to be 30') and 15 000 employees. Hammarby Sjöstad has a good international renommé and we have been on the news all around the globe, e.g. the Economist stated us to be "One of the World's highest profile examples of Sustainable City Development". More than 3000 visitors come to Hammarby Sjöstad every year, interested in cooperation, and every week one Chinese delegation visits Hammarby sjöstad. "It will be twice as efficient as any other urban development this decade!" was the goal of the political leaders before planning HS. Even though we had at the time high standards of sustainability; It was to be a modern suburb built using the latest technology. Residential and commercial energy consumption should be low, people would choose public transport rather than cars, garbage would be used to produce district heating and food waste would be turned into biogas for cooking and fuel for vehicles. The planning is based on the "The Hammarby Model is a natural cycle approach to urban living".

However, in the end the district didn't perform enough. Most of the buildings in the district consume more energy than was originally envisaged and many suffer from a lack of maintenance, specifically in the technology that they use. Cities, like companies, if you do not constantly innovative, you will not be successful. The feeling of not being "good enough" was the start for the project Hammarby sjöstad 2.0. And the organization to run this in ElectriCITY. We have now a scientific based strategy to deliver on the Paris Climate deal 2050 already in 2030. We will do this through activities in the area of energy, buildings, mobility, digitalization, communication, circular-and sharing economy. Some of the projects are described in the attached document.

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ **Carbon-free** ☒ **Climate neutral** ☒ Sustainable neighbourhood ☐ **Social aspects/affordability** ☒
Indicators/expected impact	- Environmental - Societal - Social - Economic
Overall strategies of city/municipality connected with the project	Only commercial and citizen driven
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ **(Local) Governance** ☒ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	- Citizens - Business - Utility - Housing association
Typology of energy supply	- Solar thermal energy - Geothermal energy - District heating/local heating - Heat pump system - Industrial waste heat

Success factors	Challenges/barriers
Success factor is that it is citizen and commercial driven	n/s

4 Sharing Cities, Milano, Italy

General information	
City	**Milano, Italy**
Project name	**Sharing Cities**
Project status	planned ☐ under construction ☐ **realized** ☒ in operation ☐
Project start – end	2016 – 2020
Contact	Piero Pelizzaro, Clara Maddalena Callegaris
Project website	www.sharingcities.eu and www.milano.sharingcities.it
Size of project area	2.8 (28.000 m²)
Building structure	Newly built ☐ **Existing neighbourhood** ☒ Mixed ☐
Land use	Residential: 100% 
Financing	For private residential buildings more than 70% of the costs have been covered by residents (with the help of different financial mechanisms: tax credit, transfer of tax credit, loans, etc.) and the rest of the costs have been funded by the programme through unit-cost mechanism (i.e. the partner in charge for the measure implementation receives a reimbursement on the base of the achieved results). For San Bernardo 29A, the Municipality covered with its own resources 90% of the costs, while Sharing Cities EU funds covered the rest 10%.

Overview description of the project
Sharing Cities is a H2020-SCC1 project. Sharing Cities is proving ground for a better, common approach to making smart cities a reality; by fostering international collaboration between industry and cities, the project seeks to develop affordable smart city solutions. In each of the three lighthouse cities (London, Lisbon, Milan), a district has been identified for the implementations, that are • Charging points: 60 charging points (40 normal and 20 fast) for boosting private and shared electric mobility, located in 10 Mobility Areas • Bike sharing: 150 new e-bikes for bike sharing with child seats and 7 new project bike sharing stations (plus 7 financed by City of Milan) • Community car sharing: 2 e-vehicles and dedicated recharging points. • e-logistics: 11 e-vehicles (2 cargo bikes) for goods delivery in the area. • Smart parking: 175 parking places with sensors (for logistics, disabled people, no-parking areas, Mobility Areas) • Smart lampposts as the enabling infrastructure for several new services: Wi-Fi antennas, environmental noise and transport monitoring. The telecommunication infrastructure uses LoRaWAN protocol. • Among the other implementations conceived for creating a Smart District, the one closely related to PED theme is the Residential building retrofit. Within Sharing Cities has been refurbished: - 24.000 smq of private residential buildings integrated with sensors for monitoring and managing energy consumption. Owners co-designed interventions with a dedicated process with project's experts. Estimated

energy consumption saving 50-70%. Buildings located in Via Tito Livio 7 (ca. 2000), Via Verro 78 BC (ca. 3.800), Viale Fiamma 15-1 (ca. 3.300), Via Passeroni 6 (ca. 6.500) and Via Benaco (8.800). 5.000 smq of public residential building with PV, heat pump and comfort monitoring system. Estimated energy consumption savings around 60%. Building in Via San Bernardo 29A.

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒
Indicators/expected impact	A wide monitoring tool has been implemented in order to assess the effectiveness of the measures in terms of: • Energy and emissions saving (environmental) • Comfort and liveability (social) • Economic affordability (economic)
Overall strategies of city/municipality connected with the project	Urban Renewal Strategy: Sharing Cities interventions represent a best practice for the wider initiative of the Municipality of Milan of tackling building retrofit challenge. In particular, for private ones a 23 million of € call has been launched for financing interventions on obsolete heating systems and for energy efficiency measures. For the public ones the technical requirements identified and designed within Sharing Cities will be applied for future interventions on public residential properties that are in planning phase.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ Sustainable production ☐ **Sustainable consumption** ☒ **(Local) Governance** ☒ Legal framework ☐ Business models ☐
Innovative stakeholder involvement strategies	The main challenge of multi property private residential is to make the majority of residents agree about the need of building retrofit intervention and about which kind of energy efficiency interventions have to be implemented. The methodology developed and applied in Sharing Cities tries to address this issue choosing and co-designing the interventions involving the residents from the very beginning of the process. The methodology will be spread through easy and user-friendly materials able to depict the entire process, highlighting barriers, opportunities and constraints. These materials will be one of the main output of the project in terms of knowledge enhancement about how to address the building retrofit issue.
Typology of energy supply	- Solar thermal energy - Geothermal energy - Heat pump system

Success factors	**Challenges/barriers**
- Wide public-private partnership - Innovative methodology (codesign) - Cross-cutting work within different departments of the Municipality - Measures included in a wide strategy of the Municipality	- New GDPR affects most of the activies - Public Administrative procedure not aligned with Innovation project timing

5 Åland Island, Finland

General information	
City	**Åland Island, Finland**
Project name	**Smart Energy Åland - A society scale demo of an energy system running on renewables**
Project status	planned ☐ under construction ☐ realized ☐ **in operation X**
Project start – end	2014 - 2019
Contact	Berndt Schalin
Project website	**https://flexens.com/the-demo/**
Size of project area	Åland Islands, Area: 13 300 sq km, Population: 30 000
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	n/a
Financing	Smart Energy Åland is a public – private – people partnership.

Overview description of the project

The energy transition requires a place where to pilot and demonstrate a fully renewable energy system which is sustainable both technically and economically. Flexens has identified the opportunity to develop and build a full society scale energy system based on renewables on Åland – an island with ideal wind and solar conditions, an ambitious climate- and energy strategy as well as a population dedicated to sustainability. All the island will be here the experimental/demonstration area.

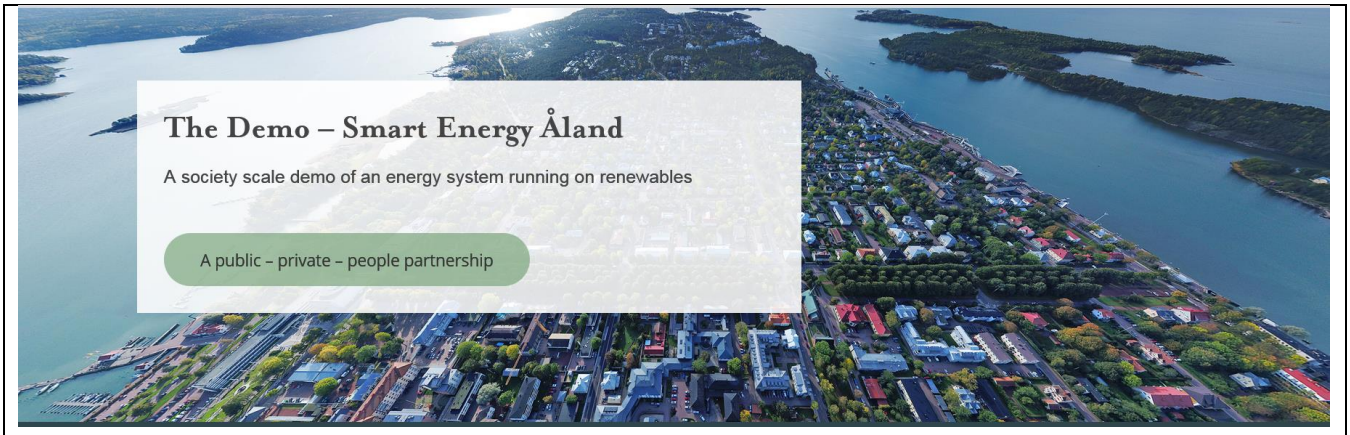
The area will become a unique place for companies to test new energy solutions, and it will also act as a reference for the Finnish export industry. In addition, it can provide a unique piloting platform attracting international investments, operators and technology providers.

Smart Energy Åland is a public – private – people partnership.

Key goals and priorities:

- To demonstrate a society based on 100% renewable electricity Flexens will work actively to promote further investments in renewable generation capacity and decarbonising the heating and transportation systems. The basis for successful renewables integration in an open and competitive market is a flexibility trading platform – this demo will be high on the agenda.
- The success of the demo will depend on citizen engagement and promotion of the prosumer concept. Cost efficiency and affordability of the implemented technologies is in focus.
- The demo will include technology piloting with focus on storage technologies and new digital services.
- The demo is also a platform to develop new business ventures.

https://flexens.com/the-demo/



Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ Energy neutral ☐ **Energy efficient** ☒ **Carbon-free** ☒ **Climate neutral** ☒ **Sustainable neighbourhood** ☒ Social aspects/affordability ☐ Other: Supports the goals of the climate strategy recently prepared for the Åland Islands. The landscape's energy and climate strategy for Åland until 2030 shows how political energy and climate work will be managed in the coming years, as a contribution to meeting the goals of the Paris agreement. Smart Energy Åland becomes a tool for Åland in implementing this strategy. The main goal of the strategy for 2030 is to: • Reduce carbon dioxide emissions by at least 60% compared to 2005. • Increase the proportion of renewable energy to at least 60%. • Increase the proportion of locally produced renewable electricity to at least 60%. • Reduce emissions from road traffic by at least 50% compared to 2005. https://smartenergy.ax/om-smart-energy-aland/
Indicators/expected impact	Smart Energy Åland brings many direct and indirect benefits to Åland. • Jobs are created during the construction of new facilities. • Åland's profile as a tourist destination and settlement is increased. • New companies are created with the development of new products and solutions for energy distribution. • For participating private actors and companies, Smart Energy Åland becomes an important reference, a platform for innovation and an opportunity to develop new business ideas. • Smart Energy Åland becomes a tool for Åland in the realization of the landscape government's Climate and Energy Strategy. https://smartenergy.ax/om-smart-energy-aland/
Overall strategies of city/municipality connected with the project	The Åland landscape government is pursuing an ambitious climate and energy policy and has set up Åland's sustainability and development agenda with seven objectives that must be met before 2030 and the energy and climate strategy for Åland until 2030. With the autonomy, Åland has its own energy legislation and can therefore adapt more quickly to innovative market concepts. https://smartenergy.ax/om-smart-energy-aland/ https://www.regeringen.ax/infrastruktur-kommunikationer/el-energi/energi-klimatstrategi-aland-ar-2030

Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ Mobility ☐ Buildings ☐ Materials ☐ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ **(Local) Governance** ☒ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	The Government of the Province of Åland CLIC Innovation Oy Business Finland In order to realize the project, the stakeholders have founded the company, Flexens Oy Ab, with the ambition to commercialize the expertise created in the implementation of Smart Energy Åland on the world market for energy systems. Flexens will, in the longer term, operate both in Åland and elsewhere. https://smartenergy.ax/om-smart-energy-aland/ https://tem.fi/artikkeli/-/asset_publisher/keskustelu-ahvenanmaasta-alykkaan-energiajarjestelman-testialue-
Typology of energy supply	Åland is an island with ideal wind and solar conditions and a separate independent electricity system. Installations of solar panels on both private and commercial buildings are steadily increasing and in wind power, Åland is a pioneer, with a wind power park that started to be built in 1994. Already today, our wind turbines can produce about 20 percent of annual energy consumption. Focus of energy supply: Solar, Wind, Heat and CHP, bioenergy, wave power, geothermal, E-Storage  Picture taken and slightly adapted from Smart Energy Åland (https://smartenergy.ax/energimolnet/)

Success factors	Challenges/barriers
Strong support from the Finnish national innovation agency, Business Finland. Highly committed population and local government.	

6 Smart Otaniemi,Espoo, Finland

General information	
City	**Espoo, Finland**
Project name	**Smart Otaniemi**
Project status	planned ☐ under construction ☐ realized ☐ **in operation X**
Project start – end	2018 - 2024
Contact	Ismo Heimonen; smartotaniemi@vtt.fi
Project website	**https://smartotaniemi.fi/**
Size of project area	n/a
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	n/a
Financing	Total budget of 6.6 Mill. € Research institutes 2.7 Mill. €, companies 3.9 Mill. € Partly (50 – 60%) financed by Business Finland

Overview description of the project
The target of Smart Otaniemi is to plan and implement a new type of smart energy piloting area and ecosystem in a large and dynamic district. Smart Otaniemi is an ecosystem of 34 partners, working on 6 concrete pilots, developing new ideas and creating new energy business. .An essential objective is to realise a showroom for new smart energy solutions and especially for Finnish competence. At the same, pilots from different domains (smart energy, buildings, transport, and communication) will be combined in Otaniemi which enables finding synergies and maximising benefits from cross- cutting value chains. Smart Otaniemi pilot platform serves both experimental research activities as well as close-to- market proofing of concepts and products. Thus it enables both testing and piloting of solutions in development phase and proof of feasibility for commercial and exportable solutions. Smart Otaniemi aims to be a living lab with real customers involved. Focus will be especially on utilizing all types of data (energy, weather, traffic etc.) for new applications and services and on making Otaniemi more real-time monitorable and controllable area. The Smart Otaniemi innovation ecosystem is open to all and will be lasting and developing over time following the progress on its relevance areas.

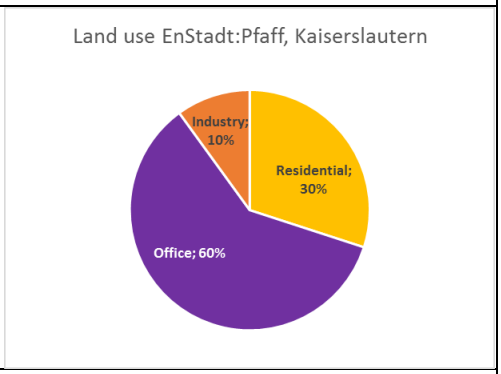
Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ **Climate neutral** ☒ Sustainable neighbourhood ☐ **Social aspects/affordability** ☒ Other: Smart Otaniemi seeks to establish a piloting platform that contributes to four common objectives: societal development, innovation capabilities, export businesses and new investing possibilities.

	Smart Otaniemi clearly targets the objectives set by Business Finland Smart Energy program. In terms of high level objectives, Smart Otaniemi contributes to developing smart energy ecosystems and platforms. Further Smart Otaniemi addresses utilization of digitalization and IoT in energy sector, as well as develops new business models for energy efficiency, renewable energy, smart grids, system flexibility and customer interface. At the same, Smart Otaniemi supports export industry be means of providing an international level showroom and reference cases for new solutions. There is also a strong need of coordinating and evaluating of different Smart Energy pilots in Finland. Smart Otaniemi can act as a hub for these pilots and produce combined information in order to get even more benefits of Smart Energy innovation ecosystems in Finland for business and decision-making purposes.
Indicators/expected impact	n/a
Overall strategies of city/municipality connected with the project	Smart Otaniemi will offer Espoo one potential channel to realise parts of their vision to become emission free by 2030. Aalto Campus has the target of being carbon free by 2030. Smart Otaniemi provides one roadmap how to get to this target. The key issues are intelligent management of local renewable energy resources, harnessing of the flexibility of the local loads, energy storages management, Electric Vehicles smart charging systems and intelligent integration of the mentioned resources into the energy markets. The Helsinki Metropolitan Smart & Clean Foundation is a five-year (2016-2021) step change project. The foundation's task is to drive the change in the Helsinki capital region and the City of Lahti for the area to be the world's best test bed for smart and clean solutions. The close cooperation with the Smart & Clean Foundation will ensure that possible cross insemination of data, ideas, and pilots lead to cross sectoral innovation. The learnings from Smart Otaniemi Pilot can be distributed to other areas and cities as well as used for creating open data platforms for other sectors.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ Refurbishment ☐ **Sustainable production** ☒ Sustainable consumption ☐ (Local) Governance ☐ **Legal framework** ☒ Business models ☒
Innovative stakeholder involvement strategies	VTT (Research) Aalto University (Research) ABB (Industry) ACRE (real estate owner) e2m (Industry) Empower IM (Industry) Eneron (Industry) ESF (Industry) Fourdeg (Industry) Ensto (Industry) GEF (Industry) Granlund (Industry) Merus (Industry) Nokia (Industry)

	Nuuka Solutions (Industry) Parking Energy (Industry) Savon Voima (Industry) Seneqo (Industry)
Typology of energy supply	District heating (open district heating), Deep Geothermal energy

Success factors	Challenges/barriers
Strong support from the Finnish national innovation agency, Bussiness Finland. The Ecosystem has increased and there are now 70 partners. The pilots are ongoing and feasibility studies have been done. More pilots are planned and in the pipeline for a 2nd and 3rd phase. Regulatory sandbox under evaluation.	Regulatory barriers for test bed/piloting experimentation.

7 EnStadt:Pfaff, Kaiserslautern, Germany

General information	
City	**Kaiserslautern, Germany**
Project name	**EnStadt:Pfaff**
Project status	**planned** ☒ **under construction** ☒ realized ☐ in operation
Project start – end	10/2017 – 09/2022
Contact	Gerhard Stryi-Hipp, Fraunhofer ISE, (scientific project leader) Bettina Dech-Pschorn, City of Kaiserslautern, (project leader)
Project website	www.pfaff-reallabor.de / www.pfaff-quartier.de
Size of project area	18 ha
Building structure	**Newly built** ☒ Existing neighbourhood ☐ **Mixed** ☒
Land use	- Residential: ca 30% - Office, research, culture: ca 60% - Industry: ca 10% 
Financing	The development is pre-financed by the city (public), supported by the federal state of Rheinland-Pfalz and will be refunded by selling the construction ground.

Overview description of the project
The City of Kaiserslautern plans a climate neutral district on the area of the former sewing machine factory Pfaff close to the city centre. The German federal ministry for economy affairs and energy together with the ministry of education and research funding the project EnStadt:Pfaff, which is a Reallabor (living lab), in which innovative technologies in the fields of energy, buildings, mobility and ICT are developed, demonstrated, evaluated and optimized in the first construction phase of the Pfaff-Quarter. In addition, socio-economic research is executed on aspects of acceptance and participation of the stakeholder in the quarter and a living lab centre (Reallabor-Zentrum) is implemented with an exhibition, a living lab workshop and an electric vehicle and battery lab to demonstrate, explain, and work together in the sense of co-creation and co-design with the stakeholder of the district as well as interested stakeholders from the city and from outside the city. The project consists of nine partners led by the city administration and includes companies (investors, developer, utility) and research institutes (Fraunhofer, university of applied sciences).

Plan of the Pfaff-Quarter with existing buildings, which will be refurbished (red) and planned new buildings (white)

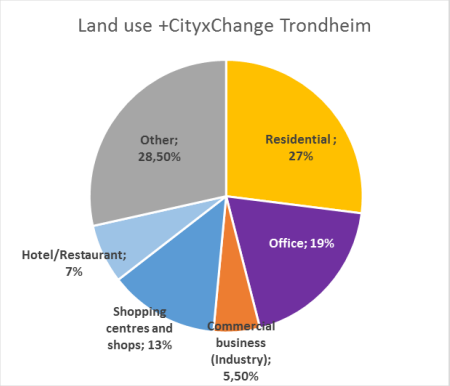
Rendering of the Living lab centre (left) and 3D animation of the quarter (Plan and images: ASTOC Mess)

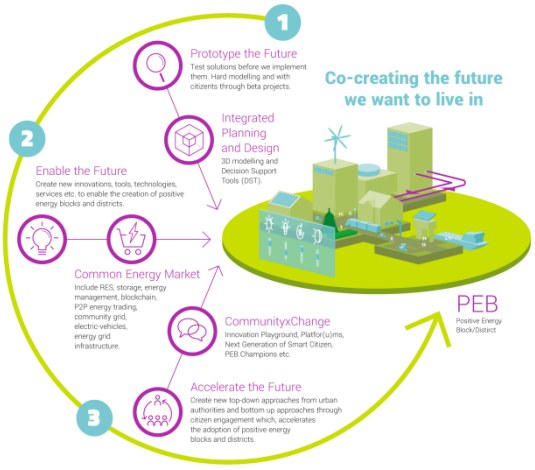
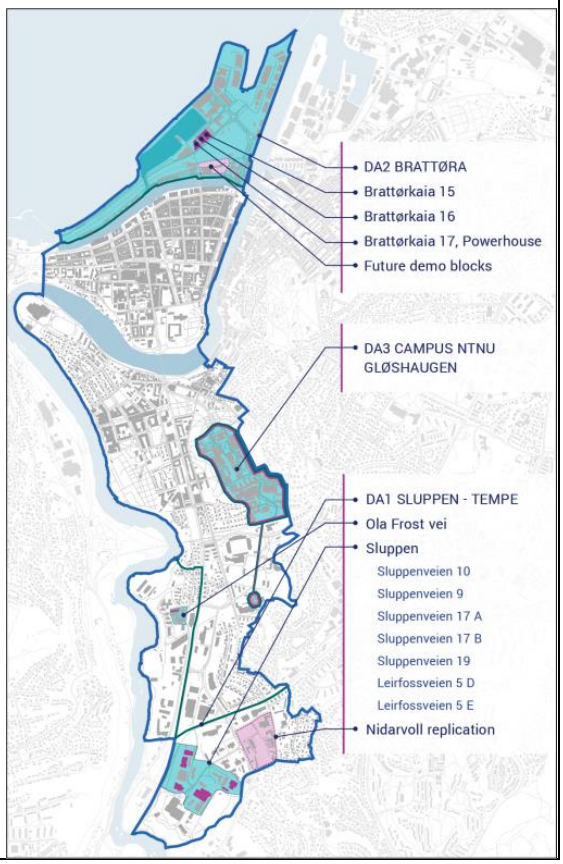
Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ **Climate neutral** ☒ Sustainable neighbourhood ☐ Social aspects/affordability ☐
Indicators/expected impact	Environmental: CO_2-neutrality Social: high quality of live, inclusive, barrier-free A mission statement (Leitbild) was developed by the project consortium.

Overall strategies of city/municipality connected with the project	Energy Masterplanning: A Master plan 100% climate protection to become CO2 neutral by 2050 was adopted by the city council in 2017. https://www.kaiserslautern.de/sozial_leben_wohnen/umwelt/klimaschutz/masterplan/index.html.de
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ Sustainable production ☐ Sustainable consumption ☐ **(Local) Governance** ☒ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	Stakeholders are involved in the planning process by public measures (Beteiligungsverfahren zum Bebauungsplan) as well as by actions of the socio economic researchers of the project, which e.g. did a survey to identify, how the Pfaff-Quarter must be designed to meet the specific needs of start-ups.
Typology of energy supply	Photovoltaic, industrial waste heat from a company close by the quarter at medium temperature, heat pumps

Success factors	Challenges/barriers
- Integrated planning (urban planning, planning of energy and mobility infrastructure) - Integrated technical solutions - Stakeholder participation supported by socio-economic research	- Long planning processes (input on an early planning phase necessary) - Development of a joint mission - Regulative framework - Limited local renewable energy resources

8 +CityxChange, Trondheim, Norway

General information	
City	**Trondheim** (Norway)
Project name	**+CityxChange**
Project status	planned ☐ under construction/**implementation** ☒ realized ☐ in operation ☐
Project start – end	01.11.2018 – 31.10.2023
Contact	Silja Rønningsen (Project Coordinator)
Project website	**https://cityxchange.eu/**
Size of project area (hectare)	Two PEBs scheduled in Trondheim (see also map above): Brattøra (30.04.2021), Sluppen (31.10.2021). Brattøra: 60 ha. Sluppen: 16 ha
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	- Residential: 27% - Office: 19% - Commercial business (Industry): 5.5% - Shopping centres and shops: 13% - Hotel/Restaurant: 7% - Other: 28.5% 
Financing	Not able to specify exact percentages on each financing type. - Public (EU and national funding instruments) - Public-private risk sharing and investment schemes - Private stakeholder financing - ESCO or similar scheme

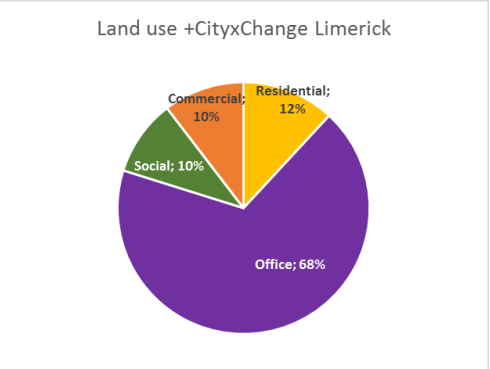
Overview description of the project
LightHouse city LHC Trondheim (Central Norway), together with LHC partner Limerick (IE), Fellow Cities Pisek (CZ), Võru (EST), Alba Iulia (RO), Sestao (ES), and Smolyan (BUL), universities of Trondheim and Limerick (NTNU and UL), and 23 industry partners and non-profit organizations make up H2020 SCC-1 funded +CityxChange project. Overall vision of +CityxChange is „Co-creating the future we want to live in", through 3 main steps: Prototyping, enabling, and accelerating. LHC Trondheim will within October 2021 deploy two PEBs (Brattøra and Sluppen), perform grid optimizing of city campus Gløshaugen (campus being ist own concession area for thermal/EL), and connect the three areas for exchange/trade of energy and capacity/effect. Important in the +CxC innovation is to establish a plug&play architecture that with some changes/amendments may be deployed in other cities. Working in detail within smaller, defined geographical areas – called community grids, we have introduced the level CSO (Community System Operator), below the DSO level. The CSO will for our PEBs in Trondheim be our EL DSO, for campus it is NTNU. In other places/cities with other preconditions and frame conditions, the CSO may be another type of organization/ company. Dividing the concession area into smaller units or energy ecosystems, and then building the whole, integrated energy system „from below" is for +CxC a sensible and viable approach towards EU Common Energy Market, and establishment of PEBs, then upscaled into PEDs.      

Strategies	
Goals/ambition	**Positive Energy** X Zero-emission ☐ Energy neutral ☐ **Energy efficient** X Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** X **Social aspects/affordability** X Other: - Generate, test and verify new business models with lower risk, decreased payback times, and focus on ROI. - Increased community awareness, engagement and involvement
Indicators/expected impact	Environmental, Societal, Social, Community participation and behavioural influence, Economic, Regulatory, Technical, Energy related, Upscaling & Replication. A total of 33 KPIs; examples: GHG and NOx emissions, RES share, RES efficiency, RES integration, RES flexibility, RES curtailment, RES traded, optimized self-consumption, total new investments in RES, reduction in grid investments, decrease in simple payback time, ROI, # new jobs, changes in regulation, # new PEB prototypes, etc.

Overall strategies of city/municipality connected with the project	- Trondheim Master Plans (Societal Plan and Area Plan) - Energy and Climate Action Plan - City Development Strategy - Strategic Business Development Plan (comprising Trondheim Region, not only city)
Which factors have been included in implementation strategies?	**Local (renewable) resources** X **Regional energy system** X **Mobility** X **Buildings** X Materials ☐ **Refurbishment** X **Sustainable production** X **Sustainable consumption** X **(Local) Governance** X **Legal framework** X **Business models** X Other: - Distributed Energy Resource Management Systems (DERMS); energy systems integration - P2P trading of energy and flexibility (virtual and physical) - Our own designed Local Energy Market (Energy Trading Platform) and Local Flexibility Market
Innovative stakeholder involvement strategies	- Risk sharing and investment models comprising public sector and core private stakeholders such as thermal and EL DSOs, building owners, and private financing institution. - Tuned EPCs for two cases: Corporate, and private tenants - Innovation Playgrounds involving both citizens, businesses, NGOs etc - Testing and experimenting of several citizen arena approaches incl use of advanced digital tools for stakeholder engagement - "Next Generation Smart Citizen" strategies and activities focusing on children/youths
Typology of energy supply	- Grid electricity (mainly hydropower with emission factor approx 21 g CO2eq/kWh, 95-100% hydro); since we follow EU definition of PEB (and BEST Table generation), grid EL is not included in local, primary energy. - District Heating (close to 100% domestic/household waste, incineration based) - PV - Several heat pumps and HP systems integration. Two new large HPs: One will extract waste heat from local data centre, one to utilise waste heat from local, large cooling/freezing facilities. All HPs to do local distribution of additional heat as well as redistribution and storage at larger district heating system. - V2B (energy/peak shaving and possibly frequency alignment) - New, distributed energy system requires 3 batteries of approx 500 kWh: Sluppen (2), Brattøra (1).

Success factors	Challenges/barriers
- Full anchoring and ownership at top level adm and political level; CEO formal project owner - Solid anchoring at all key departments within municipality - Highly skilled personnel also within municipality, on core topics such as project coordination/management, energy, business development, ICT, citizen involvement - Pro-active and innovative external partners that covers all crucial topics to realise PEBs/PEDs. DSO level totally necessary to have on board - The possibility of setting up local regulatory sandboxes with some-several dispensations from national regulator - Open, local trade of energy, effect, flexibility, frequency etc. - Viable business, investment, and risk sharing models that focuses on improved/adequate ROI for the private stakeholders involved	- To obtain the "correct"/necessary dispensations from national energy/grid/ concession legislation. Deregulation of monopolies, possibilities for P2P trading - Willingness from building/asset owners to invest - Local stakeholder engagement and involvement – including both citizens, businesses, NGOs etc. - Impact of innovative interventions difficult to quantify; scarce historic data and track records for PEB/PED cases - Will new business concepts and models float? How to get to commercially viable models on shorter term

9 +CityxChange, Limerick, Ireland

General information	
City	**Limerick, Ireland**
Project name	**+CityxChange**
Project status	planned ☐ under construction/**implementation** ☒ realized ☐ in operation ☐
Project start – end	01/11/2018 – 30/10/2023
Contact	Terence Connolly
Project website	https://cityxchange.eu/
Size of project area	1.5 hectares (serviceable floor area)
Building structure	Newly built ☐ **Existing neighbourhood** ☒ Mixed ☐
Land use	- Residential: 1927 m2 - Office: 11026 m2 - Social: 1585 m2 - Commercial: 1686 m2 
Financing	- *Retrofit Public-private:* Living City Tax Incentive: The LCCC Urban and Village Renewal Department administers and actively promotes the Living City Initiative (LCI), a tax incentive scheme for Special Regeneration Areas (SRA) in Limerick City Centre. The scheme is designed to bring life back into the heart of cities by offering tax relief for qualifying expenditure incurred on the refurbishment or conversion of certain buildings where conditions are met. - *Retrofit Public:* Structures at Risk Fund and the Built Heritage Investment Scheme: The LCCC Built Heritage and Conservation Department distributes funds for urgent works necessary to safeguard Protected Structures, Proposed Protected Structures, and Structures within Architectural Conservation Areas. - *Retrofit Public-private:* Public Interest Development Support: Working closely with the Dereliction and Vacancy Team, the Property Development Support Team actively addresses vacancy and dereliction in LCCC with the aim of establishing the structures for an intensive engagement process with property owners to encourage and enable reuse, redevelopment and refurbishment of vacant and derelict properties, in a targeted place based manner. - *Retrofit Research:* Living Georgian Limerick (LGL) Residential Development Template Pilot Project (Smart Aging Homes Project): LCCC are developing prototypes for enabling occupancy in the Georgian Terraced Houses and testing these against development equations and emerging residential cooperatives such as Smart Aging Homes etc. The team enables active discussions with owners of properties in the Georgian area of the City and with potential development partners in the Irish Smart Aging Exchange (ISAX). A submission has been made under Pillar 5 of the ReBuilding Ireland programme of the Department of Housing, Planning and Environment to facilitate the pilot project. - *Retrofit Public-private:* Living Georgian Limerick (LGL) Demonstration Projects: Five pilot demonstrator typologies have been identified to represent the diverse development market for historic Georgian properties. Property owners have been approached to act as champions for revitalization of the historic Georgian Core properties. The aim is to publicize and assist like-minded property owners, investors, tenants and residents in revitalizing the historic centre.

	- *Retrofit Research:* Urban Prototypes- Living Georgian Limerick Liveability Solutions: This Project will see the launch of an open challenge to urban innovators and entrepreneurs to address issues around renovation and renewal of the Georgian building stock in Limerick as well as the shared public spaces in these areas.

Overview description of the project
+CityxChange is a smart city project, that has been granted funding from the European Union's Horizon 2020 research and innovation programme in the call for the topic 'Smart cities and communities'. The Norwegian University of Science and Technology (NTNU) is the lead partner together with the Lighthouse Cities Trondheim Kommune and Limerick City and County Council. The +CityxChange project is developing a framework with supporting tools to enable a common energy market supported by a connected community. This is leading to recommendations for new policy intervention, market (de)regulation and business models that will deliver positive energy communities integrating e-Mobility as a Service (eMaaS). The project is structured to specifically develop value-added solutions that support replication in other EU cities as well as exploitation to commercial markets well beyond the project duration. In Limerick City, Limerick City and County Council (LCCC) are leading the implementation and testing of 11 demonstration projects under the headings of integrated planning and design, common energy market, and community exchange. These projects are taking place in close alignment with the deployment of demo projects in Trondheim. The outcomes this work in Limerick and Trondheim will guide the Follower Cities (Alba Iulia, Pisek, Sestao, Smolyan, and Voru) to replicate and scale the successful solutions, adapted to their respective local conditions.

Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☒ Social aspects/affordability ☐
Indicators/expected impact	- *Societal*: 1 politically-approved Bold City Visions with guidelines, roadmaps, and action plans - *Social*: 38 community participation events/actions organized - *Economic*: new jobs created - *Spatial*: 1 innovation labs/playgrounds contributing to the creation of DPEB - *Environmental*: 100% increase of total RES - *Environmental*: 1.5 Tonnes/year reduction in NOx emissions. - *Societal/Environmental*: 10% modal shift from fossil-fuel vehicles to EMaaS - *Economic/Environmental*: 20 new organisations with new sustainable energy approaches - *Social*: 20 Positive Energy Champions trained - *Regulatory*: 5 changes in regulation - *Environmental*: 1188 Tonnes CO2eq per year - *Regulatory*: 20 study visits by regulatory authorities - *Economic/Environmental*: 13 new DPEB prototypes enabled by a regulatory sandbox. - *Economic/Environmental:* 3 new DPEBs realised
Overall strategies of city/municipality connected with the project	1. Limerick 2030 Economic and Spatial Plan: http://limerick2030.ie/ 2. Corporate Plan 2015-2019: https://www.limerick.ie/council/services/your-council/corporate-plan/corporate-plan 3. Smart Cities Strategy: Building Ireland's First Digital City: https://www.limerick.ie/council/newsroom/news/limerick-become-irelands-first-digital-city 4. Project Ireland 2040: http://npf.ie/ 5. Ireland's Transition to a Low Carbon Energy Future 2015 – 2030: https://www.dccae.gov.ie/en-ie/energy/publications/Pages/White-Paper-on-Energy-Policy.aspx

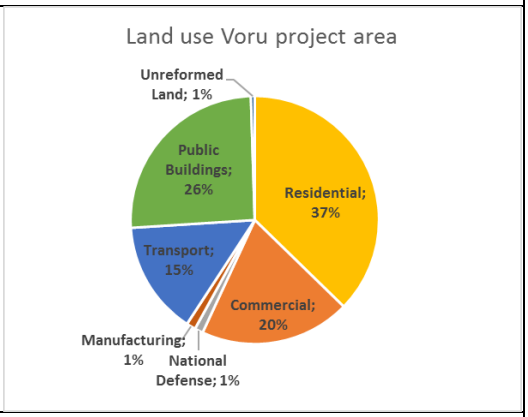
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☐
Innovative stakeholder involvement strategies	New forms of integrated spatial, social, political, economic, regulatory, legal, and technological innovations will deliver citizen observatories, innovation playgrounds, regulatory sandboxes, and Bold City Visions to engage civil society, local authorities, industry, and RTOs. - *Citizen Observatory*: This is a digital platform for increased citizen understanding, ownership and active participation including interactive mapping which will be put in place, enabling a 2-way dialogue regarding the aims, goals, motivations and ambitions of the communities with the urban authorities. - *Innovation Playground*: Innovative ideas developed by citizens, entrepreneurs, creatives and other organizations will be prototyped and piloted in specially designated Innovation Playgrounds. Successful prototypes will enter in a third stage via crowdfunding campaigns that will not only be used as funding mechanism but also as market validation tool and user feedback process. - *Regulatory Sandbox*: Examples of solutions that are to be trialled are peer-to-peer trading, integrated energy system optimisation/balancing between electricity, thermal, and liquid fuels, EV integration, demand response/flexibility and new markets for delivery of consumer-driven decentralised energy systems. - *Bold City Vision*: This cross-cutting approach will ensure that the +CityxChange solutions will lead to PEB/Ds and will enable the follower cities to provide input and to receive support for their implementation plans. In order to develop this roadmap, a review of the existing city, regional and national strategies and the vision statements and goals under different thematic headings will be carried out. Where possible, these will be aligned with the 2030 Sustainable Development Goals.
Typology of energy supply	- *Retrofit*: Improve the building envelope: ensure an air tightness level of <3m3/m2/hr @50 Pa, wall UValue of 0.26W/m2K, roof U-Value of 0.18W/m2K and glazing U-Value of 0.85W/m2K - *Retrofit*: Add advanced ventilation: for example, Mechanical Heat Recovery or Demand Controlled Ventilation solutions - *Heat Pump System*: Replace Fossil Fuels: for example, install an air to air heat pump to replace gas or oil boilers. - *Solar thermal*: Incorporate building integrated renewables: for example, solar thermal to produce Domestic Hot Water supply and/or PV to provide electricity to the building. - *Energy Management*: Install Building Energy or Home Management System: install a simple Building Energy Management System (BEMS) or a Home Management System (HMS), which will interact with the community grid trading and control system and enable energy trading and interaction with the community grid. - *Vehicle to Building*: The Gardens International building will be used to demonstrate the eMaaS solution incorporating Vehicle to Building charge.

Success factors	**Challenges/barriers**
We will deem the first year of the project a success if the following 3 targets are achieved: 1. All planning permits are in place and the project is starting to run. From October 2019 we expect installations to commence. We will have a full understanding of the energy consumption of the city. 2. We will have community support, and community interest in the project.	- The Regulatory Dispensation/adaptation/licenses for the demos will need to be secured for the project to be a success. - Local energy generation will need to be sufficient to take the block from negative to positive. We may require a greater variety of energy generation techniques, or to expand the energy generation environs. - There are number of challenges for building owners to find a good enough business model to invest in their

3. We will have a good understanding of the Financial models necessary for the project, and a roadmap to implement them.	buildings. The Financial challenge will be key to this project.

10 +CityxChange, Võru, Estonia

General information	
City	**Võru (Estonia)**
Project name	**+CityxChange** (Positive City ExChange)
Project status	planned ☐ under construction/**implementation** ☒ realized ☐ in operation ☐
Project start – end	1 November 2018 – 1 November 2023 (the duration of the action will be 60 months)
Contact	**Tiina Hallimäe**, female, is development adviser of Võru town (13 years of experiences in project management and local authority development plans). Master degree in Economics. In the present project the role is to coordinate activities which are connected with Võru town. **Diana Vene**, female, head architect of Võru town (since august 2017), TTK University of Applied Sciences- architecture, Tallinn University of Technology –architecture. Main field is urban planning and coordinate activities which are connected to this topic in Võru.
Project website	https://cityxchange.eu/
Size of project area	The Võru Demostration area covers an area of **0,22 km²** (the total area of Võru is 14 square km).
Building structure	Newly built ☐ **Existing neighbourhood** ☒ Mixed ☐
Land use	The composition of land purpose is: - Residential: 37.3% - Commercial: 19.6% - National defence: 1.1% - Manufacturing land: 1.2% - Transport: 14.8% - Public buildings land: 25.5% - Unreformed land: 0.5%
Financing	Grant



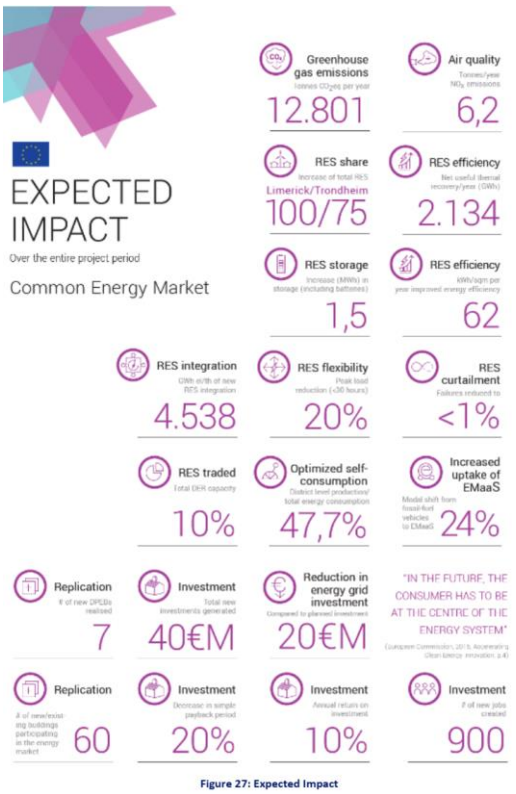
Overview description of the project
+CityxChange (Positive City ExChange) is a smart city project, that has been granted funding from the European Union's Horizon 2020 research and innovation programme in the call for the topic 'Smart cities and communities'. Norwegian University of Science and Technology (NTNU) will be the host and lead the +CityxChange consortium together with the Lighthouse Cities Trondheim kommune and Limerick City and County Council. The +CityxChange vision is to enable the co-creation of the future we want to live in. This will include the development of a framework and supporting tools to enable a common energy market supported by a connected community. This will lead to recommendations for new policy intervention, market (de)regulation and business models that will deliver positive energy communities integrating e-Mobility as a Service (eMaaS). Trondheim, Limerick, Alba Iulia, Pisek, Sestao, Smolyan and Voru and their industry and research partners are joining forces to co-create the future we want to live in. As aspiring Lighthouse and Follower Cities, respectively, they have detailed out their ambitions into the +CityxChange proposal, which describes a structured approach on how to develop and deploy Positive Energy Blocks and Districts and scale these out as part of the Clean Energy Transition. The approach combines: Prototyping the Future through Integrated Planning and Design; Enabling the Future through Creation of a Common Energy Market; and Accelerating the Future through CommunityxChange with all stakeholders of the city. New forms of integrated

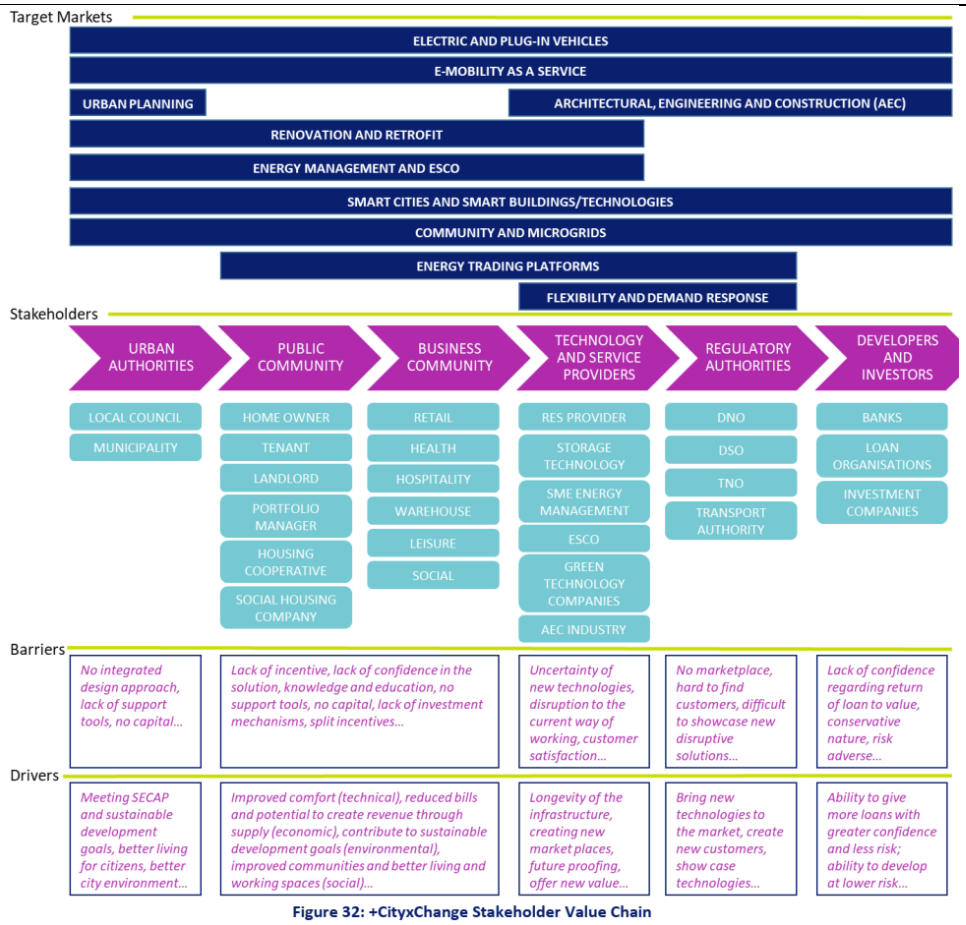
spatial, social, political, economic, regulatory, legal, and technological innovations will deliver citizen observatories, innovation playgrounds, regulatory sandboxes, and Bold City Visions to engage civil society, local authorities, industry, and RTOs to scale up from PEBs to PEBs to Positive Energy Cities, supported by a distributed and modular energy system architecture that goes beyond nZEB. On top of this, the consortium will create a new energy market design coupled to consumer-driven innovation, developed in close working cooperation with national regulators, DSOs/CSOs, property developers, and local energy communities. Flexibility will be put at the core of the distributed energy system by creating new micro-grid operation, prosumer-driven Community System Operators, and new markets for peak shaving/RES trading to reduce grid investment needs and curtailment. Their aim is to realize Europe-wide deployment of Positive Energy Districts by 2050 and prepare the way for fully Positive Energy Cities

The role of Võru in this project is Follower City, performing mainly the replication tasks indicated in WP6 leading T6.10. In addition Võru will participate in the Follower City activities in the WP7-WP10.

Võru town would like to focus on its historical part (0,37 km2, approximately 1100 inhabitant, houses are built in the period of 1784-1940) in order to find innovative solutions for decreasing CO2 emission, also to change people's habits and behaviour. Võru town would like to increase the attractiveness of this area and bring is as an example of a best living environment. As it needs bigger approach Võru town would like to make bold city vision which includes general plan of the Võru town, analysis about Võru heritage and visions for heritage area, also technical documents for innovative solutions, 3D, intelligent platform especially for heritage area.

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ **Energy neutral** ☒ **Energy efficient** ☒ **Carbon-free** ☒ **Climate neutral** ☒ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒ Other: **Sustainable Development**
Indicators/expected impact	**EXPECTED IMPACT FOR THE +CITYXCHANGE PROJECT** a. Technical implementation i. detailed specifications with respect to the technologies that were installed ii. the size of the technologies iii. design of the overall solution, iv. the company(s) that installed it, v. how long it took etc. b. Social implementation, i.e. information with respect to how the DP was implemented with respect to the citizens in the block/district, i. what engagement activities were carried out, ii. anecdotal evidence on what was successful and why etc. c. Legal implementation – information regarding any i. regulation barriers that had to be overcome ii. planning applications that had to be submitted iii. how any technologies or services were procured iv. what stakeholders (public and private) had to be consulted etc. d. Economic implementation i. costs of the overall Demonstration Project

	ii. breakdown of capital equipment, materials, installation costs etc. iii. any investments that were obtained, how they were obtained, where they came from etc. e. Environmental implementation i. the impact of the DP to the block/district, ii. how it improved the environmental capacity of the block and iii. what impact it had from an environmental perspective  Figure 27: Expected Impact  Figure 28: Expected Impact (Continued)
Overall strategies of city/municipality connected with the project	Võru town would like to be a growing smart intelligent small city (energy, innovation, renewal strategies). The strategy is currently been developed to achieve our goals.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	**City planners, building owners/managers, energy managers, investors, designers, policymakers, citizens, communities, grid operators, urban stakeholders, media, project stakeholders, local stakeholders**

	 **Figure 32: +CityxChange Stakeholder Value Chain**
Typology of energy supply	- District heating (woodchip technology) - Renewable materials, solar thermal energy

Success factors	Challenges/barriers
- First and big thing is that the project got foundation → work could be started	- It is difficult to start with innovative projects in the rural area. People are against everything new. - The project is not taking seriously because this is new for this area. - Actually it is a big challenge how to get people believe in that. - The barriers are political and financial. - +CityxChange project one of the challenges to transit to clean energy, and realize positive energy districts, lies with the regulatory framework that governs DSOs, TSOs, and energy companies throughout Europe. One of the core challenges faced in the wide-scale roll-out of Positive Energy Blocks is the physical/spatial constraints of continuity between adjacent buildings and DER resources available within the local energy system.

ANNEX: Background information on Võru
Võru was founded on 21-st of August 1784 and is situated in the South-Eastern part of Estonia and is the capital of Võru county. The total area of Võru is 14 square km2. The total population of Võru is 12 367 (In Estonia 1 315 635) – constituting 0,94% of the total population in

Estonia. Võru is the 11th biggest city by its population in Estonia. Võru is the capital of Võru region with 12.367 inhabitants (2017). Võru region has 33.505 inhabitants. Võru county's main economic sectors are forestry and wood processing, furniture and food industry and also tourism. The biggest foreign owned companies based in Võru county are AS Toftan (wood processing), AS Barrus (wood processing), AS Antsla Inno (furniture production), AS Rauameister (metal processing), AS Võru Juust (food processing) and Danpower GmbH (energy production). The county enjoys an advantageous location due to its relative proximity to Pskov in Russia (100 km) and Riga in Latvia (220 km). Accessibility is provided by several transport corridors running through the county. One of the most important transit routes in Estonia, Tallinn-Tartu-Pskov, passes the county. The South East corner of the county is crossed by the Riga-Pskov-St Petersburg major road. County is strategically placed on trade routes between the East and West. According to statistics (2015) Võru county GDP is 278,9 m euros (which is 1,4 % from GDP), in Võru county GDP per capita is 8 308,1 euros. In 2016 there were 221 companies exporting (turnover 112,3 m euros) and 371 companies importing goods (turnover 60,9 m euros). There are 4148 entrepreneurs running their businesses in Võru region.

Most of the people in Võru town are working in service sector (schools, hospitals, military, etc). The biggest industries in town are wood and food processing factories (Cristella VT, Valio).

In Võru county there are 95,3% Estonians, 3,3% Russians and 1,4% other nationalities. Two indigenous ethnic groups live in Võru county – the Võro people and the Setos. Both ethnic groups have their own language (Võro, Seto) and cultural heritage in traditions. The population in town and region is ageing; 75 % of the population lives in multi-flat buildings. There are 883,36 inhabitants per km2 (average in Estonia is 29,8). In Tallinn there are 2 676,4 and in Tartu 2 389,6 inhabitants per km². Võru region made joint procurement to provide public transport in Võru region (In town and in region). With new service provider Võru region started to CNG busses and an LNG-CNG gas station was built for that. Võru took part in a national programme aiming to reduce the usage of fossil fuels in public transport. Võru has 16 km of light traffic roads. The most problematic issue for Võru town is that people are moving out from Võru town to surrounding municipalities or bigger cities in Estonia. Also the centre of Võru and heritage area is week and poor from activities. People are moving to live from the city centre to the suburb areas of the town. As there are no universities in town, young people move to other towns in Estonia or abroad. Insufficient public transport. There is urgent need to bring people and life back to city centre and to reconstruct buildings to make them more energy efficient.

Võru is a really small city only 14km2 and 12367 inhabitants. The population and region is mainly ageing. It is a big thing to become noticeable even in Estonia.

A problematic issue for Võru is that people are moving out from Võru town to surrounding municipalities or bigger cities in Estonia. Also the centre of Võru and the heritage area are weak with poor activities. People are moving from the city centre to live in the suburbs. As there are no universities in town, young people move to other towns in Estonia or abroad. There is insufficient public transport. There is urgent need to bring people and life back to city centre, to make heritage area attractive place to live and have business and to reconstruct buildings to make them more energy efficient.

For a bigger and more integrated approach Võru town aims to build the bold city vision which includes a general plan of the Võru town, analysis about Võru heritage and visions for heritage area, linked with technical documents for innovative solutions, 3D approaches, and intelligent energy systems especially for the heritage area. A new plan for Võru town will focus on how to bring life back to the city centre (includes citizen participation, innovation, energy efficiency etc.) and include analyses, visions, and virtual plans for the historical area in the frame of energy efficiency, innovation and positive or neutral energy blocks, where technical reconstruction documents for the houses and quarters of the energy blocks will be created.

11 MAKING CITY Groningen, The Netherlands

General information	
City	**Groningen, The Netherlands**
Project name	**MAKING City**
Project status	planned ☐ **implementation phase** ☒ realized ☐ in operation
Project start – end	Start December 1st 2018. Ends December 1st 2023
Contact	Groningen municipality: Jasper Tonen, Anna Tahaparij
Project website	http://makingcity.eu/ (not yet completed)
Size of project area	The buildings in the district that participate in the project are: District North: - Energy Academy Europe Building (9.636 m2) - Nijestee Highrise 1 (3,748 m2) - Nijestee Highrise 2 (3,748 m2) - 3 Terraced houses (combined: 400 m2) – The implementation is in cooperation with the local citizens initiative Paddepoel Energiek and Grunneger Power. District South: - Mediacentrale (14,400 m2) - Powerhouse (7,800 m2) Sportscomplex (5,315 m2)
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	n/a
Financing	The actions that will be implemented depend on the owner of the building. In this project both public and private money is invested, combined with EU subsidies.

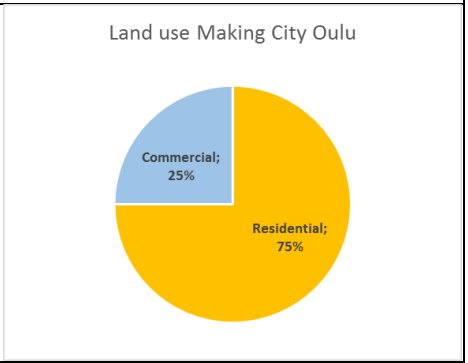
Overview description of the project
Coordinated by the CARTIF Foundation, MAKING-CITY is a 60-month Horizon 2020 project launched in December 2018. It focuses on addressing and demonstrating the urban energy system transformation towards smart and low-carbon cities, following the Positive Energy District (PED) concept. Today, cities have an essential role to play in tackle climate change by significantly reducing their carbon emissions. The PED operational models developed in MAKING-CITY (tested in the two "Lighthouse cities" Groningen and Oulu and replicated then in 6 "Follower cities"), will help European and other cities around the world adopt a long-term City Vision 2050 for energy transition and sustainable urbanisation whilst turning citizens into actors of this transformation. As MAKING-CITY is an Innovation Action (IA), technologies selected to be implemented are mature or even into the market. Moreover, the PED concept appears as a step beyond the current European building regulations by bringing major structural, societal, economical and technological changes in the cities. In the lighthouse City of Groningen the district energy approach will be tested. The methodology is replicable for all sorts of districts. In two districts, that vary a lot in types of buildings, occupation, social status etc., several buildings have been selected that (combined) should become energy positive at the end of the project. Various innovative technical solutions will be implemented and the effectiveness will be tested.

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☒ Social aspects/affordability ☐ Other: Project is part of Groningen's District energy approach
Indicators/expected impact	- CO2 neutral. - Energy positive on yearly basis and incorporating building related consumption - Other KPIs are yet to be formulated, but will include the ones mentioned
Overall strategies of city/municipality connected with the project	- Energy Masterplan: Groningen energyneutral in 2035. - The NEXT City. City Vision for the midterm.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ **Mobility** ☒ **Buildings** ☒ Materials ☐ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	A consortium of 10 partners is working on this project: - TNO, Applied scientific research institute - Grunneger Power, Community owned energy cooperative - New Energy Coalition, regional development and cluster organization - Waarborg vastgoed, Real estate investor - Nijestee, Housing corporation - CGI, business consulting, system intergration and managed services - Sustainable Buildings, young award-winning high-tech software company - University of Groningen, faculty of spatial sciences - Hanze University of Applied Sciences, technical and social developments - Warmtestad BV, local heatgrid owner All relevant stakeholders (citizens, industry, investors/real estate, business, research) are involved.
Typology of energy supply	PV, PVT, BIPV, PV on water, Solaroad, Waste digestion, Geothermal or Waste heat (from a data hotel), Geothermal heatpumps, District heating

Success factors	Challenges/barriers
This cannot be said yet, since the project has just started.	- Realising an actual PED in practise. - Overcoming legal and law related barriers, for instance the Dutch energy law. - Financial hurdles. The innovation actions have not yet been proven to be effective, so it is difficult to get funding. - Realising replication and scaling up the plans. - Make citizens problem owners as well and make them see the benefits instead of only looking at the direct costs.

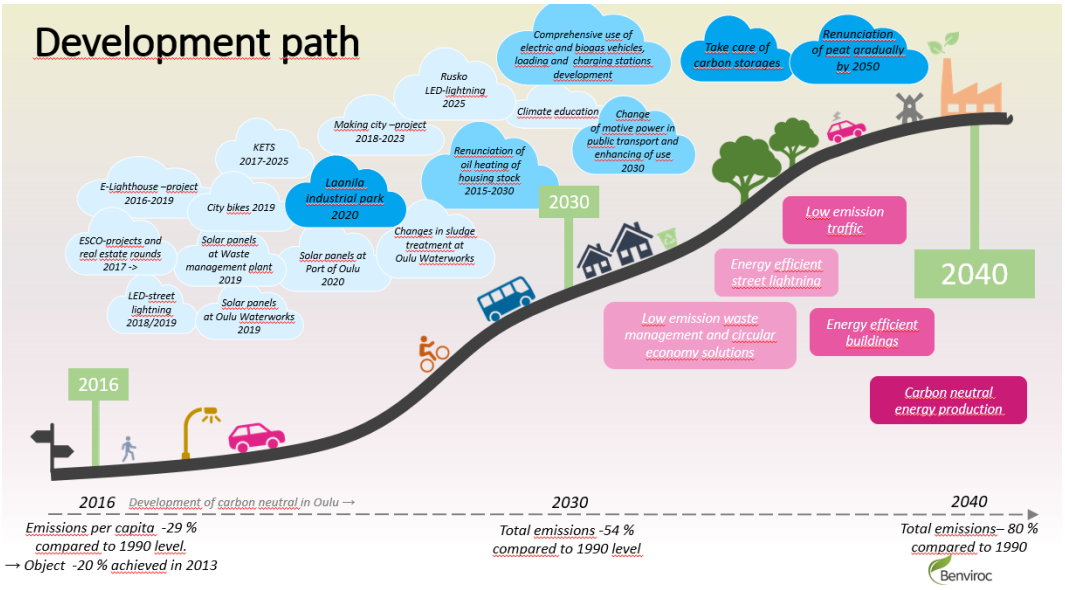
12 MAKING CITY Oulu, Finland

General information	
City	**Oulu**
Project name	**Making-City**
Project status	planned ☐ **implementation phase** ☒ realized ☐ in operation ☐
Project start – end	12/2018 – 11/2023
Contact	Samuli Rinne
Project website	Under construction
Size of project area	4 hectare
Building structure	**Newly built** ☒ **Existing neighbourhood** ☒ **Mixed** ☒
Land use	- Residential: 3 hectare (75 %) - Office: - - Industry: - - Other: Commercial 1 hectare (25 %)
Financing	- Total investment: 32,5 milj. € - 3,143 milj. € (municipal funds) - 28,29 milj € (company co-financing) - 1,127 milj € (EC)



Overview description of the project
MAKING-CITY is a large-scale demonstration project aiming at the development of new integrated strategies to address the urban energy system transformation towards low carbon cities, with the positive energy district (PED) approach as the core of the urban energy transition pathway. The project will be intensively focused on achieving evidences about the actual potential of the PED concept, as foundation of a high efficient and sustainable route to progress beyond the current urban transformation roadmaps. Located 3 km away from the city center of Oulu, the district of Kaukovainio has been selected to implement the PED concept developed in MAKING-CITY. The retrofitting of residential buildings, geothermal technology, and energy storage tanks are the main solutions that will be implemented as part of the PED concept. Besides promoting sustainable energy solutions, the PED method is expected to attract new families, foster community spirit, advance equality between population groups. Overall, the PED implementation in Kaukovainio will be driven by the 2012 Master Plan for "land use, environmental, and transport" which is based on open meetings gathering residents, key players and Oulu representatives. Firstly, the retrofitting of residential buildings (windows, home energy controllers to monitor air quality and the energy consumption…) will allow to maximise infrastructure performance.

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ **Energy neutral** ☒ **Energy efficient** ☒ **Carbon-free** ☒ **Climate neutral** ☒ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒ City of Oulu is doing ambitious work for climate change mitigation. The framework is embedded in the City strategy Oulu 2026: https://www.ouka.fi/documents/52058/17394318/ENG_Oulu2026_kaupunkistrategia.pdf/f9b8f26b-43a4-4b64-838a-fe0dde2a52eb As extension work of the city strategy a new environmental programme will be decided in the city government in April. The main object of the programme is that city of Oulu is carbon neutral in 2040. SECAP (Sustainable Energy and Climate Action Plan) is part of the programme and accepted by the city government in December 2018.
Indicators/expected impact	Project and City level KPIs are under construction. The indicators are chosen by technical, economical, environmental, societal and social points of view.
Overall strategies of city/municipality connected with the project	The City of Oulu was connected to the energy agreement and climate agreement of Covenant of Mayors for Climate and Energy in 2016 in which the 40% of the 1990 level reducing of the lighthouse gas emissions of the city has been bound itself by the year 2030. The main object reducing of greenhouse gas emissions of the agreement is through the measures which reduce energy consumption and energy efficiency and the increasing of the use of the recurring forms of energy. According to the plan of action , the City of Oulu will reduce its lighthouse gas emissions by 27 measures which have been divided into buildings and functions, service buildings, residential buildings of the city, to street lighting, traffic and waste management according to the SECAP sectors by the year 2030. Furthermore, it has been presented to the power and heat production and increasing of the use of the energy of the one recurring and the operations models to the changes joining measures and to whole urban structure. The emissions of the industry have been marked off outside the agreement.

	Vision of Carbon Neutral Oulu 2040: 
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ **Refurbishment** ☒ Sustainable production ☐ Sustainable consumption ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒ Other: Energy distribution
Innovative stakeholder involvement strategies	- City of Oulu, enabler and coordination, new forms of participations of citizens - Jetitek Oy, innovative heat pumps (Industry, Business) - Oulu Energy, new forms of heat production and distribution (Industry, Business, Investor) - Arina Oy, recirculation of waste heat (Business, Investor) - Sivakka Oy, refurbishments (Investor/real estate) - YIT Oy, innovative housing (Investor, Business) - VTT Oy, design support (Research) - University of Oulu, design support (Research)
Typology of energy supply	Geothermal technology and PV panels will support the existing heating district system. One other innovative feature is the installation of geothermal heat pumps and thermal borehole energy storage under the Arina shopping centre. Coupled with PV panels covering the roof of this building and excess heat from refrigeration, the tanks will assure a seasonal energy storage: on summer, the extra energy produced will be redistributed into the district network (heating and hot water) or stored for winter energy demand peaks.

Success factors	Challenges/barriers
The project technical actions are carried out within the first 3 years with an additional monitoring period of two years, during which time the energy consumption data is collected and energy savings potential further evaluated. The results and lessons learnt will be taken to practice on district level in other areas of the city. In order to get real emission reduction techniques must be tailored to suit different cases.	Financial viability may be questionable especially for the transition period. Also the knowledge of the issues may be lacking.

13 MAKING CITY Kadıköy, Istanbul, Turkey

General information	
City	**Istanbul-Kadıköy, Turkey**
Project name	**Making City – Follower City Kadıköy**
Project status	planned ☐ **implementation phase** ☒ realized ☐ in operation
Project start – end	2019 – 2024
Contact	Ömer Akyürek
Project website	https://smartcities-infosystem.eu/sites-projects/projects/making-city
Size of project area	n/a
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	TBD
Financing	The project is a funded project under H2020

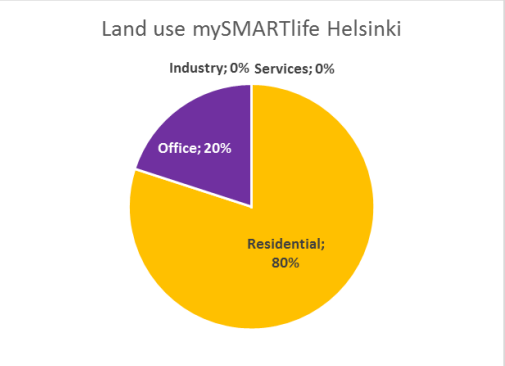
Overview description of the project
Kadıköy is one of the follower cities in the EU H2020 funded project MAKING-CITY. MAKING-CITY is a large-scale demonstration project aiming at the development of new integrated strategies to address the urban energy system transformation towards low carbon cities, with the positive energy district (PED) approach as the core of the urban energy transition pathway. The project will be intensively focused on achieving evidences about the actual potential of the PED concept, as foundation of a high efficient and sustainable route to progress beyond the current urban transformation roadmaps. Although in principle a PED approach seems a solid and ambitious strategy, this should be complemented with long term urban planning to ensure upscaling and fostering higher impacts. Currently city energy plans are starting to be designed with a 2030 horizon, according to the standard city commitments, as for instance those reflected in the SECAPs and other more specific city plans. Project will address methodologies to support cities in their long term urban planning towards an adequate energy transition, paving the way of the planning, implementation and up-scaling process. Cities of Groningen (Netherlands) and Oulu (Finland) will act as lighthouses. These cities are currently working intensively in ambitious transformation planning whose approaches fit perfectly with the project objectives. Both have committed to deploy a demonstration of at least one positive energy district. León (Spain), Bassano del Grappa (Italy), **Kadiköy (Turkey**), Poprad (Slovakia), Vidin (Bulgaria) and Lublin (Poland) will be the follower cities. Under this project, Kadıköy has commited to develop a solid execution project of Positive Energy District and foster high level of replication of the solutions demonstrated in Groningen and Oulu.

Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ Climate neutral ☐ Sustainable neighbourhood ☐ Social aspects/affordability ☐
Indicators/expected impact	The project is expected to have a wide range of impacts covering; environmental, social, economic and regulatory fields.
Overall strategies of city/municipality	Kadıköy Municipality is directly a partner to the project activity as the follower city.

connected with the project	
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ Mobility ☐ **Buildings** ☒ Materials ☐ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	To maximise citizens' awareness and to empower citizens in this city transformation process, citizens' engagement strategy will be defined to turn citizens into active actors of the city energy transition. Following a user-centric approach, this model will also include the co-creation and co-design of smart city services towards energy transition with citizens via social networking (Facebook, LinkedIn, Twitter, youtube), city apps, public consultations and participative workshops (social media strategy). The co-creation processes will be linked with events with high interest to attract participation.
Typology of energy supply	Although the discussions are ongoing, the typology will potentially involve solar thermal, solar PV, wind, local heating and heat pump technologies for Kadıköy.

Success factors	**Challenges/barriers**
This will be worked in detail throughout the project.	This will be worked in detail throughout the project.

14 mySMARTlife, Helsinki, Finland

General information	
City	**Helsinki, Finland**
Project name	**mySMARTlife**
Project status	planned ☐ **under construction/implementation** ☒ realized ☐ in operation
Project start – end	11/2016-11/2021
Contact	Marja Vuorinen, Esa Nykanen
Project website	**https://www.mysmartlife.eu/cities/helsinki/**
Size of project area (hectare)	mySMARTLife Interventions in Helsinki (BELOW : LINKS w text and pictures) • Merihaka and Vilhonvuori - Retrofitting Projects • Kalasatama High-Performance Residential Buildings • Viikki Environment House • Energy Projects • Smart Public Lighting • Solar Power Plant • E-Mobility • Helsinki Urban Platform
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	- Residential: 80 % - Office: 20 % 
Financing	City of Helsinki and H2020.

Overview description of the project
The Lighthouse project mySMARTLife aims at making the three Lighthouse Cities of Nantes, Hamburg and Helsinki more environmentally friendly by reducing the CO_2 emissions and increasing the share of renewable energy. Three Fellow Cities of Bydgoszcz (Poland), Rijeka (Croatia) and Palencia (Spain) are involved to collaborate in the project and build their sustainability agenda. The interventions include innovative technological solutions in connection with energy refurbishments of buildings, usage of renewable energies, clean transport and supporting ICT solutions. The project aims for transformation towards more sustainable and inclusive cities allowing improved quality of life. **Helsinki´s demonstration area** Vanhankaupunginlahti (old Town Bay) is representing the history, present and future of smart energy systems in Finland. While the oldest hydroelectric plant in Finland is still producing electricity on the site, the world´s most eco-efficient coal-based electricity and heat co-generation plants and further modern power plants are situated right next to it. A major step forward was the recent decision by the City of Helsinki to phase out the current

coal power plant by 2024. MySMARTLife is involved in promoting the transition towards decentralised production and increasing the share of renewable energy sources.

In this high performance area, four zones of intervention for the 47 mySMARTLife actions, in Helsinki, can be identified:

- **Zone 1 ("Merihaka & Vilhonvuori" retrofitting area)** is the residential retrofitting zone where large retrofitting actions are taking place, including smart metering and control for heat demand response. This service will also be connected to the urban platform through IoT allowing a performance evaluation and thermal imaging e.g. to pinpoint heat loss and management and optimisation of the district heating and cooling.
- Activities in **Zone 2 ("Kalasatama" new construction area)** are focusing on the construction of a high-performance residential zone with smart home solutions, smart meters in all flats, the integration of renewable energy sources for example to the e-mobility charging network and utilising waste heat from individual sources.
- **Zone 3 (Viikki environment house)** comprises a high performance office building where the contribution of renewable energy sources will be maximised through a better control and power management.
- **Zone 4 (old town bay area)** covers the entire district and even city level. Several interventions, mainly mobility actions, will be implemented

Example pic merihaka:

https://www.mysmartlife.eu/fileadmin/_processed_/8/2/csm_helsinki-merihaka1_3afe08d7cd.jpg

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ **Climate neutral** ☒ Sustainable neighbourhood ☐ Social aspects/affordability ☐
Indicators/expected impact	Example: Work in preparation has included collection of the baseline energy consumption data and estimation of the energy savings potential. VTT Technical Research Centre of Finland has performed a comprehensive technical and cost-efficiency study on suggested renovation measures for particular type of apartment buildings– information table embedded as pop-up clickable feature

	onto the model Merihaka apartment buildings) and the City of Helsinki has collected extensive data on buildings' energy information for open source use in the Energy and Climate Atlas as an integral part of the 3D City Model. https://kartta.hel.fi/3d/atlas/#/
Overall strategies of city/municipality connected with the project	Helsinki strives to reduce greenhouse gas emissions by 30 percent by year 2020 and by 60 percent by year 2030. The City of Helsinki's climate work is detailed on the pages on the Helsinki Climate Site. The goals are defined in the Helsinki City Strategy 2017–2021. Significant progress has already been made with continuous climate work. In 2017, Helsinki's emissions were 24% smaller than those in 1990, even though the number of residents had in- creased by 150,000. Per resident, the emissions were calculat- ed to be approximately 42% smaller. However, in order to make Helsinki carbon-neutral, the emissions have to be reduced even more and faster than before. A carbon-neutral Helsinki is being created in collaboration between the residents, the City, businesses and organisations.  - The Carbon-neutral Helsinki 2035 Action Plan (pdf) - Carbon-neutral Helsinki 2035, Summary (pdf)
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ **Mobility** ☒ **Buildings** ☒ Materials ☐ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ **(Local) Governance** ☒ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	Example: Helsinki uses in kalasatama (Zone 2) agile prototyping to harverst ideas from citizens. One practical idea in development is an App "Carbon ego" to be used in the daily life of a citizen to follow own carbon footprint. There will be functions like "challenges" to create social activities around the app.
Typology of energy supply	- Geothermal energy - District heating/local heating - Heat pump system - Industrial waste heat - Solar energy (crowdsourcing in panels for normal citizen)

Success factors	Challenges/barriers
The project technical actions are carried out within the first 3 years with an additional monitoring period of two years, during which time the energy consumption data is collected and energy savings potential further evaluated until the end of November 2021. The results and lessons learnt will be taken to practice on district level in other areas of the city. Engaging private stakeholders will continue in order to expand the collaboration network and influence the decision-making regarding energy saving investments. The main objectives on energy efficiency is to reduce consumption by 10 per cent in initial piloting and expand the learnings to further energy efficiency improvements.	The heating of buildings causes more than half of Helsinki's emissions. The greatest emission reduction potential lies in energy renovations: for example, when a building is renovated, it can be made significantly more energy-efficient than before. Emissions from buildings can be reduced by **80%.** Because only a small percentage of all buildings located in Helsinki are owned by the City, it is important to encourage residents and organisa- tions to take part in reducing emissions. The buildings owned by the City hold **11%** of the emission reduction potential of the entire building stock of Helsinki. The majority of the measures to reduce emissions are finan- cially attractive to building owners in the long term. They often improve liveability as well. Helsink pland to go around barriers is: • Providing advisory services to support Helsinki residents' energy renovations and increased use of renewable energy • Steering district planning more towards carbon neutrality than before • Steering people towards energy-efficient solutions and renewable energy through Building Control Services • Improving energy efficiency and increasing the use of renewable energy in the City's service and residential buildings • Taking the entire carbon footprint of construction into account and promoting wooden construction • Replacing outdoor lights with more energy-efficient alternatives • Making provisions for emission-free thermal and wind energy

15 Sinfonia, Bolzano, Italy

General information	
City	**Bolzano, Italy**
Project name	Sinfonia
Project status	planned ☐ **under construction** ☒ realized ☐ in operation
Project start – end	2014-2020
Contact	Daniele Vettorato
Project website	http://www.sinfonia-smartcities.eu/en/project
Size of project area	For Bolzano: 785 hectares (exdended district – Bolzano south)
Building structure	Newly built ☐ Existing neighbourhood ☒ Mixed ☐
Land use	mixed use area - Residential: 100% Social Housing - Office: n/a - Industry: n/a
Financing	20% Research funding 40% Public 40% Green financing

Overview description of the project

The **SINFONIA project** is a five-year initiative to deploy large-scale, integrated and scalable energy solutions in mid-sized European cities. At the heart of the initiative is a unique cooperation between the cities of Bolzano and Innsbruck, working hand in hand to achieve 40 to 50% primary energy savings and increase the share of renewables by 20% in two pioneer districts. This will be done through an integrated set of measures combining the retrofitting of more than 100,000m² of living surface, optimisation of the electricity grid, and solutions for district heating and cooling.

Since 2005, Bolzano (Italy, 100,000 inhabitants) has developed an ambitious investment plan for large scale urban refurbishment in collaboration with both public and private stakeholders. The work undertaken in SINFONIA is part of this plan, and aims to achieve 40% to 50% primary energy savings in the demo sites and to increase the share of renewables in the district of Bolzano SW (South West) by 20%.

BUILDING REFURBISHMENT

37,000m² of social housing from the 50s-70s will be retrofitted to achieve high energy performance and improve interior comfort while ensuring cost effectiveness and minimal impact on tenants. Measures include:

- Building envelope insulation;
- Integration of renewable energy sources for electricity, heating and domestic hot waterSolar PV panels;
- Additional storeys using innovative timber construction technologies.

DISTRICT HEATING & COOLING

The district heating & cooling network will be extended and optimised to reduce both the CO2 and the nitrogen equivalent emissions. Measures include:

- Real time monitoring and forecasting of peak loads and energy demand;
- Hybrid hydrogen/methane backup system;
- Study on recovery of wasted energy from local industrial park.

ELECTRICITY GRID

Bolzano will implement an Urban Service-Oriented Sensible Grid (USOS-grid) system in the South West district for improved energy distribution control. Measures include:

- Recharge points for vehicles and bicycles;
- Meteorological stations for local climate condition monitoring;
- Smart retrofitting of the public lighting system.

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☒ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒
Indicators/expected impact	**Environmental:** - Final energy consumption reduced by factor 10 - Reduced energy bills by factor 1 in social housing (tackle energy poverty) - CO2 emissions reduced by factor 8 **Social:** - 33.000 sqm of social housing refurbished **Behaviour change**: http://www.sinfonia-smartcities.eu/en/blog/post/behaviour-change-how-to-increase-the-impact-of-energy-efficient-renovation-projects
Overall strategies of city/municipality connected with the project	Energy Masterplanning: the project is connected to the SEAP
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	- Industry: partner of the project. Local energy provider + startups incubator - Research: partner of the project Good practices for effective stakeholder engagement: explore our database of solutions http://www.sinfonia-smartcities.eu/en/blog/post/good-practices-for-effective-stakeholder-engagement-explore-our-database-of-solutions
Typology of energy supply	- Solar thermal collectors integrated in the facedes for domestic hot water production - NSGE - District heating - Heat pumps - Industrial waste heat recovery feasibility study.

Success factors	**Challenges/barriers**
- Empowerment of project partners - High visibility of results	- Slow procurement procedures. - Technology integration is not BAU in the market: difficulties to find market players able to provide/bring

- Growing interest on the Smart City transition in the city	technologies from TRL7 (minimum requirement for innovation) to 9 (requested by public tender rules). - Public funds not always lockable for 5 years time horizon (changes of local governments)

16 Laser Valley – Land of Lights, Măgurele, Romania

General information	
City	**Măgurele, Romania**
Project name	**Laser Valley – Land of Lights (ELI-NP, Magurele)**
Project status	planned ☐ **under construction** ☒ realized ☐ in operation
Project start – end	from 2019
Contact	Cosmin Holeab, Elena Simion
Project website	http://landoflights.ro
Size of project area (hectare)	Smart technological development centered on the city of Măgurele - Măgurele City: 4.500 ha - Măgurele Science Park: 20-60 ha - Măgurele Science Village: 5-10 ha - Urban regeneration (Măgurele city centre): 60-80 ha
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	Mix of - housing, - office space/business, - schools, university/science, - cultural facilities, - natural facilities (river, forests, Neajlov River delta)
Financing	- Public - Public-Private - Research funding - Green financing - Other (business angels)

Overview description of the project

Laser Valley - Land of Lights is about capitalising on the uniqueness of the scientific and technological Pan-European research infrastructure Extreme Light Infrastructure - Nuclear Physics (ELI-NP), about valorising the scientific, technological and talent hub already existing in the city of Măgurele, Ilfov County, about taking advantage of the geographic location, neighbouring the Southern area of Bucharest and close to the Danube River, about creating an economic growth pole as a regional science, innovation and entrepreneurship ecosystem, about integrated disruptive development ('game changer') and about an accelerator of territorial transformation.

In essence, it is about an accelerator for Romania's development.

Laser Valley - Land of Lights targets an entire territory, covering several counties in Romania with high implications for the development, transport and European mobility Axis represented by the Danube, with expectations regarding its association as a strategic, flagship project to the EU Strategy for the Danube Region (EUSDR). The years 2018 (the centennial of Romania's Great Unification) and 2019 (Romanian EU Council Presidency) are opportunities and challenges for Laser Valley as well. Due to its uniqueness, size, complexity and potential socio-economic impact, the project is among the most challenging in post-1989 Romania - certainly the largest in terms of smart territorial development.

Considering the recommendations from the Socio-Economic Impact Study on ELI-NP developed by PwC in partnership with Aspen Institute Romania and in dialogue with international funding bodies - EIB, EBRD and WB, we concluded that a sound substantiation of joint decisions and actions for the development of Laser Valley - Land of Lights requires

governance mechanism, preferably an open method of coordination. This mechanism should coordinate the development of the science, innovation and entrepreneurship ecosystem in Laser Valley - Land of Lights by:

- providing a public-public and public-private dialogue platform;
- providing the necessary institutional framework to prepare the development strategy and the implementation plan;
- substantiating an Integrated Territorial Intervention in Măgurele, around ELI-NP and the hub of facilities and talents, to contribute to the development of a knowledge region;
- coordinating communication and dialogue with the international funding institutions; informing the Government, Parliament, local public administration, businesses and citizens on a regular basis.

Resources:

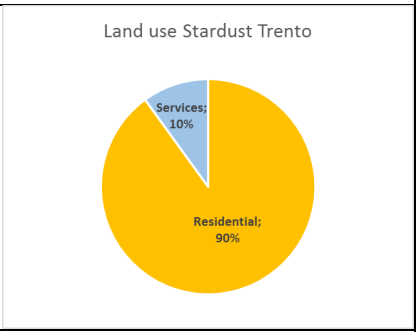
- Office space, housing, schools, university
- Mix of housing, business, science, cultural facilities and natural facilities (river, forests, Neajlov River delta)
- Environmental target for all development projects (fossil fuel-free by 2030)
- Energy target for all developments
- An 'understood' territory, ready for smart territorial development
- A Science village which will attract more than 500,000 students / year, starting with 2020
- A science park with a core of 20 ha; a hub of public research facilities; companies, business incubators and accelerators, a cognitive computing and cyber security research pole.

Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ Energy neutral ☐ **Energy efficient** ☒ **Carbon-free** ☒ Climate neutral ☐ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☐ Environmental target for all development projects: fossil fuel-free by 2030
Indicators/expected impact	Areas of impact: - Environmental - Societal - Social - Economic - Spatial

	- Regulatory Impact expected: - More than 12,000 new jobs - EUR 1.26 billion annual turnover - EUR 500 million taxes collected to the state budget yearly
Overall strategies of city/municipality connected with the project	- Smart City Strategies - Urban Renewal Strategies - Energy Masterplanning - Growing City - Entrepreneurship ecosystem support policies
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	- Citizens - Industry - Investor/real estate - Business - Research
Typology of energy supply	- Geothermal energy - Solar thermal energy - District heating/local heating

Success factors	Challenges/barriers
The success of Laser Valley - Land of Lights depends on the successful action of the state, as an entrepreneurial state, on the public-public partnership (local - central administration), on the public- private partnership and on the private initiatives, both individually but, especially, orchestrated. The public commitment at Government level, the local administration commitment, the stakeholders' involvement and national and international communication are also key drivers for concrete results. The need for an open governance structure for the development of Laser Valley is a major conclusion of 2016. This structure is instrumental for the coordination of interventions, for the exploitation of the exceptional potential and for delivering positive impacts on competitiveness and welfare. As ELI-NP is an example of continuity, ever since 2009, when it was assumed by the Government, we strongly believe that Laser Valley - Land of Lights already has the necessary dynamics to be on the agenda of any Government, at least for the next decade.	Ambitious planning based on existing and planned resources. Considering the recommendations from the Socio-Economic Impact Study on ELI-NP developed by PwC in partnership with Aspen Institute Romania and in dialogue with international funding bodies - EIB, EBRD and WB, we concluded that a sound substantiation of joint decisions and actions for the development of Laser Valley - Land of Lights requires governance mechanism, preferably an open method of coordination. This mechanism should coordinate the development of the science, innovation and entrepreneurship ecosystem in Laser Valley - Land of Lights by: providing a public-public and public-private dialogue platform; providing the necessary institutional framework to prepare the development strategy and the implementation plan; substantiating an Integrated Territorial Intervention in Măgurele, around ELI-NP and the hub of facilities and talents, to contribute to the development of a knowledge region; coordinating communication and dialogue with the international funding institutions; informing the Government, Parliament, local public administration, businesses and citizens on a regular basis.

17 STARDUST, Trento, Italy

General information	
City	**Trento, Italy**; Case Study: Madonna Bianca Urban District
Project name	**STARDUST**
Project status	**planned** ☒
Project start – end	October 2017 – September 2022
Contact	Paola Penasa, Ivano Gobbi, Daniele Vettorato, Luigi Crema
Project website	https://stardustproject.eu/
Size of project area	30 ha
Building structure	Newly built ☐ **Existing neighbourhood** ☒ Mixed ☐
Land use	- Residential: 90% - Office: - - Industry: - - Services: 10% 
Financing	- Public-Private 40% - Research funding 30% - Green financing 30% About 12 million euros of total investments in the STARDUST project.

Overview description of the project

STARDUST is a project funded under the European Union's Horizon 2020 smart cities and communities lighthouse programme.

The STARDUST consortium is composed of 30 organizations from 9 different countries: 7 cities, 4 research institutions, 6 SMEs and 13 industrial partners. They represent all the different stakeholders targeted by STARDUST. These include research experts, public authorities, industrial partners, SMEs, dissemination and exploitation experts, and investors.

In STARDUST, intelligent solutions for energy, mobility and ICT will be integrated in cities together with innovative business models, which will serve as blueprints for replication across Europe and abroad. These synergy of actions will transform cities into living labs, platforms where citizens and community engagement will become the driving elements to improve not only their way of life but also their local economies.

For the first phase of the STARDUST project, a set of technical and non-technical interventions will be carried out in cities labelled as "lighthouse cities" (Pamplona, Tampere, Trento). They will serve as a basis prior to developing the replication strategy suitable for other cities termed as "follower cities" (Cluj-Napoca, Derry, Kozani, Litomerice). Technical interventions will be carried out in selected demonstration sites in all the three cities. The transformation will be carried out in district housing and mobility with the help of Information and Communication Technology (ICT).

In the lighthouse city of Trento, the main area of intervention is the Madonna Bianca Urban District including a social housing residential complex composed by 14 towers, with a population of 1800 inhabitants, lying in a common green area

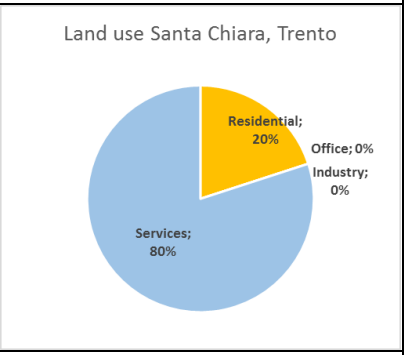
of approximately 300 000 m2. The social housing Madonna Bianca is a mixed-property complex having as major stakeholder and manager the project partner ITEA. The complex was built in the Seventies. Each tower has 13 floors for a total area of roughly 5700 m2/tower. About 70% of apartments are ITEA`s property- the rest being privately owned. STARDUST aims at renovating 3 of the 14 towers within a nZEB vision through the following actions: refurbishment of the building envelope (integrating a modular, semi prefabricated BIPV facade with lean installation approach); creation of a thermal chimney for free ventilative cooling; creation of a low temperature smart district heating system replacing gas heating with ground source heat pumps (GSHPs); connection of the local supermarket to the smart grid; retrievement of the supermarket`s heat waste; installation of smart meters and monitoring systems in each unit to encourage energy-saving habits; creation of a communication interface with inhabitants to stimulate an energy-aware culture. The remaining 11 towers will be the focus of a local replication plan.

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ **Energy neutral** ☒ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☒ Social aspects/affordability ☐
Indicators/expected impact	- Reduction of thermal demand: 1.3 GWh/year - Local RES production: PV = 140 MWh/year; geothermal = 786 MWh/year heat - Environmental: reduction of CO2 emissions = 484 tCO2/year - Economic: reduction of energy cost = 117000 euro/year
Overall strategies of city/municipality connected with the project	- Smart City Strategies - Urban Renewal Strategies - Energy Masterplanning
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ Mobility ☐ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ (Local) Governance ☐ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	- Citizens: 164 dwellings - Industry: DOLOMITI ENERGIA, DEDAGROUP, HABITECH - Investor/real estate: ITEA - Business: OFFICINAE VERDI - Research: FBK, EURAC
Typology of energy supply	- PV: 180 kW, 140 MWh/year - Heat pump system: 450 kW, 1.1 GWh/year heat - Geothermal energy: 11600 m of BHEs - District heating/local heating - Waste heat

Success factors	**Challenges/barriers**
- Involvement of main public and private stakeholders as STARDUST project partners - Involvement of all citizens living in the 164 apartments of the 3 towers of Madonna Bianca - High reduction of heat demand (-54%) - Refurbishment of existing buildings and shift from 0 to 50-100% in the use of renewable sources - Construction of new highly efficient buildings 100% powered by renewable sources	- The social housing Madonna Bianca is a mixed-property complex (Public-Private): share technical solutions, subdivision of costs and incentives - High financial commitment - Intervention on existing buildings (for example: use of radiators instead of underfloor heating) - Optimal integration of multiple renewable sources and waste heat

- High production of renewable electrical (140 MWh/year) and thermal energy (786 MWh/year heat) - Optimal integration of multiple renewable sources and waste heat (power to heat; low temperature DH) - Inclusion of the study area in the Province of Trento characterized by renewable electricity production (mainly hydroelectric) greater than consumption (in an annual balance) - Introduction of advanced monitoring and control systems, integrated in a single BMS (Building Management System) with data visualization differentiated for the Tower managers and the inhabitants	- Introduction of advanced monitoring and control systems, integrated in a single BMS (Building Management System) with data visualization differentiated for the Towers Managers and the inhabitants

18 Santa Chiara Urban District, Trento, Italy

General information	
City	**Trento (Italy)**; Case Study: Santa Chiara Urban District
Project name	**Santa Chiara Open Lab**
Project status	**planned** ☒
Project start – end	December 2017 – December 2023
Contact	Giuliano Franzoi, Sara Verones, Luigi Crema
Project website	http://www.comune.trento.it/Comunicazione/Il-Comune-informa/Ufficio-stampa/Comunicati-stampa/S.-Chiara-Open-Lab-approvazione-dei-progetti
Size of project area	3.5 hectare
Building structure	Newly built ☐ Existing neighbourhood ☐ Mixed ☒
Land use (%)	- Residential: 20% - Office: - - Industry: - - Other: (Services) 80% 
Financing	- Public-Private - Research funding About 41 million euros of total investments in the Santa Chiara Open Lab project.

Overview description of the project

In the north of Italy, Trento has a population of about 117 000 inhabitants and a surface area of 158 km². Every year, the city classifies among the first five in Italy for quality of life and has been selected in 2014 to enter the IEEE Smart Cities initiative. Trento`s energy saving action plan includes: a global energy saving (mostly by retrofitting of public buildings) of 760 000 MWh, a renewable energy share of 10 200 MWh and a CO2 reduction of 210 500 tons.

In 2016 the Municipality of Trento has drawn the “Programme for refunctionalization and sustainable reuse of the area Santa Chiara”. The total amount of the project is approximately 41 M€ and has been recently funded by the Italian Government for 18 M€ in the call "extraordinary intervention program for urban regeneration and the safety of the suburbs".

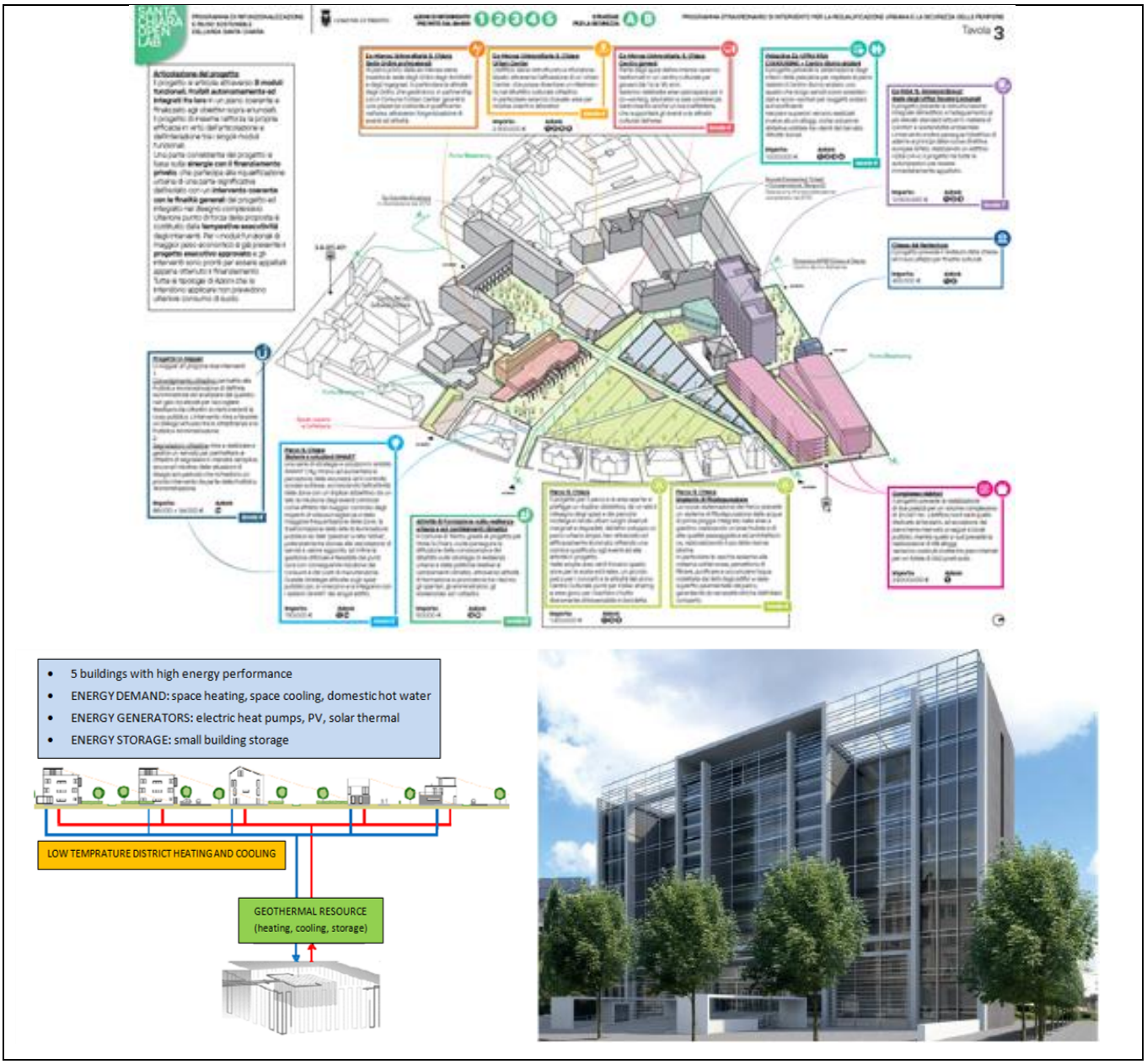
Starting from 2019, in the Santa Chiara Urban District will be refurbished four public building complexes (volume: 25995 m3, floor area: 9076 m2) and will be built another new private building complex (Habitat complex, volume: 31047 m3, floor area: 11088 m2). These buildings are designed to: public offices, public meeting areas, social and health needs, cultural, shops, housing.

The 5 involved buildings will be supplied with an innovative “geosolar” heat and cool supply concept. The system consists of the following main components:

- A central geothermal resource providing heating and cooling through borehole heat exchangers and acting as a seasonal storage for the residual heat from building cooling and for the excess solar heat production;

- A low temperature DHC network (T < 50°C) that connects the geothermal resource with buildings;
- Electric heat pumps at building level providing the necessary heat and cool to the buildings (space heating, space cooling and domestic hot water);
- Distributed PV feeding electric heat pumps;
- Distributed solar thermal collectors for domestic hot water and space heating;
- Distributed small building storage for domestic hot water and space heating/space cooling inertia.

With only one thermal machine, the heat pump, it will be possible to provide space heating, space cooling and domestic hot water. The high expected efficiency of the heat pump (SPF>5) will be guarantee thanks to the high energy performance of the buildings (for space heating user side temperature < 50°C), the use of the geothermal source, rather than the air, and the integration of the solar source for domestic hot water and space heating. For the low temperature district heating and/or cooling network heat transport losses < 3% are expected. The outcomes of the project will include detailed dimensioning of all components, including the innovative ones, and their adjustment to each other for best performance of the overall system, development of operation strategies, evaluation of possible tariff models, identification and proof of sensitive parameters (e.g. geothermal characteristics of the ground, solar production profiles, individual building thermal demand profiles). A detailed dynamic simulation model of the whole heating and cooling supply system will be established.



Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ **Energy neutral** ☒ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ Sustainable neighbourhood ☐ Social aspects/affordability ☐
Indicators/expected impact	- Reduction of heat demand in the public building complexes: 1.3 GWh/year - Local RES production: PV = 291 MWh/year; geothermal = 734 MWh/year heat + 1100 MWh/year cold - Environmental: reduction of CO2 emissions = 351 tCO2/year - Economic: reduction of energy cost = 94000 euro/year
Overall strategies of city/municipality	- Smart City Strategies - Urban Renewal Strategies - Energy Masterplanning

connected with the project	
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ (Local) Governance ☐ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	- Citizens: Municipality of Trento, Province of Trento - Investor/real estate: Habitat - Research: FBK
Typology of energy supply	- PV: 230 kW, 291 MWh/year - Heat pump system: 1080 kW, 917 MWh/year heat + 917 MWh/year cold - Geothermal energy: 23750 m of BHEs - District heating/local heating - Solar thermal - Waste heat

Success factors	**Challenges/barriers**
- Involvement of main public and private stakeholders as project partners - High reduction of heat demand in existing buildings (-77%) - Refurbishment of existing buildings and shift from 0 to 100% in the use of renewable sources - Construction of new highly efficient buildings 100% powered by renewable sources - High production of renewable electrical (291 MWh/year) and thermal energy (734 MWh/year heat + 1100 MWh/year cold) - Use of seasonal underground thermal energy storage (seasonal UTES) - Optimal integration of multiple renewable sources and waste heat (power to heat; low temperature DHC) - Inclusion of the study area in the Province of Trento characterized by renewable electricity production (mainly hydroelectric) greater than consumption (in an annual balance) - Introduction of advanced monitoring and control systems at building and at DHC level	- Involvement of all citizens living in the Santa Chiara Urban District - The Santa Chiara Urban District is a mixed-property area (Public-Private): share technical solutions, subdivision of costs and incentives - High financial commitment - Intervention on existing buildings - Optimal integration of multiple renewable sources and waste heat - Introduction of advanced monitoring and control systems at building and at DHC level

19 Ilokkaanpuisto, Tampere, Finland

General information	
City	**Tampere, Finland**
Project name	**Ilokkaanpuisto**
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	planning completed, construction starts June 2019
Contact	Maarit Vehvilainen
Project website	**www.stardustproject.eu**
Size of project area (hectare)	Floor area for residential buildings and parking 16,600 m2 (1,7 hectares)
Building structure	**Newly built** ☒ Existing neighbourhood ☐ Mixed ☐
Land use	Residential: 100%
Financing	Private, research funding 30 milj € euro is construction cost of Ilokkaanpuisto and PV plant.

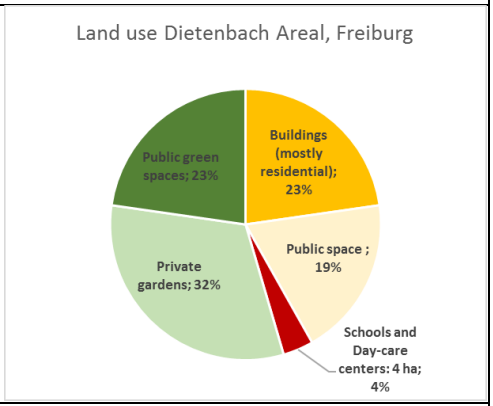
Overview description of the project
New residential area at urban environment. Apartment buildings connected either DH or has own GSHP. Own PV farm outside the urban area. H2020 Lighthouse project Stardust demonstration. Show case in Finland. Number of stakeholders from private and public sectors involved to the project.

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ Energy neutral ☐ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ Sustainable neighbourhood ☐ Social aspects/affordability ☐
Indicators/expected impact	Environmental, Economic, Regulatory
Overall strategies of city/municipality connected with the project	Smart City Strategy, Grow smart Together https://smarttampere.fi/en/home/ The City of Tampere is building into a smart city by treating city development projects as platforms for innovative solutions and new business models. The city enables this by opening data, building ecosystems and enhancing the culture of cross-industry co-operation. The City of Tampere is creating platforms that enable co-creation, business ecosystems, new business models, smart city solutions, and as a result, better quality of life. In the field of real estate and buildings the main aspects of development in Tampere are sustainability, energy efficiency, wide range of services from house maintenance to health and security services and the whole 'living as a service'.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ Mobility ☐ **Buildings** ☒ **Materials** ☒ Refurbishment ☐ Sustainable production ☐ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒

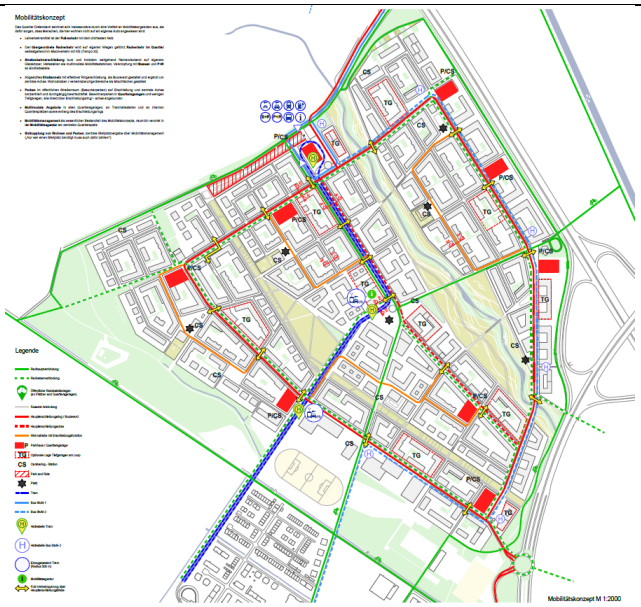
Innovative stakeholder involvement strategies	Industry, Real estate, Business, Politicians, Research
Typology of energy supply	Geothermal energy, District heating, Heat pump system

Success factors	**Challenges/barriers**
City level: The Grow Together strategy (see previous field). Regional and national Level: Ministry of Environment, The Ministry of Economic Affairs and Employment and Housing and The Housing Finance and Development Centre of Finland have positive attitude towards the project. European level: H2020 funds towards the demonstration of smart energy solutions (Stardust SCC1)	Project is the first energy community project in Finland. It is therefore a test case from legal point of view, business concept, energy transfer. Ilokkaanpuisto has needed a lot of legal and business consulting, because project it the first one and this is why ministries are following it. Solutions have been for example: - PV farm is a Ltd Real Estate owned by Ltd housing companies - Refinements to RS documents (RS is system, how housing projects are secured) - Deal with utility company

20 Dietenbach, Freiburg im Breisgau, Germany

General information	
City	**Freiburg im Breisgau, Germany**
Project name	**Dietenbach**
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	Planning is on the way, start of the development (construction): 2022
Contact	Ruediger Engel, City of Freiburg, Project manager Dietenbach development, Klaus von Zahn, City of Freiburg, Head of environment department, Gerhard Stryi-Hipp, Fraunhofer ISE
Project website	https://www.freiburg.de/pb/,Lde/495838.html
Size of project area	110 ha
Building structure	**Newly built** ☒ Existing neighbourhood ☐ Mixed ☐
Land use	- Construction area for buildings: 25 ha (predominantly residential: 6.500 flats, approx. 15.000 inhabitants) - Public space (places and streets): 21 ha - Schools and Day-care centers: 4 ha - Private gardens: 35 ha - Public green spaces: 25 ha 
Financing	The district will be developed by the City of Freiburg, which owns the construction area. The infrastructure, schools and other public buildings will be financed by selling the construction ground to the building construction companies.

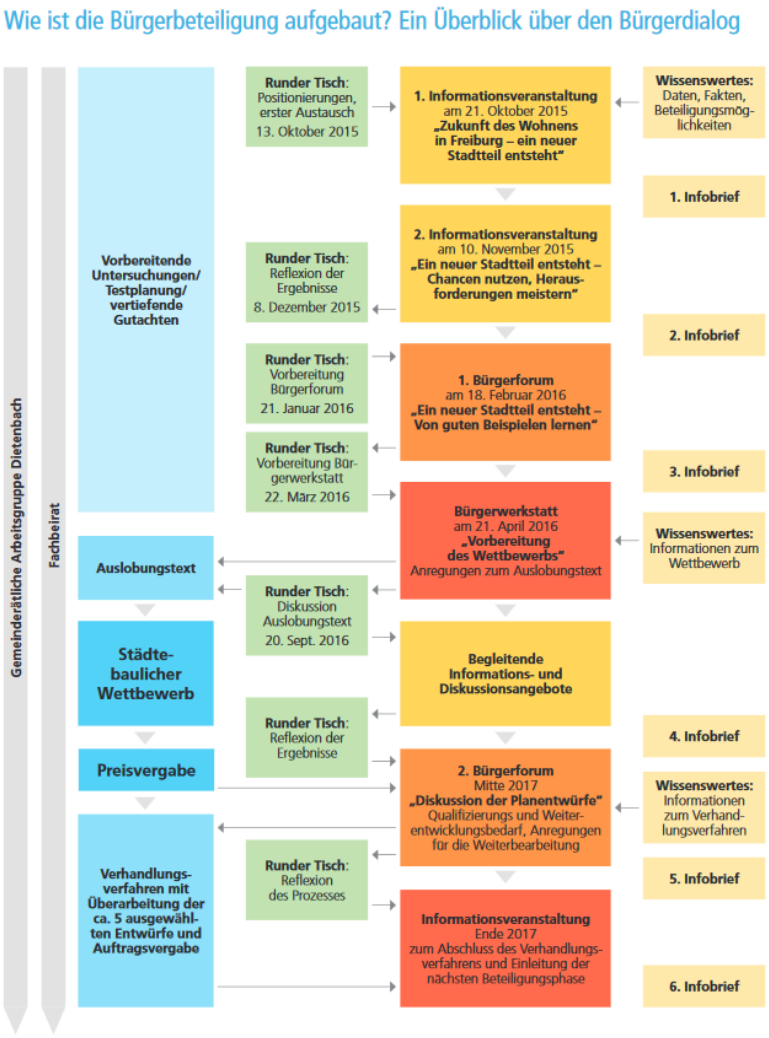
Overview description of the project
Development of a climate neutral city quarter with about 6,500 apartments for 15,000 inhabitants. To react on the strong increase of rental prices, affordable housing is an important goal. The district shall become mixed and agile with short distances and communicative areas, places, schools, sport facilities, day-care centers for children and shopping facilities. The district will become inclusive and barrier-free. An energy concept for the climate neutral / energy positive supply of the district was already part of the urban development competition. Based on the basic concept of the winning urban planning team, now the energy concept will be developed more in detail.




Markttag am zentralen Platz


Schnitt Dietenbach schmal M 1:500

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ **Climate neutral** ☒ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☐

Indicators/expected impact	(TBD)
Overall strategies of city/municipality connected with the project	- Energy masterplanning - Growing city - Regional planning
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ Refurbishment ☐ **Sustainable production** ☒ **Sustainable consumption** ☐ (Local) Governance ☐ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	Basis of the development is an intensive process of searching and selecting the construction ground for the new district. Finally, the city council decided to build it on the Dietenbach area. An extensive participation process during the selection phase and afterwards in the definition of targets and framework conditions of the district was established. However, a group of people didn't want to accept the decision of the city council and collected enough signatures for a plebiscite (popular vote). In the preparation of this popular vote many information events were organized and intensive discussions happened. Finally, 60% of the citizens decided on 24 February 2019, that the Dietenbach district shall be build. 

Typology of energy supply	The buildings are high efficient with a heating temperature of 30 °C. The energy will be supplied by Photovoltaic-Thermal-Collectors on the roofs and PV-modules on the facades and the noise protection wall. In addition, waste heat will be detracted from a main sewer canal closed by. Thermal energy will be supplied by a cold district heating network with uninsulated Polyethylene pipes and heated up by heat pumps within the buildings. Several Ice-storages will be installed.

Success factors	**Challenges/barriers**
- Extensive participation of all stakeholders. - Integrated planning from the beginning on (urban planning, mobility, energy, environment,…)	- Public opposition – intense discussion on: must the city of Freiburg further grow, can the consumption of farm land be acceptable and sustainable,…

21 New City – New Airport, Bodø, Norway

General information	
City	**Bodø, Norway**
Project name	**Ny by – ny flyplass (New City – New Airport)**
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	Ongoing planning, construction might start mid-2020s
Contact	Rakel Hunstad
Project website	https://bodo.kommune.no/nyby-nyflyplass/
Size of project area	Approx. 300 hectare
Building structure	**Newly built** ☒ Existing neighbourhood ☐ Mixed ☐
Land use	Specification of land use is currently an on-going process in the Municipality. The share the total area for instance allocated to private-housing, industry and green structures respectively, will be concluded in 2022.
Financing	Work in progress

Overview description of the project

The New City – New Airport project is amongst Bodø Municipality and the regions largest development and innovation project to this date. The area consists of 300 hectares of "blank space" that will become available for smart, green and sustainable urban development. The development will take place over 50-80 years. Developing this area will imply a doubling of the size of the city of Bodø.

Background

After about seven decades of military activity (NATO air force base constructed in 1951) activity at the air force base in Bodø will be phased out in 2022, cf. 2012 Parliamentary decision. This – together with an outdated runway system, in use for civilian air traffic as well, triggered one of the greatest projects of urban development in the history of Norway.

The construction of a new civilian airport 1 km south-west of the current civilian and military airports will open up an area of about 300 hectares for innovative and sustainable urban development. The size of the area is the equivalent to about 800 soccer fields and it will be a unique playground for international and national research, development and innovation. The city of Bodø is of the ideal size for testing new innovative solutions for urban development in Arctic climate and environmental conditions.

The municipality has bold ambitions for an energy system for the future for the "New City – New airport"-development area. At the core of this is the ambition of realising so-called zero emission neighbourhoods/areas. These areas shall have zero emissions of greenhouse gasses related to production, operations and transformation in a life cycle perspective. This entails amongst others local renewable energy production, and the sharing of energy between buildings in order to ensure flexibility in the energy system and lower pressure (peaks) on the grid. Moreover, important focus areas are the optimisation of local energy systems within a larger a larger system and responsive energy efficient buildings.

Bodø Municipality is thus a partner and pilot area in a national (Norwegian) research centre on Zero Emission Neighbourhoods (ZEN). As one of eight pilot areas in the ZEN-centre, Bodø Municipality shall serve as an innovation hub where the ZEN researchers, together with building professionals, property developers, municipalities, energy companies and building owners and users test new solutions for the construction, operation, and use of neighbourhoods in order to reduce the greenhouse gas emissions to zero on a neighbourhood scale.

© Bodø municipality

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ **Energy neutral** ☒ **Energy efficient** ☒ **Carbon-free** ☒ Climate neutral ☐ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒
Indicators/expected impact	We expect impact on all of these areas: - Environmental - Societal - Social - Economic - Spatial - Regulatory Development of the city of Bodø and the new areas place the needs of people/the inhabitants at the core. Societal and social impacts are particularly linked to high quality new urban areas within the new borough. Security of energy supply and clean and affordable energy (affecting operational costs of housing) have societal and social dimensions as well. The former is, in addition, linked to spatial qualities and the latter is linked to the expected economic impact. Environmental impact relates both to transport/mobility and to analysing the life cycle costs of a zero emission neighbourhood. In order to classify as a "zero emission area" one should not only consider emissions from the operational phase of buildings within the areas. One should also consider emissions stemming from materials and equipment, as well as emissions from the construction phase including transport.
Overall strategies of city/municipality	The strategic plan of the municipality 2030

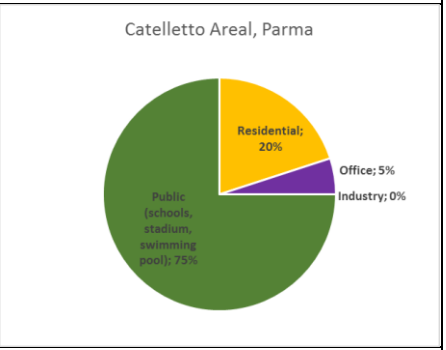
connected with the project	This municipal planning-document indicates the direction for development in a medium to long-term perspective. It incorporates growth perspectives and states three main focus areas: - Inhabitants/people at the core: high quality of life and diversity and inclusive communities are at the core; - Bodø smart and green: Urban development, facilitating for a compact city centre where innovative new solutions are created and tested, within a framework of climate and environmental considerations; - Bodø – Powerhouse in the Arctic: Take lead in developing industry and society for the future through networking and co-creation. <u>Plan for urban design and development for the new area</u> A plan for urban design and development for the new area (linked to the New City – New Airport project) is currently being developed. A final draft should be available in 2022. Energy Master-planning for the area will be an integrated part of this work. <u>Plan for Climate and Energy 2019-2030</u> A revised climate and energy plan has been drafted. The plan states that in 2050 Bodø Municipality is a low emission society. The Climate and Energy Plan includes ambitions goals for 2030: - 60% Emission reductions compared to 2009-levels - 70% Recycling degree materials Furthermore, the plan sets targets for Bodø Municipality in 2025: - Reduce greenhouse gas emissions linked to new buildings and renovated buildings by minimum 35% compared to the industry-norm in 2017. - Cut energy consumption in the municipality's own buildings by 25% compared to 2009-levels. By 2030, the municipality shall reduce its overall climate-footprint by 50% compared to 2017-levels. The Climate and Energy Plan also makes the link to Zero Emission Neighbourhoods and future energy consumption as well Bodø as a smart city. <u>Smart City Strategy</u> The municipality does not have a smart city strategy *per se*, but a dedicated Smart City Bodø project employing two full-time resources (linked to the entire municipal administration). The project functions as an umbrella for the entire municipality. Moreover, the Smart City Bodø project is partner in various smart-city networks and engaged in a wide range of R&D&I projects within several areas like health, digitalisation, circular economy, citizen involvement.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ Refurbishment ☐ **Sustainable production** ☒ **Sustainable consumption** ☒ (Local) Governance ☐ **Legal framework** ☒ Business models ☒
Innovative stakeholder involvement strategies	<u>Bodø City Lab</u> The Municipality opened Bodø City Lab in April 2018. The city lab is the natural arena to participate in various urban development projects. The development of the areas (the 300 hectares) that becomes available through the New City – New Airport project will be done in cooperation with residents, business, institutions, R&D and volunteers amongst others. The city lab shall serve as the natural meeting point for stakeholders also in this regard. The city lab does not replace conventional public consultations processes, but shall add to this process in terms of including stakeholders.

Typology of energy supply	Norway is about 98 % renewable in its power production. (94.3% hydro, 3.4% wind 2.3% other RES in 2017). Moreover, a unique feature of the Norwegian power supply is the high share of flexible renewable production capacity (hydropower), i.e. 75%. Moreover the large storage capacity (50% of Europe's reservoir storage capacity). Norway has the highest share of Renewable energy sources (RES) in its power supply in the EU and the lowest share of emissions in Europe. In 2016, Norway reached a record high power production equal to 149 TWh. In 2018 the total power production equalled 148.7. Bodø Municipality is located in an area with excess power-production. However, distribution grid remain a challenge in various parts of the region. Hence, in developing the new urban area the focus is placed on energy efficiency, reducing peak loads, constructing a robust and sustainable energy system. Efforts will be made to develop an energy system that relies on various sources of renewable energy, local renewable energy production, sharing energy within areas/neighbourhoods/districts and optimisation of local energy systems within a larger a larger regional/national/Nordic/EU energy system. Security of supply is at the core, as well as clean affordable energy for consumers. Today, Norway's thermal power plants accounts for about 2.2% of total production capacity (2017). Many of the thermal power plants are located in large industrial installations that use the electricity generated themselves. Production therefore often depends on the electricity needs of industry. These power plants use a variety of energy sources, including municipal waste, industrial waste, surplus heat, oil, natural gas and coal. The urban development in Bodø will demand that thermal power is generated from renewable sources. Thus are solar thermal energy, geothermal energy, district heating/local heating, heat pump system and industrial waste heat all relevant sources of energy supply.

Success factors	**Challenges/barriers**
n/a at this stage (still early phase)	n/a at this stage (still early phase)

22 Castelletto, Parma, Italy

General information	
City	**Parma**
Project name	**Castelletto**
Project status	**planned** ☒ under construction ☐ realized ☐ in operation ☐
Project start – end	2020 – 2025
Contact	**Enzo Bertolotti**
Project website	n/a
Size of project area	n/a
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	- Residential: 20% - Office: 5% - Industry: 0% - Other: 75% (schools, swimming pool, stadium)
Financing	- Public-Private - Research funding



Overview description of the project
The City of Parma wants to redevelop a part of the city, located in the south-eastern part, into the first PED – Positive Energy District. The area is just outside the city centre and it is mainly residential, with several sport, commercial and health facilities and a good accessibility by public transport and bicycles. The buildings involved in the PED will be: - a stadium - a school (with an auditorium and a gym) - a swimming pool - 7 residential buildings in a former industrial area.

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ Energy neutral ☐ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☒ Social aspects/affordability ☐
Indicators/expected impact	The project will have environmental, social, economic, regulatory impacts
Overall strategies of city/municipality	- Parma Smart City 2030 (2019) - SEAP (2014)

connected with the project	- SECAP (2019) - PUG 2020 (Urban General Plan)
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ Regional energy system ☐ **Mobility** ☒ **Buildings** ☒ Materials ☐ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	The project will develop innovative involvement strategies for citizens, investor/real estate, business and research.
Typology of energy supply	- Solar thermal energy - Geothermal energy - District heating/local heating - Heat pump system - Photovoltaic

Success factors	**Challenges/barriers**
- Quadruple helix model applied to PED	- The main challenge is to make local authorities drivers of the Plus Energy strategy. - The main barrier is the effective and innovative management of smart grids

23 Zukunftsquartier, Vienna, Austria

General information	
City	**Vienna, Austria**
Project name	**Zukunftsquartier** (Future Quarter)
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	07/2018 – 06/2019 (start of construction: Q3/2021; Finalisation Q3/2024)
Contact	Petra Schöfmann, UIV Urban Innovation Vienna
Project website	http://www.urbaninnovation.at/de/Projects/Zukunftsquartier
Size of project area	n/a
Building structure	**Newly built** ☒ **Existing neighbourhood** ☒ Mixed ☐
Land use	The (planned) usage mix includes about 50% living and 50% office/trade/small industry and other businesses in each examined quarter.
Financing	This exploratory study is funded by "City of tomorrow". „City of tomorrow" is a research and technology program of the Federal Ministry for Transport, Innovation and Technology (BMVIT). It is handled on behalf of the BMVIT via the Austrian Research Promotion Agency (FFG) together with the Austrian Economy Service Corporation (aws) and the Austrian Society for Environment and Technology (ÖGUT).

Overview description of the project

One of the many challenges on the path to decarbonisation is the development of sustainable, safe and affordable energy supply strategies for (new construction) quarters. As support and to set an example, the municipal government of Vienna undertook the realization of an innovative role-model city district in its governmental agreement (2015) in the chapter "energy".

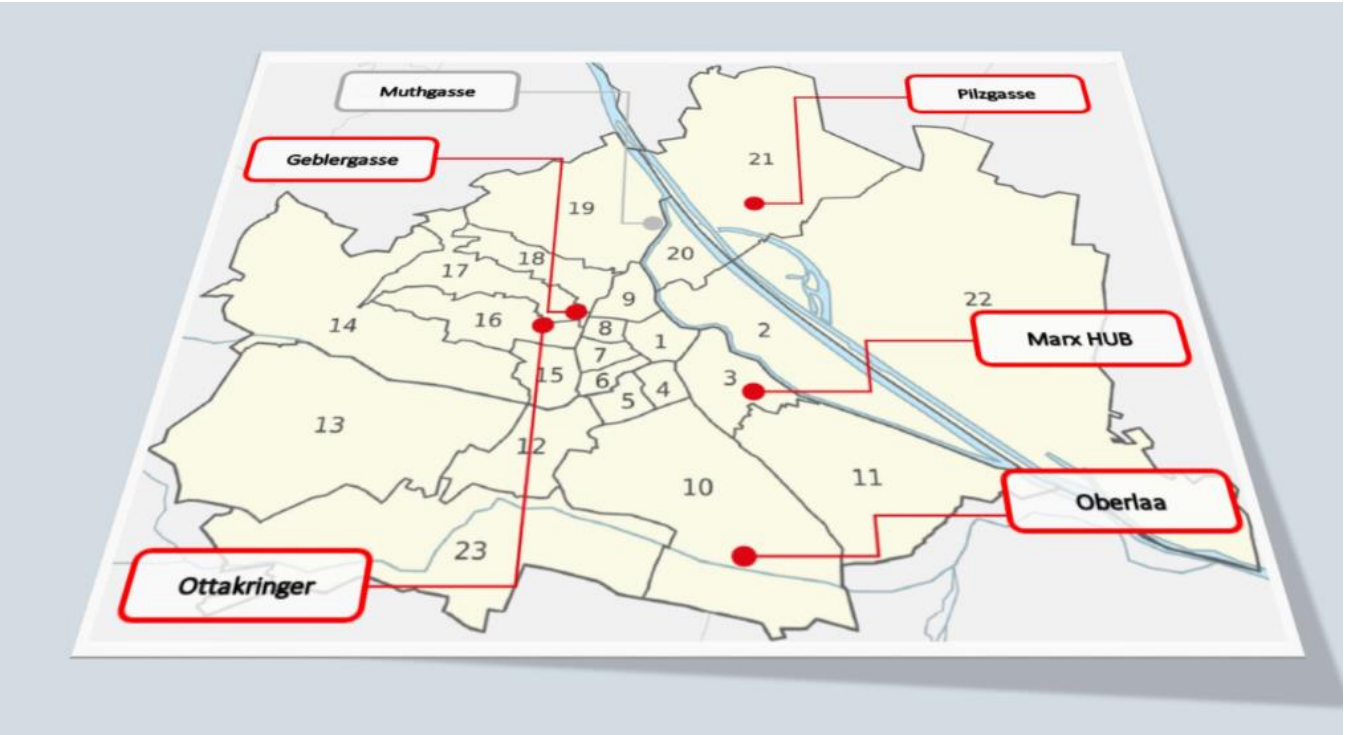
In the course of the funded exploratory study "Future Quarter" ("Zukunftsquartier") transferable concepts for plus-energy quarters are developed. Based on and subsequent to this scoping study, an energy showcase quarter in Vienna shall be realised. Plus-energy quarters are city districts which produce more energy (electricity and heat) over the year than the users consume by utilising local energy sources, synergies concerning mixed usages and flexibilities. In the course of the project, possibilities and definitions to transfer this concept to the very dense city are being investigated.

The undertaking strives for the development of a quarter-energy-system that enables the distribution of the recovered energy between the local consumers and thereby optimizes all energy services comprehensively. The areas of focus lie on the technical and economic feasibility as well as user comfort. On the basis of the exploratory study, an energy showcase quarter in Vienna shall be realised.

Under the direction of the UIV Energy Center and together with the project partners University of Applied Sciences Technikum Vienna (FH Technikum Wien) and the Institute of Building Research and Innovation (IBR&I), profound technical and economic analysis and rough energy concepts as well as variants for a number of concrete areas with mixed usage in Vienna in the 3rd, 10th, 16th, 17th and 21st district are currently being developed. These are predominantly new construction quarters, but also existing quarters of different size, that show varying on-site energy potentials which shall be used with innovative concepts. For the one or two quarters with the highest probability of realisation and on the basis of the local energy situation as well as stakeholder requirements, detailed energy concepts on the level of preliminary drafts are being developed. Thereby, the technical and economic feasibility as well as the legal framework are analysed and examined.

Property developers and planners of the respective quarters are involved in the project as well as important municipal actors. This creates the best possible conditions for a subsequent realisation. Through collective analysis of a greater number of quarters and the development of recommendations for action, the project shall give new insights for the broader application

of the concept “plus-energy quarter” and function as an important initiator and precursor for the realisation of future innovative energy showcase quarters in Vienna and other cities.



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Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ Energy neutral ☐ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ Sustainable neighbourhood ☐ Social aspects/affordability ☐ Other: - Economic feasibility - High quality of living and comfort - Early and constant user integration for reaching the positive energy goal.
Indicators/expected impact	The methodological approach is based on a primary energy balance of the quarter. In the course of the project, certain indicators and system boundaries have been developed. In order to differentiate the possibility to harvest on-site renewable energy in densely populated urban areas in comparison to less densely built regions (apartment buildings vs. single-family houses), an “energy balance” based on the floor area ration has been developed. Additionally, an “energy credit”, coming from central renewable power plants after all industry and public transport is supplied, is calculated for each Austrian inhabitant - which can then be taken into account for primary energy balancing of the quarter. To visualize economic feasibility, additional costs in comparison to a conventional energy supply (gas heating) and lower building standards are calculated.
Overall strategies of city/municipality connected with the project	The project supports the goals of the Smart City Wien Framework Strategy concerning saving resources and decarbonisation. The project helps to reach the goals stated in the Energy Framework Strategy and the Climate Protection Program, as well as the Urban Development Plan 2025. Additionally, the municipal government of Vienna decided on realizing innovative energy showcase quarters in its governmental agreement of 2015.

Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒ Other: - Needs and experiences of property owners/ developers - Integration plan for future users
Innovative stakeholder involvement strategies	A concept for the integration of future users (renters, owners, employees) will be developed. The aim is to optimize the user behaviour respectively to minimize the potential negative effects on the energy system. In order to support a realization in the best possible way, both the developers as well as the relevant administration of the city of Vienna have been involved right from the start.
Typology of energy supply	Different energy concepts and variants for concrete quarters are developed in order to achieve plus-energy over the year, while focusing on economic feasibility. Energy (both electricity and heat) can be exchanged with the (public) networks, although the on-site renewable energy supply has to be greater than the consumption over the year. Each energy system of the different quarters includes photovoltaic systems as well as geothermal (field of boreholes and/ or groundwater) heat pumps. Depending on the local availability and demand district heating and direct or indirect surplus heat are also used. The gentle cooling of the buildings during summer (via component activation) is one measure for climate adaptation and supports the economic feasibility by enabling the long term attractiveness for renters and buyers of the building. The extracted heat is stored underground and used for heating in winter. The planning of the local energy system includes flexibilities which facilitate the usage of renewable energy from Peak-Shaving through demand side management measures.

Success factors	**Challenges/barriers**
The developed system boundaries for positive energy quarters in densely populated areas have already received considerable national recognition. The early and comprehensive involvement of all implementation-relevant actors, including the city administration, was an important step in supporting a later realisation. Initial cost-effectiveness analyzes show that the plus-energy concept in combination with a suitable business model is economically viable (in some cases even without subsidies) in the long term.	On the one hand, it is very important to consider the topic of energy early in the planning process, on the other hand, it complicates the conception, as the future non-residential users are not yet known and their energetic behaviour (demand, synergy effects etc.) is therefore difficult to plan. Success factors in future realization projects will be the willingness of the quarter developers to accept longer payback times for their investment and put additional effort into the planning and innovation process. Last but not least the engagement of the future users concerning energy consumption and technology usage as well as a long term monitoring process are key to reach the planned efficiency in reality.

24 ZEN Projects Norway

NOTE BY EDITOR: Unfortunately, due to lack of time, I could not include all projects of ZEN projects Norway sent for this compilation. I included an overview of the projects and the cases of Bergen and Oslo. The rest of the projects will be included in a follow-up version of this booklet. Apologies for that, C.G.

The ZEN Research Centre[1] pilot projects serve as innovation hubs where researchers, together with building professionals, property developers, municipalities, energy companies, and building owners and users, test new solutions for the construction, operation, and use of neighbourhoods in order to reduce the greenhouse gas emissions to zero on a neighbourhood scale.

In total, the ZEN pilot projects encompass more than 30 000 people, more than 1 million m^2 built area, and more than 5.5 million m^2 land area.

The list of projects includes:

- Zero Village Bergen
- Furuset project, Oslo
- NyBy, Bodø (see chapter 21)
- Knowledge Axis Trondheim
- Ydalir project, Elverum
- Fornebu, Bærum
- Campus Evenstad

Illustrations of ZEN Projects:

Zero Village Bergen (ZVB). View of the neighbourhood, ILLUSTRATION: SNØHETTA

[1] https://fmezen.no/

NyBy, Bodø. Aerial view of the planned development, ILLUSTRATION: BODØ Municipality

Planned Central Street in Furuset, ILLUSTRATION: PLANNING DEPARTMENT OSLO MUNICIPALITY

West side of NTNU Campus, Knowledge Axis Trondheim, ILLUSTRATION: KOHT ARCHITECTS

Figure 1 Public space in Ydalir, ILLUSTRATION: tegn_3

Figure 2 Illustration of the Oksenøya Centre in ZEN pilot project Fornebu, Bærum, ILLUSTRATION: L2 Arkitekter AS

Figure 3 New Administration Building at Evenstad Campus, ILLUSTRATION: OLA ROALD ARKITEKTUR

24.1 Zero Village Bergen, Norway

General information	
City	**Bergen, Norway**
Project name	**Zero Village Bergen (ZVB)**[2]
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	
Contact	**ByBo:** Thorbjørn Haug **NTNU:** Inger Andresen **SINTEF Byggforsk:** Kari Sørnes
Project website	https://zerovillage.no/
Size of project area	n/a
Building structure	**Newly built** ☒ Existing neighbourhood ☐ Mixed ☐
Land use	Residential: 92 000 m^2
Financing	Private developer The main stakeholder in the ZVB project is the private project owner ByBo, a Bergen based developer that focuses on the development of low-energy and environmental-friendly buildings and neighbourhoods.

Overview description of the project
The Zero Village Bergen project encompass the development of a new neighbourhood on the outskirts of Bergen. The planning consists of approximately 720 dwellings (92 000 m^2), divided between terraced houses (68% of total floor area) and apartment blocks (25%). 7% of the floor area is dedicated to non-residential purposes such as offices, shops and a kindergarten. In addition, a common parking garage using mainly wood as building material, is planned. The estimated time frame for the project is 10-20 years. The key innovative elements are photovoltaic generation with excess power used for EV and public facilities, low carbon construction materials, local thermal hub, and smart energy management. The energy demand for all purposes shall be covered to the greatest possible extent by renewable energy sources without loss of natural diversity. The area is located 1.6 km south of Bergen an in proximity to the Flesland international airport (3 km) and the business area of Sandsli/Kokstad with about 15 000 workplaces. The closest centre is Blomsterdalen, a distance of 750 m. A forest and a lake, as well as, a residential area and a road surround the area. The planned development area is currently in use as a greenfield site with some semidetached houses on it. The closest public transportation hub is the light rail, 1.5 km to the north, but there is a bus stop on the site with buses approx. every 15 minutes. The main stakeholder in the ZVB project is the private company ByBo, a Bergen based developer that focuses on the development of low-energy and environmental-friendly buildings and neighbourhoods. Several private consultant agencies such as Norconsult, Multiconsult and Snøhetta and researchers from the ZEB and ZEN Centres have been involved in the planning of the project.

[2] https://fmezen.no/category/pilot-projects/

Strategies	
Goals/ambition	Positive Energy ☐ **Zero-emission** ☒ **Energy neutral** ☐ **Energy efficient** ☒ Carbon-free ☐ Climate neutral ☐ Sustainable neighbourhood ☐ Social aspects/affordability ☐ The goal is to construct residential buildings within a neighbourhood with net zero greenhouse gas emissions during the operation phase of the buildings on an annual basis (ZEB-O Standard, ref www.zeb.no). The goal is planned to be met using the following measures: • Minimize energy demand through the energy efficiency of the buildings. Development of an individual energy system based on solar cells and local thermal energy hub. • Stepwise development of the area in combination with a gradually rise of ambitions with regard to building standards (from ZEB-O÷EQ at an early stage to ZEB-COM, see www.zeb.no). • Development of a transport infrastructure based on a broad network of walking and bicycle pathways, charging stations for electrical bikes, a car pool for electric cars and an electric bus that connects the neighbourhood to the nearby train station. Creation of an attractive public space which encourages an emission-friendly lifestyle: e.g. shared space, community gardens, a market place in a central position within the neighbourhood and playgrounds.
Indicators/expected impact	KPIs
Overall strategies of city/municipality connected with the project	n/s
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ (Local) Governance ☐ Legal framework ☐ **Business models** ☒
Innovative stakeholder involvement strategies	The main stakeholder in the ZVB project is the private project owner ByBo, a Bergen based developer that focuses on the development of low-energy and environmental-friendly buildings and neighbourhoods.
Typology of energy supply	The key elements are photovoltaic generation with excess power used for EV and public facilities a local thermal hub based on renewable energy. The energy demand for all purposes will be covered to the greatest possible extent by renewable energy sources.

Success factors	Challenges/barriers
n/s (planning phase)	Based on a literature study based publications from the ZEB Centre[3] and PI-SEC project[4], six major **challenges and risks** have been identified in the planning process so far: 1. Limited knowledge and understanding about ZEN ambitions, and embedded requirements are a low priority on the executing level (construction side).

[3] https://www.zeb.no/index.php/en/about-zeb/about-the-zeb-centre
[4] https://www.ntnu.edu/smartcities/pi-sec

	2. Time pressure: Ongoing construction around the area, such as the regional road Hjellestadvegen, requires a decision about the connection of the ZVB development area to the technical infrastructure. A later connection to the infrastructure network will result in higher project costs. 3. Uncertainty and risk: High uncertainty about the acceptance of the project by the authorities, the time pressure, and the assumed cost increases, heighten the risk for hindering project implementation. The risk is mainly carried by one private developer, and the risk of project cancellation is therefore medium. 4. Conflict of goals (Risk): The ZVB project refers differently to goals for emission reduction and densification than the public actors, and thereby offers room for disagreement among the involved partners. 5. Political commitment (Risk): Disagreement between the local and regional authorities on the evaluation of the project with regard to planning regulations could jeopardize the implementation of the project. The associated time lag arises will cause more costs and uncertainty for the private developer. 6. Costs to develop alternative solutions (Risk): The development of alternative solutions (e.g. wood as construction material for the parking garage) is cost-intensive and the approval of funding proposals is perceived as low. Due to the described uncertainty and risk, the ability of the private developer to bear the costs is limited.

24.2 Furuset project, Oslo, Norway

General information	
City	**Oslo, Norway**
Project name	**Furuset project**[5]
Project status	planned ☒ under construction ☒ realized ☐ in operation
Project start – end	The estimated timeframe for completion is 2030.
Contact	**Oslo municipality:** Helene Egeland **Micro energy system:** Trond Moengen trond.moengen@energidata.no **NTNU:** Inger Andresen **SINTEF Byggforsk:** Harald T. Walnum
Project website	**https://www.futurebuilt.no/Forbildeprosjekter#!/Forbildeprosjekter/Furuset** **https://byplanoslo.no/content/furuset-skal-vise-vei-satser-stort-pa-klima**
Size of project area	n/a
Building structure	Newly built ☐ **Existing neighbourhood** ☒ **Mixed** ☒
Land use	n/a
Financing	Public

Overview description of the project
The Furuset project aims to combine the physical upgrading of the neighbourhood center of Furuset from the 1970's with high environmental ambitions. The renewal includes the infrastructure taking into consideration energy, waste and water, traffic, green landscaping and social issues, the extension of the number of residential units and work places, and the development of an attractive urban space. Furuset has good transport connections with two metro stations, 4 bus lines and close proximity to the E6. The local center offers a broad range of shopping and service facilities. An ice stadium, a school and kindergarten complements the social infrastructure in the neighbourhood. The exact number of the planned 1 700 – 2 300 housing units and 2 000 – 3 400 workplaces depends on the realization of a covered E6 highway. The estimated timeframe for completion is 2030.

Strategies	
Goals/ambition	**Positive Energy** ☒ Zero-emission ☐ Energy neutral ☐ **Energy efficient** ☒ Carbon-free ☐ **Climate neutral** ☒ **Sustainable neighbourhood** ☒ **Social aspects/affordability** ☒

[5] https://fmezen.no/category/pilot-projects/

	Furuset is a multi-functional local neighbourhood centre in the eastern part of Oslo. The refurbishment area incorporates about 3.800 residential units (90% are in apartment blocks) and 1 500 workplaces. The overall goal – to develop a climate-friendly and attractive neighbourhood – incorporates several sub-goals such as the creation of attractive urban spaces, strengthening of the green infrastructure with blue-green connections, a broad and varied supply of residential units, and a well-functioning traffic hub. These goals are facilitated by area regulation adopted in 2016. In addition, the development of a micro energy system aims to establish a local energy system with zero-emissions. In addition to the area regulation, a separate action plan describes the planned measures: • Investment in social infrastructure with the building of the Verdensparken skole (World Park School) and the nursing home, Furuset Hagelandsby. • Creation of a mobility centre and attractive urban spaces in a central location at Trygve Lie's place. • Development of a micro energy system: The establishment of a common waterborne energy system which utilizes – among other things – the surplus heat of the local ice stadium. This system will guarantee an environmentally friendly, economically feasible and flexible system, that will gradually extend during the forth-coming years. Climate friendly construction of buildings: Energy consumption in buildings should be reduced and optimized by applying a standard Greenhouse Gas (GHG) accounting method in the planning and utility phase. The municipality has this focus when developing public-owned estates such as schools and nursing homes.
Indicators/expected impact	ZEN KPIs
Overall strategies of city/municipality connected with the project	Urban Renewal Strategies
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ **Materials** ☒ **Refurbishment** ☒ **Sustainable production** ☐ Sustainable consumption ☐ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	The main stakeholders involved are the municipality with several departments, the administration of the city district Alna and the FutureBuilt Programme from public side. The planning department was the leading actor during the planning phase. The climate department (Klimaetat) took over in 2016. Several consultant agencies participated in different stages of the process. Other stakeholders involved are 12 housing cooperatives, private landowners, the transportation agency Ruter and the energy utility company Fortum Oslo Varme. Furuset lies within Fortum Oslo Varme's concession area for district heating.
Typology of energy supply	n/a

Success factors	Challenges/barriers
n/s (planning phase)	Based on findings from the PI-SEC project[6] report and three additional qualitative interviews with Oslo municipality, six major **challenges and risks** in the planning process so far have been identified: 1. Evaluation and consideration of alternative energy system solutions: The design and planning process of the local energy system is dominated by a few stakeholders and thereby a limited number of alternatives is considered. This is linked to the concession as well as the high public stakeholder presence and lack of incentives to include more energy stakeholders. Furthermore, the in-house municipal capacity on energy in urban planning is unexplored. 2. Conflict between the plan for a 'highway lid' over E6: This structural measure would make the area more attractive, quieter, and add more space for buildings. It is desired from the municipality and the residents. Due to financial considerations, the National Road Administration has rejected this measure. 3. Pressure to speed-up construction activities: There is a mismatch between the urgent need for more housing in Oslo and the perceived slow process from planning to implementation in Furuset. 4. Knowledge transfer: The planning and design of the neighbourhood and in particular the micro energy system needs a fast and current knowledge transfer. There is a particular need for knowledge within the field of legal/juridical questions and the application of an integrated planning approach that connects the different technological solutions. 5. Acceptance of physical measures among the residents (Risk): The construction phase, providing a connection between two central roads, as part of the re-modelling of the transportation system was delayed due to protests from residents. This emphasises the importance of communication and the integration of residents during both the planning and implementation phases. (Challenge/risk) 6. Low interest from private stakeholders (Risk): Due to the relatively low real-estate prices in the neighbourhood, the interest of private stakeholders in the construction of residential and commercial buildings is limited. This can jeopardize the estimated construction scope and time frame. The development of the sites owned by private landowners is crucial for the establishment of a comprehensive energy system.

[6] https://www.ntnu.edu/smartcities/pi-sec

25 SCITHOS Project, Vienna, Austria

General information	
City	**Vienna, Austria**
Project name	**SCITHOS**
Project status	planned ☐ under construction ☐ realized ☐ **in operation** ☒
Project start – end	May 2016 – September 2019
Contact	Ko Koens
Project website	www.scithos.eu
Size of project area	n/a
Building structure	n/a
Land use	- Residential - Services (__urban destinations _____)
Financing	Research funding

Overview description of the project	
This project introduces Smart City Hospitality as a concept that consists of guidelines and tools to help cities find solutions to make the transition towards environmentally and socially responsible tourism that simultaneously contributes to long-term prosperity. SCITHOS actively involves the public in doing so, for example by means of the 'SCITHOS challenge', which brings together policymakers, residents and other local stakeholders to discuss the future of tourism in their destination in a playful setting.	 © scithos.eu

Strategies	
Goals/ambition	Positive Energy ☐ Zero-emission ☐ Energy neutral ☐ Energy efficient ☐ Carbon-free ☐ Climate neutral ☐ **Sustainable neighbourhood** ☐ Social aspects/affordability ☐ The project aims to support stakeholders in making decisions related to tourism while aiming for sustainable neighbourhoods and overall the city.
Indicators/expected impact	SCITHOS project focuses on the values of equitability, liveability, economic wealth, experience quality, natural viability and smart hospitality. In doing so, the expected impacts are expected to work on a spatial distribution of an urban destination, but also at the regulatory level, where new policies and regulations can be implemented.

Overall strategies of city/municipality connected with the project	The project predominantly focuses on the smart city strategies for managing tourism in an urban space embracing the growth of tourist arrivals.
Which factors have been included in implementation strategies?	Local (renewable) resources ☐ Regional energy system ☐ Mobility ☐ Buildings ☐ Materials ☐ Refurbishment ☐ Sustainable production ☐ **Sustainable consumption ☒** **(Local) Governance ☒** Legal framework ☐ Business models ☐
Innovative stakeholder involvement strategies	- Citizens - Industry - Business Through the SCITHOS-challenge, a serious gameplay, all stakeholders in a destinations are invited to plan the destination and collaborate. Through the gameplay, stakeholders get a better understanding how the implementation of policies to manage the city impacts the stakeholders but also the sustainable values representing the quality of life and in the city and visitability of tourists.
Typology of energy supply	n/a

Success factors	Challenges/barriers
- 6 pilot cities across Europe - Serious gaming prototype - Variety of engaged/involved stakeholders - Raised awareness among participants	- Collaboration between partners - Cultural differences of partnering cities - Willingness to participate among specific stakeholders

26 Turku, Finland

General information	
City	**Turku**
Project name	n/a (under planning)
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	n/a
Contact	**Miia Paananen**
Project website	n/a
Size of project area	n/a
Building structure	Newly built ☐ Existing neighbourhood ☐ **Mixed** ☒
Land use	n/a
Financing	n/a

Overview description of the project
In this questionnaire we introduce a few examples of ongoing energy pilot projects in the city of Turku. Turku aims to be carbon neutral by the year 2029. Some examples of our energy projects: - Energy solutions in the Student Village of Turku (managed by the Turku Student Village foundation TYS) - The new sustainable residential district of Skanssi - Several other, separate energy projects in the city

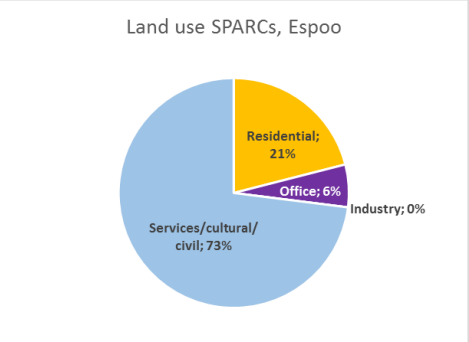
Strategies	
Goals/ambition	Positive Energy ☐ **Zero-emission** ☒ Energy neutral ☐ **Energy efficient** ☒ **Carbon-free** ☒ **Climate neutral** ☒ Sustainable neighbourhood ☐ Social aspects/affordability ☐ Other: **Stakeholder and citizen participation**
Indicators/expected impact	n/a
Overall strategies of city/municipality connected with the project	Turku, with its surrounding municipalities, is an energetic centre of growth in the Baltic Sea area. The city strategy is strongly supported by a strategic programme of Competitiveness and sustainable growth. There are over 190 000 residents in Turku. Turku has an estimated population growth of almost 20 000 new inhabitants by 2040, and the Turku subregion is estimated to have a population growth by 30 000 inhabitants by 2040. The city has two universities and four higher education institutions with over 35 000 students altogether. Turku is the sixth largest city and the third largest urban area in Finland. The city of Turku aims to be carbon-neutral by 2029 and has established milestones to reach this goal. We will extend the energy-efficient and resource-wise way of operating across all operations. We will increase the share of renewable energy sources and develop our energy system to make it

	smarter. We will engage companies, institutions of higher education and citizens in developing carbon-neutral innovations and implementing solutions. In order to reach the target of carbon neutrality by 2029, Turku City Council unanimously approved a Sustainable Energy and Climate Action Plan in June 2018. Furthermore, the plan includes a target of becoming a climate positive area with negative net emissions from 2029 onwards. Turku is a global forerunner in climate policy, and the city wants to be part of an international network of cities that will solve climate change issues. Environmental protection and natural diversity is important to Turku, and the city works actively to protect the Baltic Sea and the Archipelago Sea in particular. We will implement the principles of zero emissions, zero waste, sustainable use of natural resources and efficient use of resources by 2040.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ Refurbishment ☐ Sustainable production ☐ Sustainable consumption ☐ (Local) Governance ☐ Legal framework ☐ Business models ☐
Innovative stakeholder involvement strategies	The sustainable district of Skanssi is a combination of smart solutions, sustainability and sense of community. The district of Skanssi is a platform for piloting and using low-carbon energy solutions, sustainable mobility and smart built environment. For creating motivation and solutions together, we have involved the developers, service-providers and inhabitants of the Skanssi area. Series of workshops have been organized and different means of consultation and co-creation put to use. Turku also takes part in the Energy Wise Cities-project together with the six largest cities in Finland. The project creates concepts of intelligent and energy-wise buildings and promotes new business opportunities and energy efficiency partnership models. The project has successfully organized e.g. market mapping events with themes such as building life-cycle and energy wise service buildings. In the Spring of 2019 a project called Carbon Neutral and Resource Wise Industrial Areas will start (ERDF). The project concretizes what carbon neutrality means for business parks and industrial areas and develops new means through stakeholder involvement and co-creation. Turku's pilot area for this project is Blue Industry Park, a production and innovation cluster of the maritime and manufacturing industries. The city of Turku also works in close so-operation with the Finnish Innovation Fund Sitra regarding climate goals and circular economy. Co-operation in the next months will involve for example co-operation in conceptualizing what a climate positive city means and how for example city districts can become climate positive.
Typology of energy supply	Some recent and upcoming examples: - The student village in Turku has several ongoing building projects that promote the use of renewable energy sources. The Turku student village foundation has recently finished building a new residential building "Aitiopaikka" that utilizes solar electricity and has the potential of producing more energy than it consumes especially during Summer with its 515 solar panels. The building has 255 apartments. Electricity can be shared in the student village area. - The Turku student village foundation is currently planning its next climate friendly building project "Tyyssija". Tyyssija will use ground heat as its energy source and will furthermore have a waste water heat recovery, that collects waste water heat from approx.. 30 other buildings beside Tyyssija. Solar panels are also planned to be installed on the roof of Tyyssija. - The Skanssi district's energy vision includes new solutions to produce heat e.g. with solar collectors and to store the heat in the ground. Two-directional heat trade and a low-

	temperature district heating network are piloted in the Skanssi district. The first parts of the area have been built and the heat storage systems have been installed. An enabling factor for this experiment is the lower temperature solution for the heat grid in the area. By lowering the temperature in the grid down to sixty-seventy degrees Celsius we enable profitable heat production by solar collectors and other local means. - The Energy Wise Cities -project simulates and plans the realization of zero-energy district/blocks and examines the development of regional energy systems. - Different ways of storing energy (e.g. with energy poles) is also piloted in the Lämpöä-project run by Turku University of Applied Sciences. In the district of Kupittaa in Turku the Turku Energy company has built a solar park with 450 solar panels (approx.. 1 MW). Turku Energy company rents out the solar panels to customers, and the produced energy can then be credited in the customer's electricity bill.

Success factors	Challenges/barriers
n/a	n/a

27 SPARCs, Espoo, Finland

General information	
City	**Espoo, Finland**
Project name	**SPARCs**
Project status	**planned** ☒ under construction ☐ realized ☐ in operation
Project start – end	Potential: 01/2020 - 12/2025
Contact	Elina Wanne, City of Espoo Francesco Reda, Project international coordinator
Project website	https://www.sparcs.info/ (partly under construction)
Size of project area	about 52 ha
Building structure	**Newly built** ☒ **Existing neighbourhood** ☒ **Mixed** ☒
Land use	- Residential: 21% - Office: 6% - Industry: - - Services/cultural/civil: 73% 
Financing	The PEDs demonstration are included within the city activities for the carbon free transformation by 2030, which mobilizes a huge capital from different financial resources: - Municipal funds: 172.3 M€ - Private funds: 507.3 M€ - Research EC funds: 6 M€ (pending approval) - National research funds: 6Aika collaboration platform with a total budget of 100M€ and covering the 6 largest cities in Finland, including Espoo

Overview description of the project
Sustainable energy Positive & zero cARbon CommunitieS demonstrates and validates technically and socio-economically viable and replicable, innovative solutions for rolling out smart, integrated positive energy systems for the transition to a citizen centred zero carbon & resource efficient economy. The project will facilitate the participation of buildings to the energy market enabling new services and a virtual power plant concept, creating VirtualPositiveEnergy communities as energy democratic playground (positive energy districts can exchange energy with energy entities located outside the district). Espoo, PEDs demonstration activities focus on mixed-use building blocks, consisting of both existing building stock and new-built, within fast growing districts along the multimodal public transport network.

Strategies	
Goals/ambition	**Positive Energy** ☒ **Zero-emission** ☒ Energy neutral ☐ **Energy efficient** ☒ **Carbon-free** ☒ **Climate neutral** ☒ Sustainable neighbourhood ☐ **Social aspects/affordability** ☒

Indicators/expected impact	Environmental, Societal, Social, Economic, technical, Spatial, Regulatory PEDs demonstrations will enable, inform and support the efficient urban transformation of cities into carbon free societies, including especially smart networks, low carbon transport solutions, a sustainable energy transition, and improved air quality In numbers, the project targets a 64% carbon emission reduction, 65% increase in share of RES, and 53% of energy savings
Overall strategies of city/municipality connected with the project	Espoo is the fastest growing city in Finland, and an integral part of the Helsinki capital metropolitan area. Espoo expects to reach 300,000 inhabitants by 2022 and continue growth to 400,000 residents and 180,000 jobs by 2050. The overarching sustainability objective of Espoo is to reach **carbon neutrality by 2030**, including fossil-free district heating, and reduce its emissions per capita by 60 % by 2030, compared to 1990. Espoo has set in the city strategy a **cross-administrative development programme "Sustainable Espoo"** for the council term 2017-2021 to implement actions towards the carbon-neutrality 2030 objective. These actions are implemented in collaboration with companies, RDI institutions, NGOs and local residents. The focus of the programme period is the implementation of fast-acting methods in the promotion of carbon neutrality. The planned PEDs are actions towards these objectives. The programme has five key utility goals: - Espoo is built and developed using smart solutions, - Citizen mobility is made easier and multi-modal transport is fostered, - Emission-free energy production and smart energy solutions, - Espoo citizens act responsibly. - Environmental benefits and recreational opportunities of the nearby surroundings grow.
Which factors have been included in implementation strategies?	**Local (renewable) resources** ☒ **Regional energy system** ☒ **Mobility** ☒ **Buildings** ☒ Materials ☐ **Refurbishment** ☒ **Sustainable production** ☒ **Sustainable consumption** ☒ **(Local) Governance** ☒ **Legal framework** ☒ **Business models** ☒
Innovative stakeholder involvement strategies	Citizens, Industry, Investor/real estate, Business, Research, Energy utilities, Regulators, educational institutes. Alliance models for smart city development, citizen engagement strategies.
Typology of energy supply	Solar thermal energy, Geothermal energy, District heating/local heating, Heat pump system, waste heat, seasonal storages, batteries, PV, Biomass CHP, Bi-directional eV charging; 2nd life battery; Peer to Peer energy transaction, Virtual Power Plant

Success factors	**Challenges/barriers**
The city is a frontrunner in intelligent and sustainable, smart city development: Espoo is the most sustainable city in Europe, and won the international Intelligent Community Award 2018. Espoo has been nominated pioneer and one of 25 the cities participating UN's SDGCity leadership programme of the UN Agenda 2030 Sustainable Development Goals. The city joined the Covenant of Mayors 2020 commitment in 2010. In February 2018, Espoo has also signed the Covenant of Mayors 2030 commitment to reduce the city's greenhouse gas emissions by 40% by 2030. The City of Espoo was also the first municipality in Finland to join the national Commitment 2050 - the Society´s Commitment to Sustainable Development. Espoo has also been recognized as being among the first movers in the Nordics in working with the 2030 Agenda. The goal is to be a top performer of sustainable city development in Europe.	Changes in the business environment challenge the city development, requiring the city to take the initiative for active, new and innovative co-creation models for stakeholder collaboration. Rapid growth of the city as well as demographic changes, cause increased demands on resources and e.g infrastructure, to be concurrently developed towards sustainable and carbon neutral solutions. Hence emissions can be decreased per inhabitant, whereas the total use of e.g. energy tends to increase. Main Challenges during the PEDs planning: - Wide network of different stakeholders involved, do we understand each other's position and goals thoroughly?

	- The change in theme of energy is currently very rapid, how can we take this into account when planning this kind of long ambitious project? - There are challenges due to the climate and northern location regarding heating and energy demand. These are different from Central Europe. How can these be brought forward.

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