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POCITYF

D8.8 Hvidovre Replication Plans and City-Vision for 2050

WP8: Replication Plans and 2050 Vision by Fellow Cities

T8.8: Hvidovre Replication Plans and City-Vision for 2050

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PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

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

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Executive Summary

POCITYF is a 5-year project co-financed by the European Union's Horizon 2020 program. The project is designed to support a positive energy transition in two Lighthouse Cities (LC), Alkmaar (NL) and Evora (PT), and six Fellow Cities (FC), Ioannina (GR), Granada (ES), Ujpest (HU), Bari (IT), Celje (SI) and Hvidovre (DK). In the context of the project, FCs are provided with the opportunity to learn from the innovative technologies and methodologies demonstrated in the LCs, and then to develop and actualize locally adapted Replication Plans (RP). The learnings from the Replication Plans can thereafter be used as roadmaps for other cities across the world to develop Positive Energy Blocks and Districts, supporting the creation of more environmentally, socially, and economically sustainable cities.

This document is the first version of Hvidovre Municipality's Replication Plan and City Vision for 2050. The Replication Plan presents the work completed and current plans of Hvidovre Municipality and its local partner, European Green Cities, up through September 2022. A second, and final, version of the Replication Plan will build from and overhaul this document in September 2024.

In this first version, Hvidovre Municipality's Replication Plan starts with a benchmark framework, providing details of Hvidovre Municipality's context. This importantly includes not only information about the FC as a physical area, but also about various smart city indicators (energy, environment, mobility/transport, economic, ICT, social, governance) and how each is currently being implemented or being envisioned. This knowledge is then used to motivate Hvidovre FCs interest in investigating and implementing various Innovative Elements (IEs), which are being or have been tested in the LCs. The benchmark framework is rounded off in a discussion of potential legal, technical, and financial challenges associated with implementing IEs in the local context. Challenges discussed in the RP show how Danish law on both energy production and distribution presents significant legal barriers, especially to producing, storing and distributing energy through citizen energy communities.

To counter potential challenges for Hvidovre FC, the Replication Plan also includes an in-depth description of various relevant processes. These include both governance processes in the municipality, and the engagement of local stakeholders and active work groups. Up through September 2022, Hvidovre FC has focused primarily, and successfully, on supporting especially the engagement of local work groups: Avedøre Green City, a stakeholder group who work with sustainable initiatives in general in the area, and Avedøre Energy Community, a stakeholder group who work specifically on a sustainable

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energy transition in the area. The support and engagement of these two groups of stakeholders has been prioritized, especially in the early stages of the project, as it is considered essential to the successful implementation of any IEs, and the propagation of POCITYF principles, also after the project's end.

The Replication Plan continues with a description of how the tools developed by the consortium have been utilized in preparing Hvidovre FC through September 2022; a list of exploited tools includes knowledge transfer workshops from the LCs, fact sheets about the IEs developed in collaboration with technical partners, the concept of the aforementioned work groups, and questionnaires. The utilization of these tools has allowed Hvidovre FC to both deepen stakeholders' technical knowledge of technical solutions and evaluate the acceptance of local stakeholders and citizens.

The Replication Plan concludes with the 'meat' of the document: Hvidovre Municipality's Smart City Vision, the final criteria to be used to choose IEs, and a conclusive list of the IEs which have already been replicated or which are planned to be replicated. There will be special focus on expanding upon this section, including conducted feasibility studies, in the final version of the Replication Plan. Overall, this document depicts how Hvidovre FC has been successful in setting up processes and structures to implement and support the long-term role out of the chosen IEs, especially regarding local stakeholder engagement.

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Abbreviations and Acronyms (in alphabetical order)

Abbreviation	Definition
AEC	Avedøre Energy Community
AGC	Avedøre Green City
AQI	Air Quality Index
BEMS	Building Energy Management System
DC	Direct Current
DHC	District Heating and Cooling
DSO	Distribution System Operators
EGC	European Green Cities
ETT	Energy Transition Track
EU	European Union
EV	Electric Vehicle
FC	Fellow City
HD	Heavy duty
HEMS	Home Energy Management System
HM	Hvidovre Municipality
ICT	Information and Communications Technology
IE	Innovative Element
IS	Innovative Solution
KAB	Copenhagen Social Housing
KPI	Key Performance Indicator
kWh	Kilowatt hour
LHC	Lighthouse City
Li-ion	Lithium-Ion
Li-metal	Lithium metal
LV	Low voltage
MV	Medium voltage
NiMH	Nickel-metal hydride
NSB	Nation Standardisation Body

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POCITYF

Abbreviation	Definition
PAYT	Pay-As-You-Throw
PCM	Phase-change Material
PED	Positive Energy District
PM2.5	Fine inhalable particles smaller than 2.5 micrometres
POCITYF	A POsitive Energy CITY Transformation Framework
PV	Photovoltaic
P2P	Peer-to-Peer
RP	Replication Plan
SDG	Sustainable Development Goal
SME	Small and Medium sized Enterprise
UN	United Nations
VPP	Virtual Power Plant
V2G	Vehicle-to-Grid

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1 Introduction

POCITYF is an EU Horizon 2020 funded project concerning Smart Cities and Communities. As such, it aims to support an energy transition by nurturing and bettering positive energy buildings and districts in two Lighthouse Cities (LCs), Évora (Portugal) and Alkmaar (Netherlands), and six Fellow Cities (FCs), Granada (Spain), Bari (Italy), Celje (Slovenia), Ujpest (Hungary), Ioannina (Greece), and Hvidovre (Denmark).

Since its inception in 2019, POCITYF has identified ten integrated solutions (ISs), made up of 73 innovative elements (IEs), each of which are a technology, tool, or method. Four Energy Transition Tracks (ETTs) were defined to encompass these ten ISs. While ETT#1 revolves around solutions that transform both existing and new buildings to an Energy Positive state, ETT#2 includes solutions that offer energy management services, especially those which consider the grid flexibility and those which optimize energy flows to maximize self-consumption and reduce grid stress. ETT#3 includes solutions that promote sustainable e-mobility, and solutions encompassed by ETT#4 are those which focus on citizen-driven innovation in the co-creation of smart city solutions.

Table 1: Energy Transition Tracks

Energy Transistion Tracks (ETT)	Solutions
ETT#1:	Innovative Solutions for Positive Energy (CH) Buildings and Districts
ETT#2:	P2P Energy Management and Storage Solutions for Grid Flexibility
ETT#3:	e-Mobility Integration into the Smart Grid & City Planning
ETT#4:	Citizen-Driven Innovation in Co-creating Smart City Solutions

Each of the 73 IEs categorized within the four ETTs have been tested in the two LCs and will be replicated in the FCs. In this context, present replication plan is dedicated to documenting the replication of the IEs in the FCs. The main objectives of the replication plan are:

- to demonstrate the implementation of the IEs at both a building and district level, creating energy positive districts and enabling increased energy self-consumption, energy savings, and an increased share of locally produced renewable energy,
- to ‘Demonstrate active citizen engagement services and solutions providing an open innovation ecosystem for citizens to participate in co-creation, decision making, planning and problem solving within the Smart Cities’,

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- to test the business models and investment concepts developed and discovered in the LCs, that consider the whole lifecycle of the Positive Energy District (PED),
- to develop feasibility studies and business plans for the IEs in a range of cities with different sizes, geographies, climatic zones, and economic situations,
- to further develop the IEs alongside the other FCs so that they are market-ready by the end of the project, and
- to identify regulatory barriers, legal aspects and data security/protection issues and test the proposed solutions to these barriers.

This report is concerned with the replication activities carried out in Hvidovre Municipality and is structured in five sections.

- Section 1 (Introduction): introduces the general scope of the document, including relevant background information and objectives.
- Section 2 (Benchmark Framework): introduces Hvidovre Municipality as a FC, describes the parts of Hvidovre Municipality which has been identified as the replication area. Furthermore, the IEs which Hvidovre FC is motivated to replicate in this replication area are identified, and foreseen challenges and barriers to the ensuing replication activities will be defined.
- Section 3 (Processes towards the implementation of the Replication Plan): describes the governance and administrative processes related to planning the replication activities, as well as the engaged work groups and local stakeholders. Moreover, this section describes the proposed use of the IEs chosen to be replicated, and the processes behind the selection of.
- Section 4 (Building up the Replication Plan): provides a final view of the selection of IEs to be replicated, and of the replication design. Lastly, the financial aspects of implementing the Replication Plan will be addressed.
- Section 5 (Conclusions): summarizes the work of the document.

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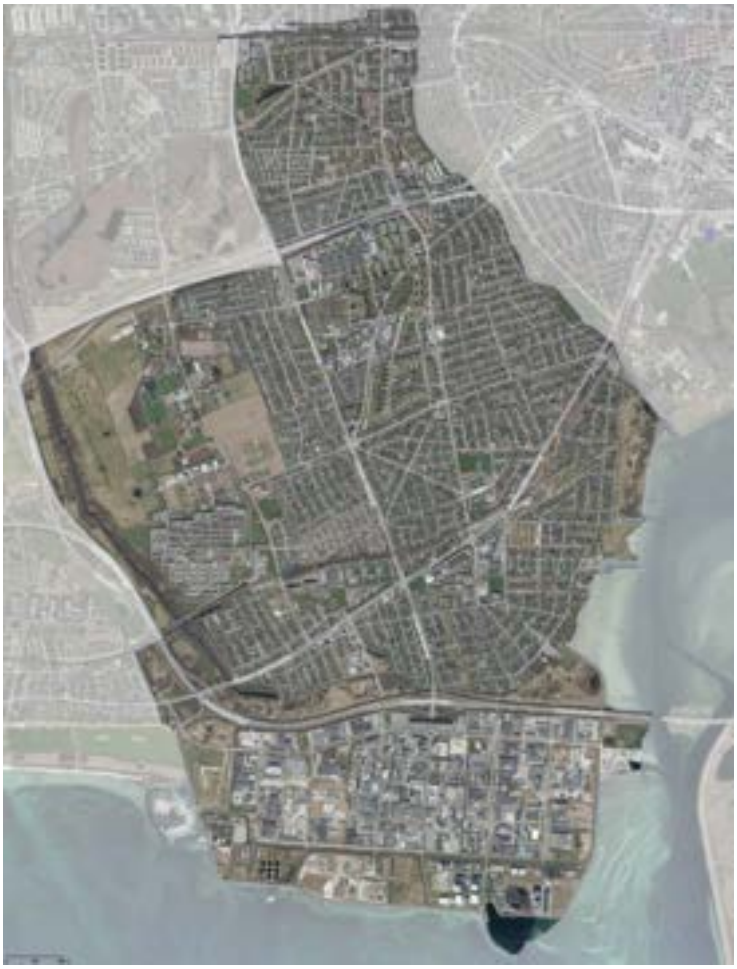
2 Benchmark Framework

2.1 General description of the city

Hvidovre FC is located just south of Copenhagen, the capital city of Denmark, on the island of Zealand. The municipality covers an area of 22 km^2 and has a total population of 53,451. Around 40% of the housing stock in Hvidovre is social housing. The site of the municipal council is the town of Hvidovre, though the municipality also includes the town of Avedøre, the town of Friheden, and the industrial area, Avedøre Holme. Hvidovre Municipality is currently planning further expansion in the form of nine artificial islands in Øresund, the straight between Zealand and the southern Swedish region of Skåne.

Figure 1: Map of Hvidovre Municipality



A description of the status of Hvidovre Municipality as a smart city regarding energy, environment, mobility/transport, economics, ICT, social situations, and governance can be found below:

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Table 2: Smart City Indicators in the context of Hvidovre Municipality's Status and Vision

Smart City Indicator	Status	Vision
Energy	Hvidovre Municipality has a variety of sustainable energy initiatives up and running. The following list outlines the status of some of those initiatives: • *Solar panels* are a regular sight in Hvidovre Municipality. For example, in Avedøre Stationsby, Store Hus and some of the buildings in Avedøre North have PV panels on their rooftops. The new charging station by Hvidovre High School also has solar panels on its roof. • The roof of Hvidovre Hospital hosts a 6,000m^2 *solar plant* which produces between 600,000 and 800,000 kilowatt hours of electricity per year. The project was funded by the Capital Region of Denmark with a grant of 10 million DKK. • There is currently not a consistent presence of or plans for *storage* possibilities for electricity. • Across the Capital Region, *smart meters* are being rolled out for all households. Hourly billing should be possible within the next two	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Reduce CO_2-emissions from publicly owned buildings by 2% each year. • Eliminate the use of oil and fossil fuels in heating. • Offer the possibility to connect to the district heating grid to all buildings by 2031. • Increase the share of renewable energy sources in the energy mix. • Improve citizens' sense of power over the sustainability of their energy consumption. • Meet the targets of the 'DK2020' climate partnership by becoming CO_2-neutral by 2050 or earlier. • Achieve a fossil-free electricity and heat supply by 2035, as is the goal in the Capital Region. • Support energy efficiency projects such as low-temperature district heating systems, groundwater storage, heat pumps, photovoltaic thermal collectors (PVT) and building-integrated photovoltaics (BIPV).

	years, hopefully influencing peaks in energy use. • Avedøreværket, situated at Avedøre Holme in Hvidovre Municipality, is a *combined heating and power plant*, which converts biomass to *district heating* and electricity. When the supply of biomass is too low, however, it uses coal. • At the wastewater treatment plant in Avedøre Holme, BIOFOS currently *produces biogas from waste*.	
Environment	According to IQAir, [1] the average air quality in Denmark is measured at 39 AQI in 2020 which is 'good' (50 or below). Although the PM2.5 concentration exceeds the WHO annual air quality guideline value. The Danish Ministry of Environment[2] tracks air, noise and waste pollution in Denmark. Emissions that are of particular focus include air pollution from stoves, traffic and shipping, noise pollution from traffic and wind turbines, and waste pollution from food, electronic and shipping waste. Hvidovre Municipality provides information about 'Nature, Environment, and Climate' on their municipal website.[3]	• Reduce CO_2/greenhouse gas (GHG) emissions using a diverse set of interventions. • Improve air-quality by reducing transport emissions, including, but not limited to, increasing the number of bike and car sharing projects, increasing e-mobility actions, enhancing walking and cycling experiences, and increasing the percentage of electric cars in Hvidovre Municipality's fleet.

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Mobility/Transport	Hvidovre Municipality has a variety of transport and mobility related projects completed and in progress. The following list outlines select initiatives: • The S-train is a *train system* centered around Copenhagen on which one can take their bike for free. Two S-train lines run through Hvidovre Municipality. • *Bus* lines, in theory, connect the area between the S-train stops. All *buses* in the Capital Region of Denmark are planned to be EV by 2027. • There are plans to either use a new *metro* line, *light rail*, or *bus rapid transit system (BRT)* to connect Hvidovre Hospital to the existing grid. • Three 'bike highways' exist in the municipality. These are part of a strategy 'Bicycle City Hvidovre', which aims to make Hvidovre a good place to *bike*. • There is currently no bike, e-scooter, or car-*sharing* strategy in Hvidovre Municipality. In Copenhagen, however, there are shared city bikes 'Bycyklen' which have more than 130 pick-up points within a 10-kilometer radius. It will soon expand to Hvidovre Hospital. • *EVs* have been a focal point of Hvidovre Municipality, both for internal municipal use	• Increase the share of electricity in the mobility sector. • Reduce the total energy consumption in the mobility sector. • Improve citizens' sense of ownership over the sustainability of their mobility choices. • Expand EV infrastructure by increasing the number of EV charging stations. • Increase the number of electric cars in the municipality's car fleet. • Further the 'Bicycle City Hvidovre' concept by increasing the quality of Hvidovre Municipality's bike lanes, both with regards to safety and comfort. • Support both bike-sharing and car-sharing projects and schemes. • Support the transition of the transport sector in the Capital Region (of which Hvidovre Municipality is a part) to be fossil-free by 2050, by transitioning Hvidovre Municipality's transport sector to a fossil-free sector.

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	and for all citizens. The municipality has experimented with EVs and is now changing all cars to EV. • *EV charging stations* have been installed in Central Hvidovre, at the Town Hall and on Avedøre Holme. A plan for more EV charging points will be developed in the future. • Major highways run both north of Avedøre village, west of AGC, and a bit further south of Avedøre Stationsby.	
Economic	In recent years, Hvidovre Municipality has been able to offer a Green City Fund[4] for citizens in Hvidovre. The fund has, up to date, financed 29 projects. A new round of projects is taken into consideration every six months. Social housing makes up 40% of Hvidovre Municipality's housing stock. Hvidovre Gymnasium is one of a few high schools in Denmark selected to be afforded extra funds in 2022-2023. Hvidovre Gymnasium has chosen to use these funds to create a program for its students where they can gain more know-how about both the climate and democratic processes.	• Strengthen the economic power of citizens by, for example, providing inexpensive energy and mobility options. • Support the growth and power of local businesses by increasing their technical and bureaucratic know-how. • Support green citizen-run projects through a local green financing pool.
ICT	Denmark is a highly digitalized country. Information for citizens and companies can be found on a variety of interconnected national digital platforms, e.g.	• Establish a fiber network in Hvidovre Municipality with fast internet.

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	borger.dk (citizen platform relating to addresses, marriage, divorce, etc.), sundhed.dk (platform for health issues), skat.dk (platform for doing your taxes), and virk.dk (platform for administrating your company or association). Furthermore, citizens receive information directly relevant to them, including notices from the state, libraries, police, tax authorities, and banks, directly in an online secure email through aforementioned platforms. Information about public transportation routes, times, and prices can be viewed on the digital travel platform 'Rejseplanen.dk', which has both web and app platforms. Tickets then take the form of either a PDF if purchased online, a confirmation screen if bought on the app, or a 'Travel card' which can be reloaded and tracked online. There has been a local focus in Hvidovre Municipality on expanding fiber-optic. On December 7th, 2018, then Mayor, Helle Adelborg, initiated the rollout of a fiber-optic network in Hvidovre South in collaboration with TDC, a large telecommunication company.	• Digitalize all maps to be available to citizens on the municipal website.
Social	Denmark has a strong welfare system and quality of life is relatively high.	• Improve citizens' physical living conditions by, for example, refurbishing buildings and/or providing locally rooted mobility options.

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		• Strengthen the economic power of citizens both by providing options for citizens to obtain funding for green projects and by providing inexpensive energy and mobility options. • Enhance the experience of children and families by, for example, capitalizing on the power of school communities. • Support the growth and power of local businesses by increasing their technical and bureaucratic know-how. • Support green citizen-run projects through a local green financing pool and create a people-centric and people-responsive mobility plan.
Governance	Participatory processes and citizen-driven initiatives already play an important role in both Danish national and municipal politics and the work of social housing organizations. A recent addition to this tradition from 2018 offers the opportunity for any citizens to present a proposal to the Hvidovre city council if at least 500 citizens agree upon that proposal. Furthermore, as mentioned above, Hvidovre Gymnasium has extra funds in the coming years which have been set aside to an ambassador program. Students who follow the program will gain	• Increase citizens' sense of belonging to and ownership to their local area. • Improve citizens' sense of ownership over the sustainability of their choices, including mobility and energy consumption. • Advance citizens' ability to contribute to- and impact policy, including that which relates to energy production and consumption.

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	know-how about both the climate and democratic processes.	

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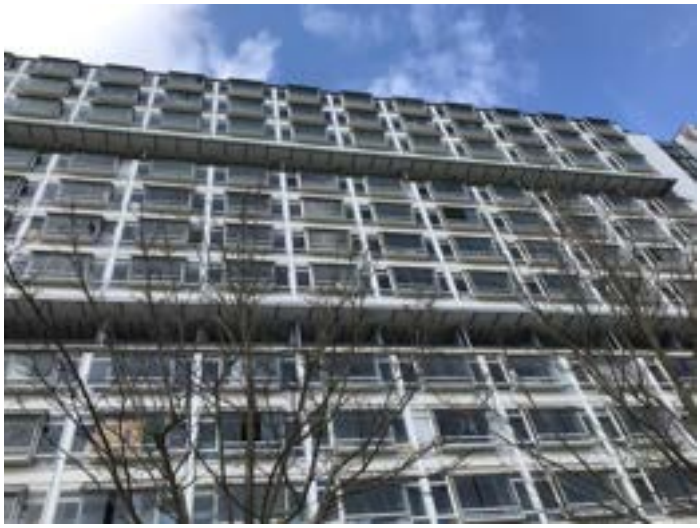
2.2 Defined Replication Areas

The replication area in Hvidovre FC lies within the geographical area called Avedøre Green City (AGC). [5] This geographical area lies in Hvidovre Municipality, and consists of Avedøre Barracks (Avedørelejren), Film City, Avedøre Village, and Avedøre Stationsby.

Figure 2: Store Hus



Avedøre Stationsby, planned in 1968 and built between 1972 and 1982, is somewhat reminiscent of Le Corbusier's vision of future cities. It offers a complete 'city package', with schools, shops, a church, a library, and other institutions alongside a large green area.

Avedøre Stationsby is host to Hvidovre High School, Avedøre South, Avedøre North, and Store Hus. Avedøre South, Avedøre North, and Store Hus are three social housing organizations which account for around 2,500 flats and terraced houses with approximately 6,000 inhabitants.

Specific areas of interest for implementing POCITY solutions are:

- **Avedøre South** was planned in 1968 and built in-between 1972 and 1982. There are about 1,028 flats with a total building area of 87,010 m^2. The tenants have explicitly expressed a desire to use the area as a hub for testing new sustainable solutions as part of the renovation process to be realized between 2019 and 2023.
- **Film City** borders both Avedørelejren and Avedøre Stationsby. Film City was built between 1911-1913 as a film studio complex. Today, it is considered a cultural heritage site, and is used for residential purposes and as home to film studios for Zentropa. There are around 6,000 m^2 of buildings worth preserving in Film City.
- **Hvidovre High School** was built in 1973. It is a secondary school with 254 pupils and an area of 7,565 m^2.

AGC, however, is not only a geographical area, but an organizational network with a steering committee made up of local stakeholders. In addition to local stakeholders from Avedøre Barracks, Film City, Avedøre Village, Hvidovre High School, Avedøre South, Avedøre North, and Store Hus, the AGC Steering Committee also has representatives from Hvidovre Municipality and Avedøre District Heating. The AGC Steering Committee provides

a significant opportunity for local stakeholder engagement in replication activities, especially because it can share information and present the IEs to local stakeholders.

Both the geographical area and stakeholder make-up of AGC Steering Committee has, in part, been defined by the area to which Avedøre District Heating provides services. This area has been further solidified as 1) an area of green urban development, and 2) a Positive Energy District (PED) in POCITYF, through the creation of Avedøre Energy Community (AEC).[6] AEC was formed, partly with support from POCITYF, to produce, sell, buy, provide, and store renewable energy in AGC.

Figure 3: Avedsøre South (Syd)

The presence and interest of Avedøre Energy Community offers the possibility to invest in innovative solutions across the replication area that involve the creation, sale, purchase, provision, or storage of renewable energy to citizens in AGC. It also provides a representative and invested group of stakeholders, and a structure within which one can continuously develop interest in different IEs.

Given the presence of both AGC Steering Committee and Avedøre Energy Community, there are good opportunities in the replication area to:

1. install more energy solutions in the area, including those related to consumption reduction, self-consumption increase, and renewable energy increase,
2. support the development of legislation that creates opportunities and good business cases for renewable energy source systems (RES) solutions in the area, and
3. engage more people in the activities of the AGC Steering Committee and Avedøre Energy Community.

It is relevant to note that Avedøre Energy Community is the first Danish energy community, and legislation needs to be changed to support the integration of energy communities into the Danish context. This is both a challenge and a huge opportunity for POCITYF to support meaningful change to the Danish legal energy landscape. This is outlined in more detail in Section 2.4.

AGC as a geographical area is the first Danish 'Green City', but it is far from the first city to be concerned with and invest in a sustainable future. As is apparent from the 'DK2020' partnership amongst 95 of 98 Danish municipalities, there is a strong political desire to reduce energy consumption and support the transition to more sustainable energy and practices. That being said, AGC as an organization offers a framework for high citizen

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involvement, holistic problem solving, and the implementation of concrete projects which support municipal desires.

It is the expectation that the involvement of the POCITYF project will continue to 1) drive the development of AGC as a stakeholder-driven, actualizing organization, 2) support the development of Avedøre Energy Community and therefore the conditions for energy communities in Denmark, and 3) offer inspiration for tested and demonstrated sustainable energy solutions (IEs).

2.3 Envisioned Replication Area and city needs towards Smart City

The following tables describe the ISs for which we have manifested an interest. For each of the ISs for which Hvidovre FC has an interest, the related goal/vision of Hvidovre Municipality is depicted as a motivation. Further details on the status and planning of the ISs will be elaborated in Section 4.2.

Table 3: ISs of interest to Hvidovre FC from ETT#1

ETT#1: Innovative Solutions for Positive Energy (CH) Buildings and Districts		
IS 1.1: Positive Energy (stand-alone) Buildings		
IE X.X.X	**Technology**	**Motivation**
IE1.1.1	PV glass	• Increase the share of renewable energy sources in the energy mix. • Reduce CO_2-emissions from publicly owned buildings by 2% each year. • Improve citizens' sense of power over the sustainability of their energy consumption. • Meet the targets of the DK2020 climate partnership by becoming CO2-neutral by 2050 or earlier. • Reduce CO_2/GHG emissions using a diverse set of interventions. • Strengthen the economic power of citizens by, for example, providing inexpensive energy options. • Support the growth and power of local businesses by increasing their technical and bureaucratic know-how. • Improve citizens' physical living conditions by, for example, refurbishing buildings.
IE1.1.2	PV canopy	
IE1.1.3	PV Skylight	
IE1.1.4	Tegosolar PV	
IE1.1.5	Traditional PV Shingle	
IE1.1.6	Bidirectional smart inverters	
IE1.1.7	Energy router	
IE1.1.9	HEMS/BEMS	
IE1.1.11	Positive Computing Data Centre	
IE1.1.13	Triple glazing	
IE1.1.14	Solar roofs and facades	
IE1.1.17	Li-ion batteries	

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IS 1.2: Positive Energy Districts Retrofitting		
IE1.2.4	P2P Trading Platform	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Reduce CO_2-emissions from publicly owned buildings by 2% each year. • Eliminate the use of oil and fossil fuels in heating. • Offer the possibility to connect to the district heating grid to all buildings by 2031. • Increase the share of renewable energy sources in the energy mix. • Improve citizens' sense of power over the sustainability of their energy consumption. • Meet the targets of the DK2020 climate partnership by becoming CO2-neutral by 2050 or earlier. • Achieve a fossil-free electricity and heat supply by 2035, as is the goal in the Capital Region. • Support energy efficiency projects such as low-temperature district heating systems, groundwater storage, heat pumps, photovoltaic thermal collectors (PVT) and building-integrated photovoltaics (BIPV). • Strengthen the economic power of citizens by, for example, providing inexpensive energy options. • Reduce CO_2/GHG emissions using a diverse set of interventions. • Support the growth and power of local businesses by increasing their technical and bureaucratic know-how. • Increase citizens' sense of belonging to and ownership to their local area. • Improve citizens' sense of ownership over the sustainability of their choices, including energy consumption.
IE1.2.5	Community Solar Farm	
IE1.2.6	DHC (District Heating and Cooling, biomass, waste, geothermal)	
IE1.2.10	Solar screen (previously Solar Roads)	
IE1.2.11	V2G (Smart charging and V2G system connected to energy trading platform)	
IS 1.3: Feeding of PEDs with Waste Streams (heat/materials) promoting Symbiosis and Circular Economy		
IE1.3.3	Reverse collection of waste	• Reduce CO_2/greenhouse gas (GHG) emissions using a diverse set of interventions
IE1.3.4	Circular economy building practices	

Table 4: ISs of interest to Hvidovre FC from ETT#2

ETT#2: P2P Energy Management and Storage Solutions for Grid Flexibility
IS 2.1: Flexible and Sustainable Electricity Grid Networks with Innovative Storage Solutions

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IE X.X.X	Technology	Motivation
IE2.1.2	Micro-grid controller platform	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Reduce CO2-emissions from publicly owned buildings by 2% each year. • Eliminate the use of oil and fossil fuels in heating. • Improve citizens' sense of power over the sustainability of their energy consumption. • Meet the targets of the 'DK2020' climate partnership by becoming CO2-neutral by 2050 or earlier. • Achieve a fossil-free electricity and heat supply by 2035, as is the goal in the Capital Region. • Reduce CO_2/GHG emissions using a diverse set of interventions. • Support the transition of the transport sector in the Hvidovre Municipality (Capital Region) to be fossil-free by 2050, by transitioning to a fossil-free sector. • Strengthen the economic power of citizens by, for example, providing inexpensive energy and mobility options. • Improve citizens' physical living conditions by, for example, refurbishing buildings and/or providing locally rooted mobility options. • Strengthen the economic power of citizens both by providing options for citizens to obtain funding for green projects and by providing inexpensive energy and mobility options.
IE2.1.3	Flexibility control Algorithms	
IE2.1.6	City Energy Management System	
IE2.1.10	V2G	
IE2.1.11	DC grid with smart lampposts	
IE2.1.12	Fuel cells hydrogen	
IS 2.2: Flexible and Sustainable District Heating/Cooling with Innovative Heat Storage Solutions		
IE2.2.3	Low temperature heat grid	• Meet the targets of the 'DK2020' climate partnership by becoming CO_2-neutral by 2050 or earlier. • Achieve a fossil-free electricity and heat supply by 2035, as is the goal in all of the Capital Region. • Support energy efficiency projects such as low-temperature district heating systems, groundwater storage, heat pumps, PVT and BIPV. • Reduce CO_2/GHG emissions using a diverse set of interventions.
IE2.2.5	Low-temperature waste heat	
IE2.2.7	HeatMatcher thermal grid controller	
IE2.2.8	Heat Island concept	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 864400.

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Table 5: ISs of interest to Hvidovre FC from ETT#3

ETT#3: E-mobility Integration into Smart Grid and City Planning		
IS 3.1: Smart V2G EVs Charging		
IE X.X.X	**Technology**	**Motivation**
IE3.1.1	EV charging management platform	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Increase the share of renewable energy sources in the energy mix. • Improve citizens' sense of power over the sustainability of their energy consumption. • Meet the targets of the 'DK2020' climate partnership by becoming CO_2-neutral by 2050 or earlier. • Reduce CO_2/GHG emissions using a diverse set of interventions. • Improve air-quality by reducing transport emissions, including, but not limited to, increasing the number of bike and car sharing projects, increasing e-mobility actions, enhancing walking and cycling experiences, and increasing the percentage of electric cars in Hvidovre Municipality's fleet. • Increase the share of electricity in the mobility sector. • Reduce the total energy consumption in the mobility sector. • Improve citizens' sense of ownership over the sustainability of their mobility choices. • Expand EV infrastructure by increasing the number of EV charging stations. • Increase the number of electric cars in the municipality's car fleet. • Support the transition of the transport sector in Hvidovre Municipality (Capital Region) to be fossil-free by 2050, by transitioning to a fossil-free sector. • Strengthen the economic power of citizens by, for example, providing inexpensive energy and mobility options. • Improve citizens' physical living conditions by, for example, providing locally rooted mobility options.
IE3.1.2	EV charger prototype with PV integration	
IE3.1.3	Bidirectional smart inverters	
IE3.1.4	V2G	
IE3.1.5	Smart lamp posts with EV charging and 5G functionalities	
IE3.1.6	Intelligent and optimal control algorithms	

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		• Strengthen the economic power of citizens both by providing options for citizens to obtain funding for green projects and by providing inexpensive energy and mobility options.
IS 3.2: E-mobility Services for Citizens and Auxiliary EV technologies		
IE3.2.1	EV sharing	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Increase the share of renewable energy sources in the energy mix. • Meet the targets of the 'DK2020' climate partnership by becoming CO_2-neutral by 2050 or earlier. • Reduce CO_2/GHG emissions using a diverse set of interventions. • Improve air-quality by reducing transport emissions, including, but not limited to, increasing the number of bike and car sharing projects, increasing e-mobility actions, enhancing walking and cycling experiences, and increasing the percentage of electric cars in Hvidovre Municipality's fleet. • Improve citizens' sense of ownership over the sustainability of their mobility choices. • Support both bike-sharing and car-sharing projects and schemes. • Support the transition of the transport sector in Hvidovre Municipality (Capital Region) to be fossil-free by 2050, by transitioning to a fossil-free sector. • Strengthen the economic power of citizens by, for example, providing inexpensive mobility options. • Improve citizens' physical living conditions by, for example, refurbishing buildings and/or providing locally rooted mobility options. • Strengthen the economic power of citizens both by providing options for citizens to obtain funding for green projects and by providing inexpensive energy and mobility options.
IE3.2.3	Energy producing noise cancelling screens (previously Solar road)	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 864400.

Table 6: ISs of interest to Hvidovre FC from ETT#4

ETT#4: Citizen-Driven Innovation in Co-creating Smart City Solutions		
IS 4.1: Social Innovation Mechanisms towards Citizen Engagement		
IE X.X.X	**Technology**	**Motivation**
IE4.1.3	Tourist apps	• Improve citizens' sense of power over the sustainability of their energy consumption. • Digitalize all maps to be available to citizens on the municipal website. • Increase citizens' sense of belonging to and ownership to their local area.
IE4.1.4	Cultural experiences market (mobile app)	
IE4.1.6	Value based design	
IS 4.2: Open Innovation for Policy Makers and Managers		
IE4.2.1	TIPPING approach[7]	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Reduce CO_2/GHG emissions using a diverse set of interventions. • Support the growth and power of local businesses by increasing their technical and bureaucratic know-how. • Advance citizens' ability to contribute to and impact policy, including that which relates to energy production and consumption.
IS 4.3: Interoperable, Modular and Interconnected City Ecosystem		
IE4.3.1	City Urban Platform	• Host efficient and smart energy production and consumption practices, while meeting the demands of citizens and companies. • Improve citizens' sense of power over the sustainability of their energy consumption. • Reduce CO2/ GHG emissions using a diverse set of interventions. • Support the growth and power of local businesses by increasing their technical and bureaucratic know-how. • Digitalize all maps to be available to citizens on the municipal website. • Improve citizens' physical living conditions by, for example, refurbishing buildings and/or providing locally rooted mobility options. • Enhance the experience of children and families by, for example, capitalizing on the power of school communities.
IE4.3.2	Wi-fi data acquisition systems	
IE4.3.3	Data lake intelligence for positive communities	
IE4.3.5	Citizen Information Platform	

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		• Increase citizens' sense of belonging to and ownership to their local area. • Advance citizens' ability to contribute to and impact policy, including that which relates to energy production and consumption.

2.4 Challenges & Barriers

The challenges and barriers for implementing the Replication Vision in Hvidovre Fellow City (FC) are discussed in three different sections below: Legal, technical, and financial.

Legal Challenges and Barriers

Many of the legal challenges and barriers related to replicating POCITYF solutions are related to legal challenges facing energy communities. Much of the work completed in POCITYF is affected by these challenges since energy communities are an efficient way to create acceptance for and to involve EU citizens in a green transition. With that being said, there are some IEs which are implemented directly by the municipality, or other stakeholders. Additional legal challenges and barriers related to this work will therefore be expanded upon in the next version of this document.

Principally, it is important to note that the national Danish Energy Agency[8] is performing a so-called minimum implementation of the Renewable Energy Directive II[9] into Danish law. New legislation will take effect on January 1st, 2023, and not only will energy communities be directly mentioned for the first time, but there will also be some economic incentives for energy communities. POCITYF-related initiatives in AGC can be used to showcase, for politicians and the Danish Energy Agency, that energy communities can be an invaluable tool to both take a green transition seriously and involve citizens in the process.

At the moment, however, there are several concrete challenges with Danish energy community-related legislation. The main challenge is related to the taxation of energy when it crosses land register borders. The current taxation rules and rates create a negative incentive for communities and individuals aiming to send energy across land register borders. Communities and individuals, such as energy communities, who are imagining new ways for energy to be generated, stored, and locally used (before interacting with a collective grid) are unduly burdened or prevented from using new technologies or systems. As of recent, the distribution system operators (DSO) have started to see the need for change, given the potential of, for example, energy communities when it comes to grid flexibility, local consumption (reduced load on the collective grid) and local investments. Furthermore, one of main problems with this taxation problem is the influence and interest of the Ministry of Taxation. As mentioned

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above, the Energy Agency is in the process of creating incentives for energy communities in Denmark. Energy taxation, however, is primarily the responsibility of the Ministry of Taxation. Thus, changes to the taxation of energy in Denmark is still a legal barrier.

A second concrete legal challenge to implementing POCITYF solutions is that, per an executive order by the Danish Energy Agency, energy communities in Denmark are neither permitted to own, rent, or lease established segments of the collective grid in a local area (anything 'in front' of the meter). Instead, the collective grid in Denmark is typically owned by the DSO. This makes it very difficult for an energy community to control and monitor a local grid, meaning that the potential that energy communities might otherwise have to create a maximum flexibility grid situation in a local area is, in reality, a huge challenge.

A third concrete challenge for Avedøre Energy Community, and the aims of POCITYF, is both legal and financial in nature. Companies in Denmark are generally able to get a tax deduction if they purchase energy. However, if the energy is purchased from the same land register where there is an energy producing facility, that tax deduction is no longer available. Thereby creating a small economic incentive for companies to be located outside of the land register where the energy is produced.

Fourth and last, it is not all types of stakeholders who are allowed to be a part of energy communities. Specifically, there have been some problems with social housing associations being barred from participating in energy communities, despite being a central stakeholder for an energy community in a specific area. This 'barring' is a result of social housing associations are classified as SMEs and that the financial turnover of SMEs is capped, often below the financial turnover of large social housing organizations. As a note, social housing associations are typically non-profit companies that are owned by the tenants themselves; and there is generally a substantial amount of regulation prohibiting them as a company from doing anything else than taking care of their apartments and administrating the rent of their tenants.

Overall, it should be emphasized that Avedøre Energy Community is the first Danish energy community, and that the legislation is constantly changing to support the integration of energy communities into the Danish context. This presents both a challenge and a huge opportunity for POCITYF to support meaningful change to the Danish legislation on energy.

Technical Challenges and Barriers

Two important technical challenges face Hvidovre FC concerning the operation and expansion of Avedøre Energy Community. These challenges affect the replication of POCITYF solutions, as Avedøre Energy Community is one of the main groups involved in

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implementing the solutions. Technical challenges related to the work of, for example, Hvidovre Municipality in separately implementing POCITYF solutions will be expanded upon in the next version of the Replication Plan.

Real-time data is an essential element of providing flexibility to the collective grid. It allows for real-time monitoring and control of currents within the energy community. However, there is a problem in obtaining the real-time energy data. Without access to the data, Avedøre Energy Community is unable to monitor and have direct control of the grid, and thereby unable to store, produce or sell power at an optimal time, decreasing the rentability. On a positive note, the local DSO has provided Avedøre Energy Community with energy consumption data concerning both heat and electricity in Hvidovre FC's replication area, but it is still a challenge to obtain the energy data in real-time.

The second technical challenge facing the replication plan for Avedøre Energy Community, and Hvidovre FC, is identifying and obtaining equipment and software that can control energy currents in a manner that both creates optimal energy efficiency and a good business case. This technical challenge is related to the legal challenges mentioned above, especially relating to the land register legislation; these legal challenges need to be clarified before any technical equipment or software are purchased.

Financial

The financial challenges and barriers discussed here are related to Avedøre Energy Community, which is a key stakeholder in implementing POCITYF solutions. Additional challenges and barriers will be considered in the next version of the Replication Plan, especially those which are present for the implementation of solutions outside of the framework of AEC.

The vision behind Avedøre Energy Community is to be financially sustainable, making enough money from selling the renewable energy produced to fund future projects to create new sources of renewable energy. Currently, however, there are not enough energy sources, and the community still relies on external funds.

Hvidovre Municipality offers a 'Green City Fund', that institutions, schools, housing organizations, and citizen groups can apply to for funding of 'green' projects in Hvidovre Municipality. Various projects in AGC have already been supported and implemented by using the fund. However, energy communities are not, as of now, permitted to receive money from the 'Green City Fund' because they are categorized as a company.

In the aim to support Avedøre Energy Community, one of the challenges for POCITYF's replication in Hvidovre FC is, therefore, getting enough local, regional, and national

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stakeholders to invest money in concrete and visible energy producing projects in AGC and thereby income for Avedøre Energy Community.

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3 Processes towards the implementation of the RP

3.1 Governance and administrative processes: Planning solutions

For Smart City projects, the same administrative and bureaucratic procedures must be followed as for any other project run by the Municipality. Smart City projects are mostly funded through national co-funded or EU-funded programs, each of which has its own framework and requirements, but typically they are deployed as it is briefly described below.

In order to plan and implement smart city measures in Hvidovre FC, certain administrative and bureaucratic procedures must be followed. The necessity of each of these procedures may vary, depending on the type of smart city measure, e.g., planning and implementing an electric charging station on municipal ground, circular economy building practices by a housing organization, or a tourist app.

During the project planning, the existing architectural, environmental, and other commitments are investigated, and actions are taken to properly issue the required permits (archaeology, environmental assessment and environmental conditions, approval by the forest service, etc.). The Project Manager in collaboration with the responsible supervising Directorates also plans the implementation of all necessary land expropriations/acquisitions for the execution of the project.

The following describes the general processes for planning and implementing smart city measures funded by the municipality. A short description then follows, detailing the considerations which need to be taken for all projects planned and implemented within the municipality, whether they are publicly funded or not.

The planning and implementation of municipally funded smart city initiatives

Hvidovre Municipality's motivations in planning and implementing smart city measures in Hvidovre FC are largely motivated by the climate partnership DK2020. To meet its goal of being CO_2 neutral by 2050 as part of this partnership, Hvidovre Municipality has set a milestone of reducing CO_2 by 80% in 2030 relative to corresponding levels from 1990.

The Municipality has prepared a Climate Action Plan, which it is currently in the process of political approval and public hearing. After the final approval (foreseen in December 2022), the initiatives in the Climate Action Plan will be financed via the municipal budget in the coming years.

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When the budget is set, the projects will be planned, including the final approval and financing of the projects, by means of preparing the following steps/items:

- meeting with the relevant department in the municipality,
- initial description of the project,
- presenting the project to the administration of the municipality,
- preparing the project by the relevant department for a decision in the municipal council (including gaining the approval of documents by the law and economics departments),
- proposing and answering any additional questions, and
- approval by the council.

The planning and implementation of all smart city initiatives

All smart city measures conducted in Hvidovre Municipality must consider and submit to any relevant locally enforced regulations. For one, the Building Regulations[10] - defined by the national Danish Ministry of Transport,[11] Building and Housing[12] - apply to all smart city initiatives that involve the:

- construction of new buildings,
- additions to existing buildings,
- demolition of buildings, and/or
- maintenance or other alterations of existing buildings which have an impact on the energy consumption of the building.

A building permit must be obtained from the local council unless otherwise stated, and the relevant structural engineers and fire consultants must be used. Moreover, all smart city initiatives must take the local plans into account. Local plans regulate the appearance of new and existing construction projects. Local plans for Hvidovre FC, including the replication area, can be found here[13] in Danish.

In addition, the national law concerning energy can be considered of particular importance to planning of smart city measures in Hvidovre FC. In Denmark, energy is regulated by the Act of Electricity Supply[14] and the Act of Electricity Taxes.[15] Important for POCITYF, and a potential barrier for the implementation of smart city measures involving social housing companies, is the fact that electricity consumption from plants over 6 kW can no longer be offset in the collective electricity supply without having to pay taxes.

3.2 Work Groups: supporting the planning processes

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To plan and implement the smart city measures of POCITYF in Hvidovre FC (AGC) as the replication area, both the AGC Steering Committee and the board of Avedøre Energy Community have been heavily involved.

The AGC Steering Committee is made up of stakeholders from local organizations, businesses, and a representative from the municipality. Up until September 2022, the representative from the municipality has been from the Center for Planning and the Environment. The steering committee is also periodically joined by technical experts on energy infrastructure to turn desired smart city measures into concrete projects. Technical experts who have been involved in already implemented projects include Solar Lightning[16] and FlexShape.[17]

The board of Avedøre Energy Community is also made up of local stakeholders, namely, representatives from the three social housing organizations (Avedøre South, Avedøre North, and Store Hus), Avedøre Barracks, Film City, Hvidovre High School, Avedøre Village, Hvidovre Municipality and Avedøre District Heating.

While many of same stakeholders are involved in both workgroups, the concerns of the two differ. AGC is concerned with supporting projects which help the overall sustainable transition of AGC, while Avedøre Energy Community is concerned with supporting projects which help the sustainable energy transition in the area.

3.3 Local Stakeholders engagement

The local stakeholder engagement strategy in Hvidovre FC exists at many levels. For one, the core of local stakeholder engagement in AGC is the empowerment and activation of AGC as an organizational network.

Steering Committee

The AGC Steering Committee meets regularly, holding themed workshops and updating their vision for a sustainable and positive energy district. Meetings are now held bi-monthly, unless otherwise specified. Meeting topics are identified in advance and serve in part to help keep the stakeholders in the Steering Committee updated with rapid developments in the field while also preventing them from being overwhelmed by expert technical information. POCITYF IEs are therefore always presented in a relevant and concrete language for local stakeholders.

It should be noted, that in the next period, there are plans to broaden the group of stakeholders involved in the AGC Steering Committee, and at the same time, strengthen democratic processes in the organization.

Ambassador Network

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Another layer of the stakeholder engagement work is the creation of an AGC Ambassador Network, for which the purpose is two-fold. For one, the network contributes to spreading information about the 'goings on' in AGC and further engaging citizens in the replication area by sharing news on social media, inviting neighbours or friends to events, and participating as volunteer representatives in different circumstances. For another, the AGC Ambassador Network is provided with the opportunity to give inputs to sustainable initiatives in the area, without investing a lot of time. The AGC Ambassador Network has, for now, one working group, the 'Mobility Working Group', and has been acknowledged as an important group for Avedøre Energy Community.

Communication Initiatives

In addition to engagement with stakeholders in the AGC Steering Committee and the AGC Ambassador Network, Hvidovre FC has implemented a variety of initiatives to increase the visibility of POCITYF, AGC, and Avedøre Energy Community more broadly. General descriptions and images of select initiatives can be found in Table 7Table 7.

Table 7: Communication initiatives to further the visibility of the POCITYF Working Group, AGC

Date	AGC Communication Initiative
August 19th 2021	In collaboration with Avedøre Energy Community, AGC hosted an official 'opening' for the EV charging station with a PV roof on August 19th, 2021. Figure 4: Invitation to the official opening of the EV charging station with a PV roof 

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Figure 5: The previous mayor of HM charging a municipal car at the opening

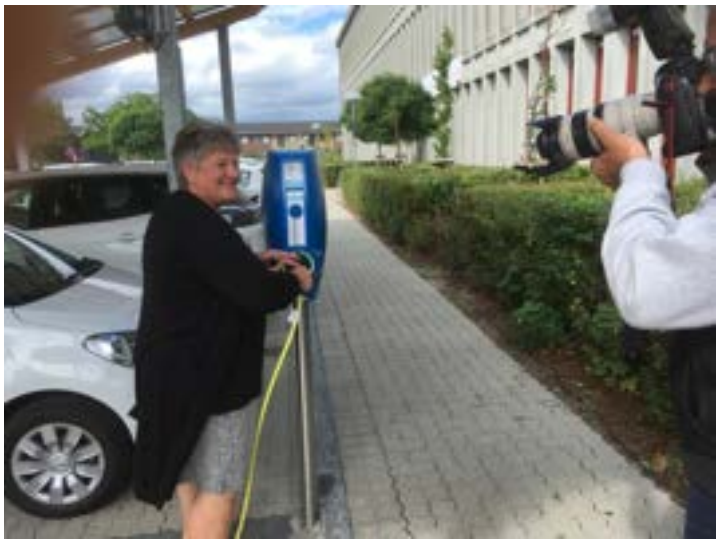

Figure 6: The previous mayor of HM giving a speech at the opening

Figure 7: The previous mayor of HM and the foreperson of AEC/Principal of Hvidovre Gymnasium talking before the opening

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Fall 2021

Figure 8: Flyer created by high school students about the sculpture

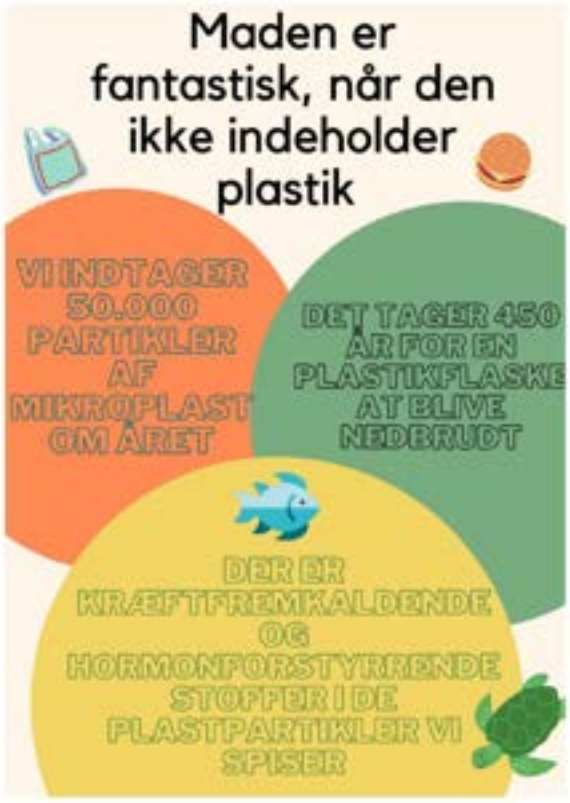

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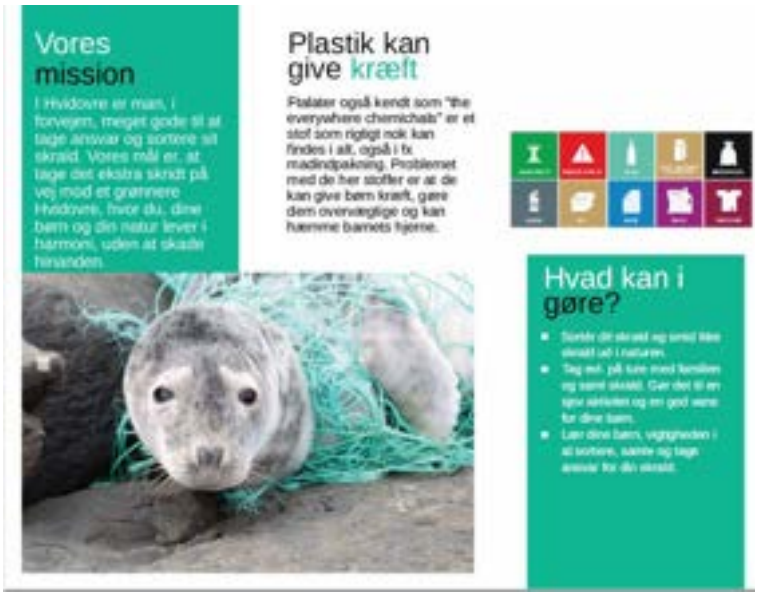
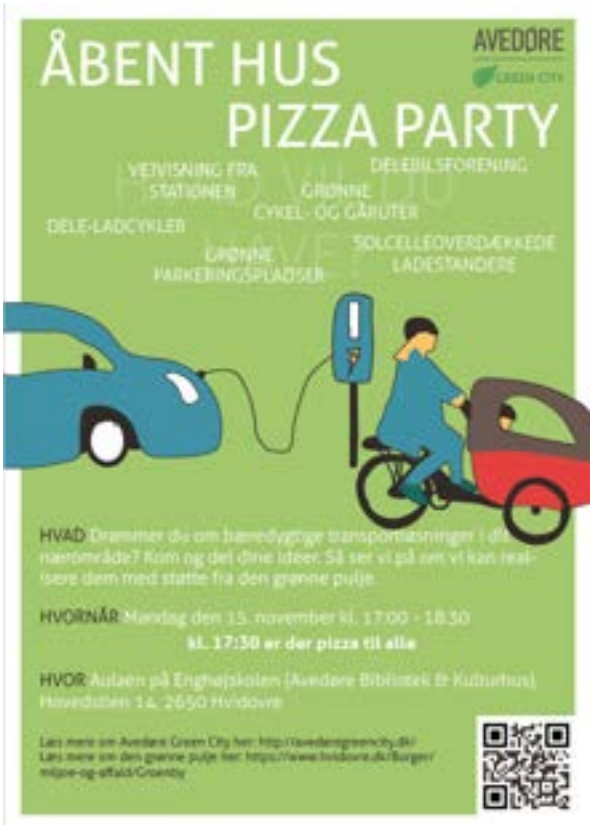
	Figure 9: Flyer created by high school students about the sculpture 
November 15th 2021	In November 2021, AGC offered an open house to citizens where different electric mobility options were presented and discussed. Figure 10: Invitation to the open house 

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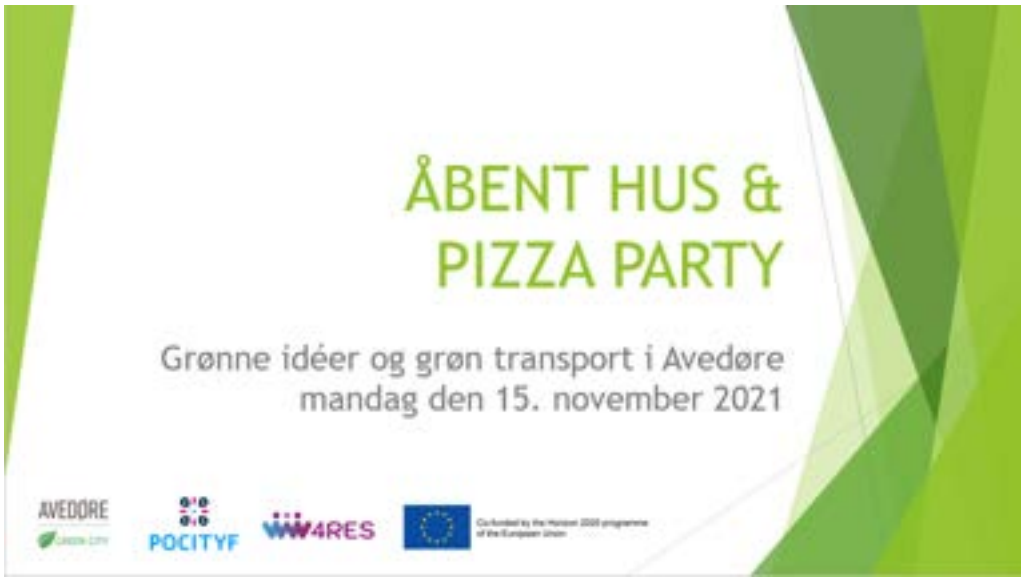
Figure 11: First slide of the presentation presented at the open house



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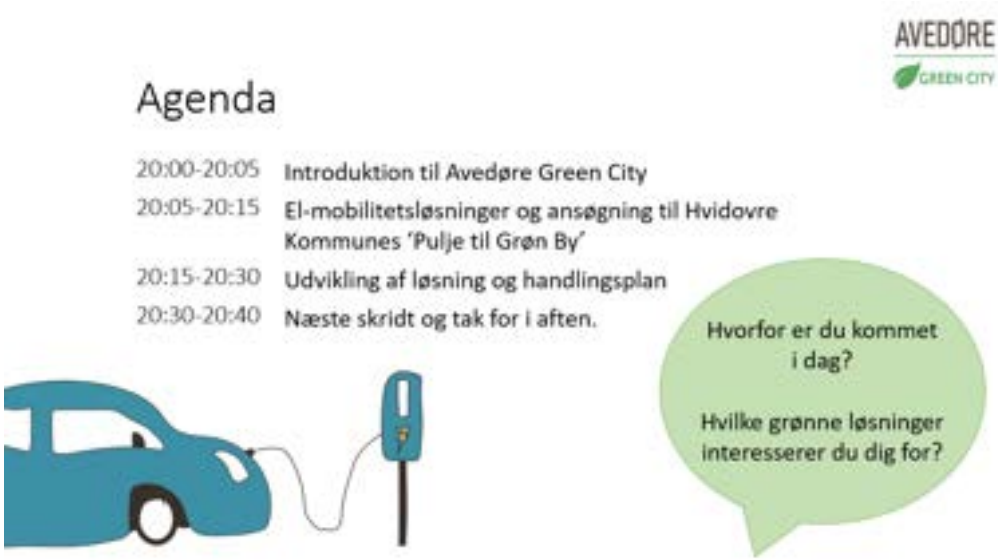
May 17th 2022	In May 2022, AGC offered an online workshop where different mobility initiatives were presented using input from the November 2021 open house. Figure 12: Slide from the open house presentation 

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May – June 2022	In May and June 2022, a treasure hunt was put up throughout Avedøre Stationsby. This treasure hunt provided young families with a fun activity where they could engage with different green mobility questions and send in their inputs.

Figure 13: Example of a question sheet from the treasure hunt

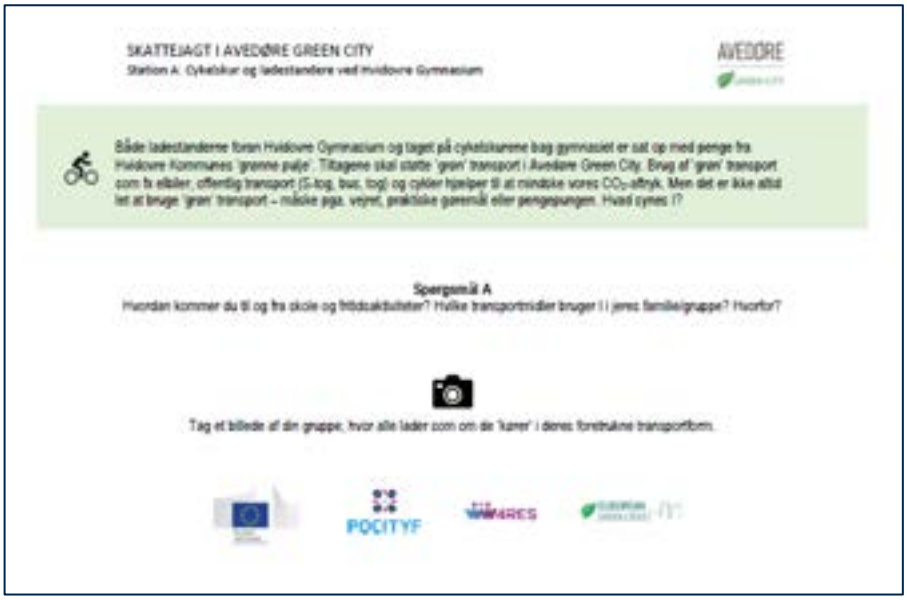
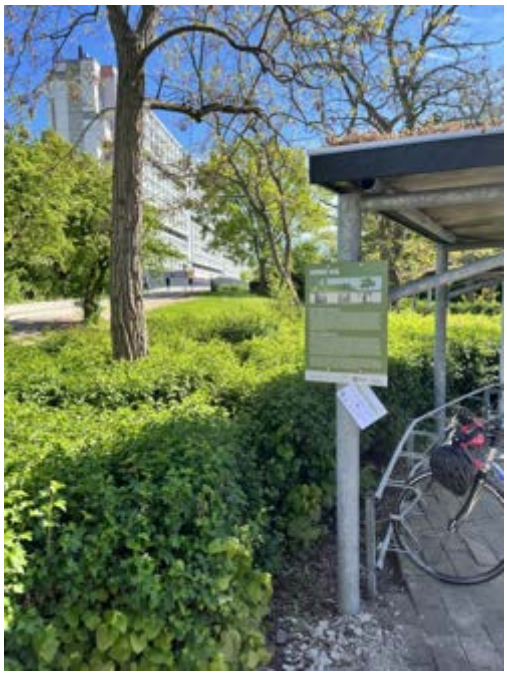


Figure 14: The treasure hunt by Hvidovre High School's bike parking



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 864400.

Figure 15: The treasure hunt by Store Hus

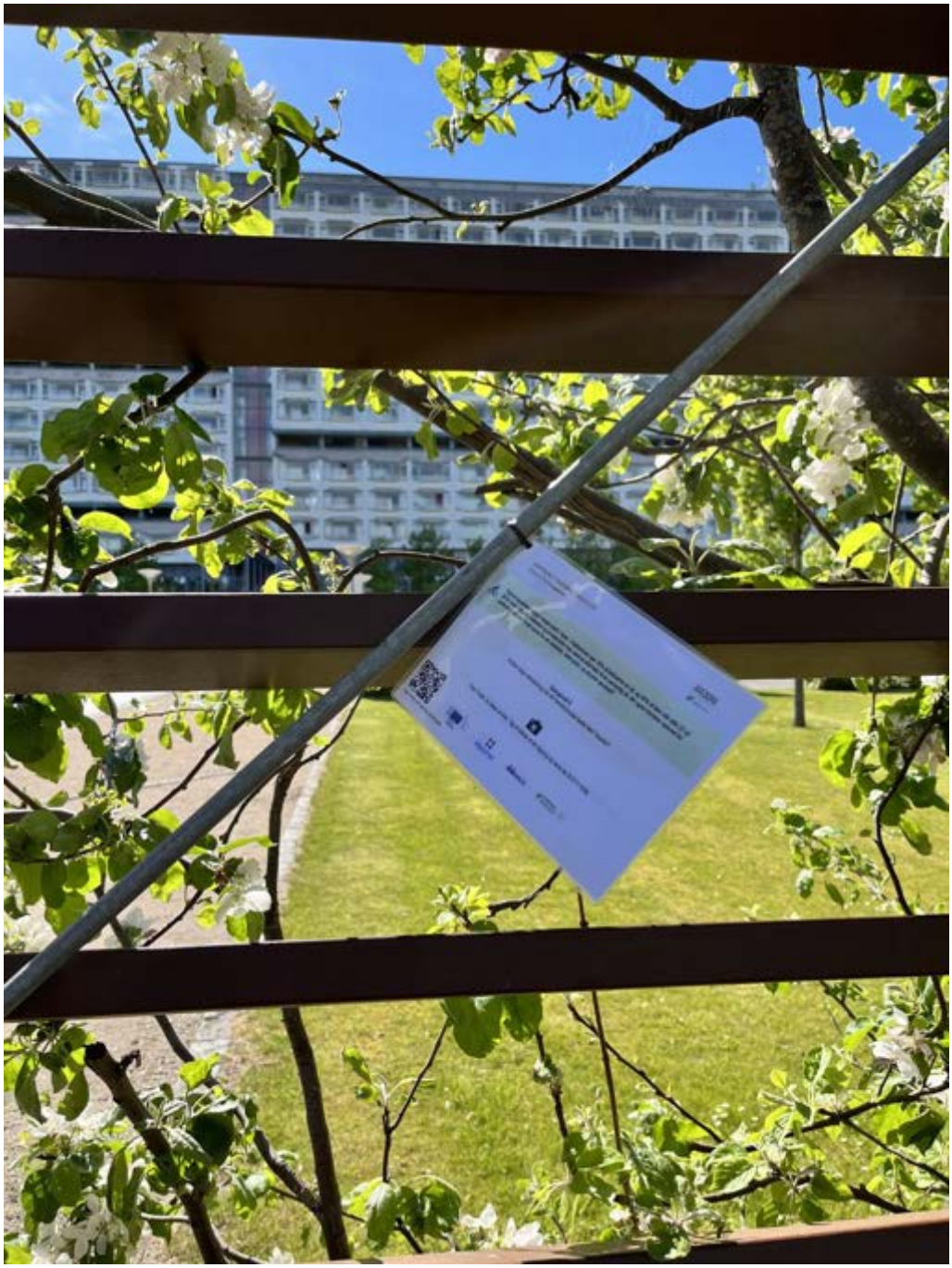


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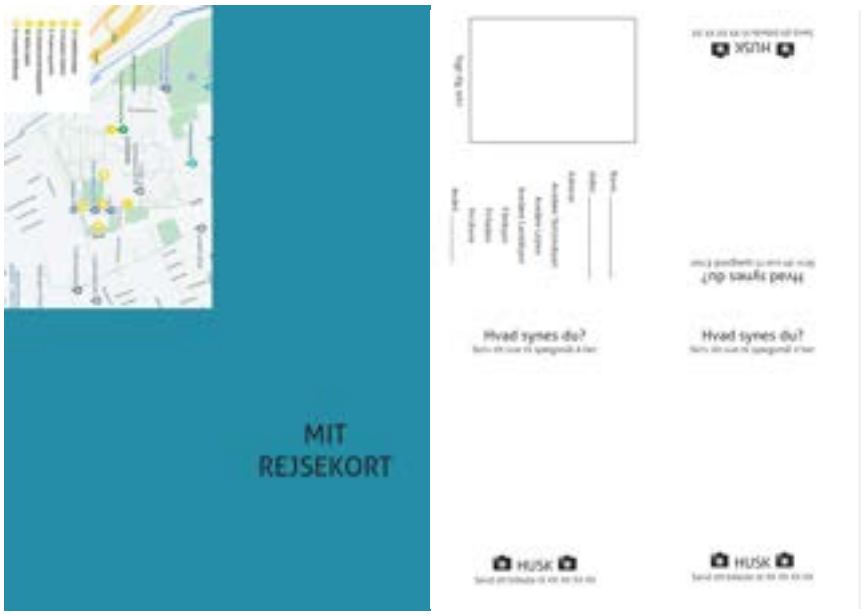
Figure 16: The treasure hunt by some construction, run by Avedøre District Heating

Figure 17: Two pages from a printable Treasure Hunt 'Travel Card'



These initiatives can be seen as an important outer layer of the stakeholder engagement work, both in terms of recruiting more active stakeholders for AGC (Steering Committee and Ambassador Network) and increasing widespread knowledge about and visibility of POCITYF, AGC, and Avedøre Energy Community. These citizen engagement initiatives are seen as very important, because they reflect the idealistic aims of AGC and Avedøre

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Energy Community in the interests of citizens throughout the area and showcase the practical necessities for citizens to 'buy into' (sometimes unattractive) construction projects. More specifics about the different initiatives can be seen in the most recent Citizen Engagement Plan for Hvidovre FC.

3.4 Replication Tools utilization

The utilization of five 'replication tools' is outlined in the following section: Knowledge transfer workshops, factsheets, work groups, questionnaires, and local funding initiatives.

3.4.1 Knowledge transfer workshops

POCITYF's knowledge transfer workshops have been a crucial source of information for Hvidovre FC. They have provided Hvidovre FC with detailed information on how ISs are being implemented in Evora and Alkmaar, as well as best practice regarding legislative and regulatory barriers, training regarding citizen engagement. Additionally, an opportunity to discuss potentials with, for example, energy communities in different contexts.

The knowledge transfer workshops have provided a framework and inspiration for replicating the ISs in a local context. It has provided deep conversations about dos and don'ts with financial, social, and legal perspectives in mind. The conversations and materials provided via the workshops have made it easier to work with local stakeholders and other citizens when it comes to bold decisions and the implementation of ISs in the PED.

Table 8: List of Knowledge Transfer Workshops

Date	Knowledge Transfer Workshop Content
October 26th, 2020	Descriptions of the solutions being worked with in Evora LC were presented and discussed.
March 16th, 2021	Descriptions of the solutions being implemented in Alkmaar LC were presented and discussed, including information about citizen engagement initiatives.
December 20th, 2021	Solutions and best practices were presented and discussed by Evora LC and Alkmaar LH, especially regarding legislative/regulatory barriers and energy communities.
March 16th, 2022	Citizen engagement initiatives were presented and discussed.
TBA	To be determined.

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3.4.2 Fact sheets

The roll-out of the fact sheets started in November 2021; and as of now, not all have been made available to Hvidovre FC. The initial fact sheets, however, have been a valuable tool to communicate the different IEs to the local stakeholders. At an AGC stakeholder meeting in June 2022, selected fact sheets were presented to local stakeholders in a simplified form. And by discussing three fact sheets in detail, it provided the opportunity for local stakeholders to have some fruitful discussions regarding these IEs in their local context.

Further discussions of other selected fact sheets are planned to be completed later. More details will be discussed in the next version of the Replication Plan.

3.4.3 Work Groups

The local stakeholder engagement strategy has been described in Section 3.3. As is described there, AGC as an organization is the 'work group' utilized in the regime of POCITYF. AGC hosts both an Ambassador Group, and a Steering Committee, which meets regularly and makes strategic decisions about what initiatives to invest in. The Ambassador Group is still under development but is steadily being established as an umbrella structure for a variety of different Working Groups with different focus areas. There is currently one active Mobility Working Group, and initial plans for an Educational Institutions Working Group. While the Mobility Working Group are contacted regarding potential mobility projects in AGC, the Educational Institutions Working Group may be contacted to involve children and youths in communication and dissemination efforts. The ultimate hope is that the Ambassador Group as a whole, and the Working Groups underneath, can serve to engage more citizens in local sustainable initiatives than those involved in the AGC Steering Committee.

3.4.4 Questionnaires

Surveys have been used to gather information from both citizens and external stakeholders. Two surveys were sent to external stakeholders, and one questionnaire was sent to citizens.

External stakeholders' survey

The external stakeholders' survey was sent out in February and March 2022 as a further development of a survey carried out in 2020. The goal of the surveys was to identify their perceived level of power and their perceived level of interest about both POCITYF solutions and POCITYF as a whole. The surveys were sent directly to members of the AGC

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Steering Committee, who represent a variety of different stakeholder groups in the replication area.

Unfortunately, there were very few respondents to the surveys. Furthermore, AGC stakeholders communicated that it was difficult and confusing to fill out the survey. Given this 'insider knowledge', Hvidovre FC has not utilized the results of the surveys directly. Instead, focus has been on the discussions during AGC Steering Committee meetings. More detailed results from the surveys will be included in the next RP.

Citizens' survey

A survey for local citizens was developed in December 2021 and sent out to citizens in January 2022. The goal of the citizens' survey was to assess their level of awareness and interest in ten selected IEs.

To incentivize citizens to complete the survey, AGC Steering Committee stakeholders were asked to share it through their communication channels, virtually, e.g., on the municipal Facebook page and physically, e.g., on the local grocery store's message board. A raffle for a gift card of 200 DKK to a local organization of the winner's choice was offered to survey participants.

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Figure 18: Poster used to disseminate POCITYF's citizens' survey

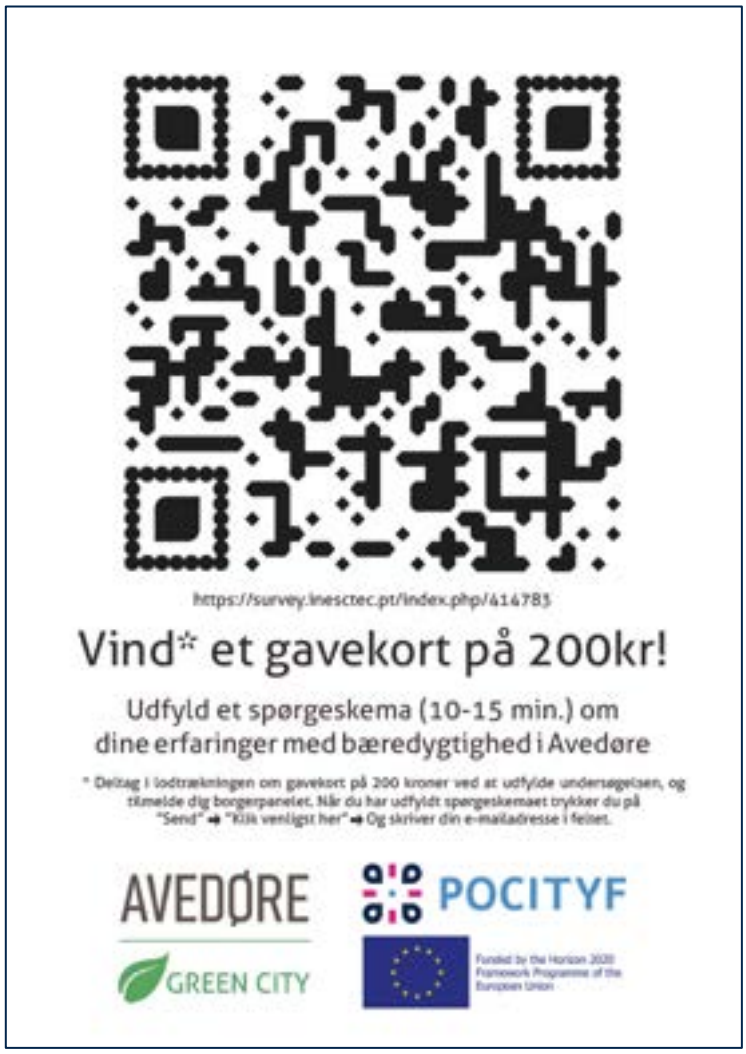

Figure 19: SOME graphic used to disseminate POCITYF's citizens' survey

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The results for the citizens' survey were ultimately higher than that expected by the AGC Steering Committee. The final number of replies for Hvidovre FC can be seen in Table 9.

Table 9: Results from POCITYF citizens' survey, January 2022

City	Partial	Full	Total
Hvidovre	89	48	137

Unfortunately, the citizens' survey still received a fair amount of negative feedback from both local stakeholders on AGC's Steering Committee and other citizens on online platforms (e.g., Hvidovre Municipality's Facebook page). The participants were unhappy with both the format and the questions, and unfortunately found it difficult to complete them. There were, however, two suggestions for future locations of EV charging stations, as a concrete and positive input.

As a result, a concern has been raised by the AGC Steering Committee about the integrity of the project if future similar questionnaires should be required. This fact will be well thought over in the future, as a part of our value-based design. Other results and feedback from the questionnaire have not yet been actively used.

3.5 Integrated Elements: Evaluation criteria and Propagation KPIs

In planning for a successful replication procedure for Hvidovre FC, propagation is an essential element to consider. Propagation is related to both replicability and scalability. In the context of POCITYF's smart city solutions and Hvidovre FC, propagation refers to the ability of these to be replicated and expanded upon. Two indicators are used in this context to assess a successful outcome: Social compatibility and technical compatibility.

Table 10: Propagation KPIs for FCs

Propagation KPIs	Concepts, key aspects, and process behind the variables used for the Propagation KPI	Scope/Objective
Social compatibility	This indicator aims to represent how much the innovative solution is mentally and socially accepted by a given community. This is fundamental for the replication dimension as the acceptance of a community is one the most critical requirement for driving a specific solution on a city.	Evaluate the acceptance response of citizens. This KPI is more contextually related to the replication as it is specifically related to the "forma mentis" (mindset) and traditions.

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Technical compatibility	This indicator represents the degree of compliance with all the technical regulation requirements in place of a given country. Key aspects and elements behind the indicator are the degree of compliance with EU CEI-CENELEC-ETSI regulations as well as the compliance with specific NSB (National Standard Bodies) regulations: Does the solution comply with EU standards? And with specific national technical and legal standards? Although the compliance with EU regulations should be a "must" for the POCITYF ISs., the compliance with NSB regulation may be very specific according to the replication city.	It is important to check if the product specifications are compliant with the regulations and standards of the export country, where the product/service is intended to propagate).

3.5.1 Selection of IEs

Over the first two years of the project, a preliminary analysis of the POCITYF IEs was conducted. The goal of this preliminary analysis was to determine which of the solutions demonstrated in the LHCs should be replicated in Hvidovre FC. The main criteria for this analysis were, as described in Section 4.2.1, the maturity of the technology, the availability of the technology, and the ability of the technology to serve the needs of stakeholders and citizens. This initial analysis ultimately led to both the identification of each IE as either 'surely', 'most probably', 'maybe' or 'interested', and thereby an initial depiction of which solutions are of most interest to Hvidovre FC.

The Citizens' and stakeholders' surveys (described in more detail in Section 3.4.4) utilized a selection of the IEs identified in the preliminary analysis. Initial conversations about the results of these surveys have been conducted internally and with the AGC Steering Committee. A more in-depth analysis of the results, however, is still needed and will be described in the next version of this report. By looking more closely at the results of these surveys, while considering the methodological shortcomings, it is imagined that some of the IEs will be withdrawn, replaced, or added. In other words, the initial categorization from the preliminary analysis is open to adjustment.

With that being said, the results of the Citizens' and stakeholders' surveys are not the only tools which have been, or are planned to be, used in adjusting the preliminary analysis of the IEs. Information from the Knowledge Transfer Workshops, Fact Sheets, and ensuing conversations with the Work Groups has led to the continuous adjustment of this analysis, and the list of interesting and relevant IEs.

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Furthermore, feasibility studies are planned to be carried out in the next phase and will help guide Hvidovre FC in identifying whether and how the selected IEs will support Hvidovre Municipality in its goals as a Smart City. The next version of the Replication Plan is therefore expected to depict a slightly different version of the list of IEs to be replicated.

3.5.2 Evaluating Social Compatibility Propagation

The main strategy for evaluating the social compatibility of the POCITYF IEs in Hvidovre FC's replication area has been through the Work Groups (see Section 3.4.3). Specifically, the AGC Steering Committee has been an essential group with whom to test the interest of different IEs. So far, this 'testing', and gained understanding of social compatibility, has revolved around one IE at a time, as they have become more realisable (e.g., the charging station and the Solar Roof on Hvidovre High School). In this way, it is hoped that stakeholders will continue to engage with the AGC Steering Committee and find motivation to see their voluntary role as worthwhile.

Furthermore, the questionnaires described in Section 3.4.4 were also meant to supplement the knowledge gained from the AGC Steering Committee and provide information about the social compatibility of selected IEs. Unfortunately, however, and as described previously, the results from the questionnaires may not reflect the 'true' social compatibility. There was very negative feedback about the user friendliness of the questionnaires, and it is feared that it was not interpretable enough for the results to be considered as reflective of actual opinions in the replication area.

In the next phase of the project, more systematic feasibility studies are planned to be carried out with the AGC Steering Committee, also assessing the social compatibility of the other IEs for which there is an interest in replicating.

It should also be noted that in order to encourage social compatibility, citizen engagement initiatives have been completed to inform and excite citizens in the replication area. Further information about the citizen engagement initiatives can be found in more detail in Section 3.3. More information about both future feasibility studies and future citizen engagement initiatives will be described in the next version of this document.

3.5.3 Evaluating Technical Compatibility Propagation

The technical compatibility for each IE has not yet been systematically investigated. As described in further detail throughout Section 4.4, future feasibility studies are planned to be performed in the next period. These feasibility studies will include economic and technical considerations and will be completed by the local team with support from the Work Group. The technical considerations planned to be included are described in Section 4.2.1.

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A preliminary study of the legislative requirements and regulatory framework was completed and will be commented upon more thoroughly in the next version of the Replication Plan. Legal and regulatory factors are planned to be considered in future feasibility studies (see Section 4.4), and to be investigated throughout the project.

It should also be noted that in order to be able to replicate the POCITYF IEs, it has been necessary to choose a national product provider and thereby live up to both technical and legal standards in accordance with specific NSBs and EU CEI-CENELEC-ETSI regulations.[18]

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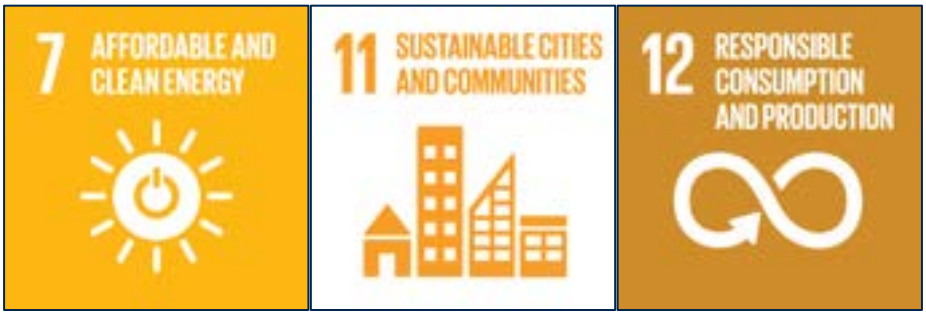
4 Building up the Replication Plan

4.1 Building up the Smart City Vision and Plan

Hvidovre Municipality aims to be both a green, sustainable and a child/family friendly city, while simultaneously hosting a variety of good learning institutions and opportunities for leisure. In recent years, the municipality has focused on pursuing several of the UN's 17 Sustainable Development Goals, including: SDG 7 – Affordable and Clean Energy,[19] SDG 11 – Sustainable Cities and Communities,[20] and SDG 12 – Responsible Consumption and Production.[21]

Figure 20: UN'S SDGs 7, 11 AND 12



As a further commitment, in 2016, Hvidovre Municipality joined the Global Covenant of Mayors.[22] In 2020, the municipality also joined the 'DK2020'[23] climate partnership. DK2020 challenges all the 94 Danish municipalities involved to develop an ambitious climate action plan which lives up to the goals of the Paris Agreement on both mitigation and adaptation fronts. The main goal is to be climate neutral by 2050, though there are other main sector-specific goals such as to have fossil-free electricity, heating sectors and a transport sector. Hvidovre Municipality's main milestone is to reduce greenhouse gas emissions by 80% of 1990 levels in 2030 by targeting activities within the geographical area of Hvidovre Municipality and activities in which the municipality takes part.

Digital and data-based solutions are widely accepted to support these targets. As described above, Denmark is a highly digitalized country, and a nation which has a tradition of producing statistics databases on a national level. In this respect, Hvidovre Municipality is well-disposed to develop a strong and concrete Smart City Vision in the regime of POCITYF.

POCITYF has already served to support the planning and implementation of selected ISs. These concrete initiatives pave the way for further elaboration and execution of other parts of the plan. They have played a significant role in both creating enthusiasm within Hvidovre's political landscape and building strong citizen-driven structures in the replication area.

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POCITYF

4.2 Final selection of IEs to be included in the Replication Plan

The following section consists of three parts, respectively describing 1) the main technical specifications considered when identifying desired IEs, 2) a condensed list of IEs to be replicated in Hvidovre FC, and 3) a list of the planned characteristics considered when evaluating Hvidovre FC as a Smart City.

4.2.1 Definition of the main technical specifications

Identifying relevant IEs to include in Hvidovre FCs Replication Plan has been hugely dependent on the work of the AGC Steering Committee, as well as the input from the board of Avedøre Energy Community's. Features which have been considered essential include (but not limited to):

- The maturity of the present technology,
- the availability of said technology,
- the ability of the technology to serve the needs of stakeholders and citizens.

Furthermore, the features that have been considered important in determining the relevance of a technical solution include (but are not limited to):

- The interest of the stakeholders in AGC's Steering Committee,
- the perceived and measured interest of citizens in AGC,
- the potential for present or future financing,
- the visibility and tangibility of the effect for the community,
- the extent to which citizens can be involved in the implementation of the technology,
- the synergies made with other projects,
- the potential for upscaling.

Other important factors, which are often considered later in the process of developing the specifics of a technological solution include (but not limited to):

- The environmental impact,
- accessibility,
- sourcing of materials,
- labeling and marketing,
- instructions and terminologies.

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POCITYF

4.2.2 List of POCITYF ISs selected to be replicated

A condensed list of the POCITYF ISs selected to be replicated can be found in Section 4.3.1.

4.2.3 Guideline: High-level technical specifications for Hvidovre Smart City

The degree to which Hvidovre FC is, and can become, a Smart City when POCITYF is concluded, should be measurable and defined. The following is a description of the initial thoughts for characteristics and key performance indicators (KPIs) which should be considered and, hopefully, reached when Hvidovre FC continues to work with Smart City solutions after POCITYF has ended. This section will be further developed for the next version of the Replication Plan by involving more specific indicators and drawn-out reflections.

We have identified relevant Smart City KPIs for Hvidovre Municipality, in two documents from Hvidovre Municipality. Firstly, Hvidovre Municipality has published a municipality plan in 2021.[24] The following references to and goals about smart city concepts are described below, translated from Danish:

- "In the aim of creating a fossil-free energy sector, there also needs to be a **smarter** use of energy."
- "Companies and the municipality should have more green and **smarter** mobility planning."

In general, this plan focuses on ways in which the municipality, businesses, and citizens can find synergies in various goals. A 'Smart City' in the context of this plan, can be understood as a city whose solutions are multidisciplinary, resource efficient, and multi-sectoral.

Secondly, Hvidovre Municipality has also produced a digitalization strategy.[25] It outlines nine areas of strategic focus regarding IT and technology, here translated from Danish:

1. Hvidovre Municipality works with the Greater Copenhagen Region in digitalization efforts.
2. Digitalization efforts should also happen in the welfare and service areas.
3. Digitalization efforts should provide citizens with greater access to the municipality.
4. IT security should be a priority.
5. Digitalization should support existing departmental goals.
6. IT systems should be well integrated and understood.
7. The municipal intranet should bring employees together.
8. The municipality should be accessible online.

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9. Digitalization efforts should provide value.

This Digitalization Strategy emphasizes that new solutions should provide value and positive change, and second, bring citizens, municipal employees and work together.

In May 2022 Hvidovre Municipality has introduced a digital community engagement platform: https://deltag.hvidovre.dk/da-DK/ (based on the platform CitizenLab: https://www.citizenlab.co/). It is the first important step to bring citizens closer to the decision processes of the municipality.

Given the context of these plans, and the current work of the municipality, potential KPIs for Smart City technologies could be identified by

- the ability of the technology to improve energy and/or mobility efficiency,
- the ability of the technology to build bridges between the aims of- and improve communication between citizens and the municipality,
- the ability of the technology to show measurable results, and
- the usability of the technology for citizens, businesses, and the municipality – including how easy it is to use, and the need for the service it provides.

The same considerations regarding the interest of stakeholders, potential for financing, upscaling potential, etc. also applies here.

4.3 Designing the replication of ISs

4.3.1 Planning the implementation of the ISs in the Replication Areas

In the process of planning where and how to implement selected ISs, it has been of utmost importance that the ISs are implemented into the urban context and alongside ongoing processes and systems. With the creation of Avedøre Energy Community, this has so far been straightforward, as initiatives have been able to be organized within an organizational context of which local stakeholders are a part. Furthermore, since the replication area is defined as the area to which Avedøre District Heating provides district heating, the interests of Avedøre District Heating are closely aligned with that of AGC, POCITYF, and Avedøre Energy Community. This offers a greater chance for support and collaboration.

The focus is currently on increasing the activity of Avedøre Energy Community itself. As of now, there is a particular potential for a Community Solar Farm, where both local businesses, the high school, the Municipality of Hvidovre, The Avedøre District Heating

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Company and local homeowners are currently looking into investing in PVs together. There are other selected ISs that require more elaborate infrastructure from the energy community (e.g., energy routers, bidirectional inverters) before taking further steps. The possibilities for such elements are yet to be seen, but are eagerly awaited in the context of AGC, Avedøre Energy Community, and POCITYF. The following four tables depict the status and/or plan for each of the IEs which are surely or most probably going to be replicated.

Table 11: Plans for ISs in Hvidovre FC from ETT#1

ETT#1: Innovative Solutions for Positive Energy (CH) Buildings and Districts **Surely // Most probably**			
IS X.X	**IE X.X.X**	**Technology**	**Status/Plan**
IS 1.1	IE1.1.1	PV glass	Avedøre Energy Community (AEC) is interested in using PV glass in two places in AGC: 1. In the entrance hall and hallways of a sports/community center which is in the planning stages between AGC, Hvidovre High School, and the Avedøre District Heating. 2. In the stairways, entrances, and elevator shafts of Store Hus. Construction is planned to take place from 2023-2024.
	IE1.1.2	PV canopy	A PV canopy **has already been replicated** in AGC as part of the project by AEC to build EV charging stations at Hvidovre High School. *This was installed in 2021.*
	IE1.1.6	Bidirectional smart inverters	AEC is interested in using bidirectional smart inverters in future PV canopies, like that replicated over the charging points at Hvidovre High School. Right now, there are no concrete projects, but interested citizen groups who would like charging points by Store Hus. They are trying to find funding. Furthermore, it is the aim that a similar system will be implemented in all places solar panels are installed in AEC.
	IE1.1.7	Energy router	AEC is interested in using energy routers in the grid to get the optimal flow between production and use of energy in the buildings in AGC. It would manage when solar panels should be used and when energy should be purchased from the grid in AEC. There are currently ongoing projects working on expanding and optimizing the DC-grid.

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	IE1.1.9	HEMS/BEMS	AEC is interested in using a HEMS/BEMS system as a management system to optimize the balance between energy production and energy needs for the individual buildings in Avedøre Green City.
	IE1.1.14	Solar roofs and facades	A solar roof is in the process of being planned to be replicated on the roof of • Hvidovre High School • Four buildings in Film City • Three buildings owned by the Municipality of Hvidovre
	IE1.1.17	Li-ion batteries	One or more large central batteries are being established at Avedøre District Heating and in relation to the Avedøre Village. It is the goal to decrease and/or eliminate the need for smaller batteries around Avedøre Green City. The batteries will be owned by Avedøre Energy Community.
IS 1.2	IE1.2.4	P2P Trading Platform	Avedøre Energy Community is interested in having a P2P Trading Platform to create awareness among the citizens in Avedøre Green City that they are part of a larger project that is using and producing green energy. Ideally, citizens in AGC could transfer/donate to a local green development project using this platform and create community while doing so.
	IE1.2.5	Community Solar Farm	Avedøre Energy Community is developing a community solar farm in the PED, Avedøre Green City.
	IE1.2.11	V2G (Smart charging and V2G system connected to energy trading platform)	Avedøre Energy Community is interested in implementing a V2G smart charging system and energy trading platform that all future EV charging points can be connected to. Because of financing barriers, the timeline of installing new charging points is uncertain – so a V2G system is not being prioritized *at this moment*.
IS 1.3	IE1.3.4	Circular economy building practices	The housing organization KAB administers about 60,000 houses and apartments in the capital region, including Avedøre Boligselskab (Store Hus, Avedøre South, and Avedøre North). They have a history of, and are currently, encouraging circular economy principles in the work that is done with their managed housing units.[26] KAB is represented in the AGC Steering Committee, where circular economy is specifically named. Specific projects are yet to be named.

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Table 12: Plans for ISs in Hvidovre FC from ETT#2

ETT#2: P2P Energy Management and Storage Solutions for Grid Flexibility **Surely // Most probably**			
IS X.X	**IE X.X.X**	**Technology**	**Status/plan**
IS 2.1	IE2.1.2	Micro-grid controller platform	Avedøre Energy Community is currently working together with the entrepreneur, FlexShape, on a platform that includes these technologies.
	IE2.1.3	Flexibility control Algorithms	
	IE2.1.6	City Energy Management System	
	IE2.1.10	V2G	The imagined project is the implementation of charging-algorithms for smart-control and smart-charging of e-buses, together with e-sharing between cars and bikes.

Table 13: Plans for ISs in Hvidovre FC from ETT#3

ETT#3: e-Mobility Integration into the Smart Grid & City Planning **Surely // Most probably**			
IS X.X	**IE X.X.X**	**Technology**	**Status/Plan**
IS 3.1	IE3.1.1	EV charging management platform	AURA has entered into an agreement with the 'Organization for Car Repair Shops' regarding the installation of 1000 charging stations. The imagined project is the integration of the same technological platform into all the charging stations that are installed under this agreement.
	IE3.1.2	EV charger prototype with PV integration	Avedøre Energy Community has installed 2x22kWh EV chargers (EV Box Erhverv) with 11.88 kWp solar cell roof in the parking lot at Hvidovre Gymnasium.
	IE3.1.3	Bidirectional smart inverters	
	IE3.1.4	V2G	The imagined project is the implementation of charging-algorithms for smart-control and smart-charging of e-buses, together with e-sharing between cars and bikes.
	IE3.1.5	Smart Lamp posts with EV charging and 5G functionalities	The imagined project is a pilot project in Avedøre Stationsby (a part of AGC) where smart lamp posts

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			provide free Wi-fi, energy to EVs, video surveillance, and LED lighting.
IS 3.2	IE3.2.1	EV sharing	Avedøre Energy Community is invested in increasing the sharing of electric mobility vehicles in the replication area and beyond. The imagined project is the implementation of charging-algorithms for smart-control and smart-charging of e-buses, together with e-sharing between cars and bikes. There have also been conversations about starting a shared-car association. However, research still needs to be done, and finances need to be obtained.
	IE3.2.3	Energy producing noise cancelling screens (previously Solar road)	The architect Mads Lützen has prepared a proposal to utilize and cover the local highway areas with solar energy plants as well as buildings and thus reduce traffic noise.

Table 14: Plans for ISs in Hvidovre FC from ETT#4

ETT#4: Citizen-Driven Innovation in Co-creating Smart City Solutions **Surely // Most probably**			
IS X.X	**IE X.X.X**	**Technology**	**Status/Plan**
IS 4.1	IE4.1.3	Tourist apps	Hvidovre Municipality has created an app, 'Mit Hvidovre' (My Hvidovre),[27] which provides information about cultural and leisure experiences and places in Hvidovre Municipality to citizens and tourists. Users can access a calendar function, view municipal services, access special offers, and create a profile to follow certain types of events. The app is accessible in English and Danish.
	IE4.1.4	Cultural experiences market (mobile app)	
	IE4.1.6	Value based design	Avedøre Green City has been developed with value-based design at its roots. All activities regarding sustainable development projects stem from citizen involvement. We are currently with the AGC Ambassador Group and theme based Working Groups in the area.
IS 4.2	IE4.2.1	TIPPING approach	Hvidovre Municipality runs the online citizens engagement platform Participate Hvidovre[28] using a purchased license to CitizenLab.[29] Citizens can interact with the platform by giving feedback about local sustainable development initiatives and other projects. Citizens can also be inspired by the engagement of other users of the platform.
IS 4.3	IE4.3.5	Citizen Information Platform	

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4.3.2 Social acceptance considerations

The social acceptance of both local citizens and stakeholders is essential to the uptake of Smart City solutions in Hvidovre FC. The previously described citizen engagement structures have therefore been the main strategy to ensure the acceptance of implemented solutions. Moreover, focus has also been on the five Social KPIs in the table below.

Table 15: Social KPIs

Social KPI	Plan/considerations
S1 - People reached	The number of people reached can be measured by: • the number of visitors on the AGC webpage (avedøregreencity.dk), • the number of people who participated in workshops and webinars, and • the number of people involved in both the AGC Steering Group, Ambassador Group, and the working group. Because of a change in webservices, the data is not presently available, but will be included in the next version of the RP.
S2 - Connection to existing cultural heritage	Interviews with the work group members are planned to better understand the considerations made to incorporate the replicated ISs into the existing cultural heritage.
S3 - Local community involvement in the planning and phase	This Social KPI is connected to both the work of the AGC Steering Group, Ambassador Group, and the Working Groups.
S4 - Degree of satisfaction	So far, this has been qualitatively measured through conversations with members of the AGC Steering Group.
S5 - Percentage of citizens' participation in online decision-making	AGC has both a webpage and a newsletter. It has recently been moved to a new server, and data, such as the number of subscribers to the newsletter or people visiting webpage can be measured. It may also be possible to measure citizens' participation on both the 'My Hvidovre' app and 'Participate Hvidovre' online platform, mentioned above.

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4.4 Financial estimation and resources allocation of the RP

4.4.1 Estimation of needed financial resources and economic sustainability of the RP

Since the Replication Plan is still at a preliminary stage, no *systematic* financial calculations have been completed for all considered IEs. But IEs which have been implemented or are in the later processes of being implemented, have had some form of economic and technical studies because of an early engagement of the AGC Steering Committee and Avedøre Energy Community. The economic and technical studies have been the responsibility of the most directly involved stakeholders:

- Avedøre District Heating and EBO Consult for the feasibility studies on the low temperature heat grid (IE2.2.3)
- Hvidovre Municipality for the 'My Hvidovre' app and 'Participate Hvidovre' platform (IE4.1.3, IE4.1.4, IE4.2.1, IE4.3.5)
- European Green Cities for the solar roof on Hvidovre High School (IE1.1.14)

While these studies have been produced ad hoc, it is planned to also perform them systematically for all relevant IEs (e.g., with a PESTEL analysis).[30] A more complete and detailed financial assessment can be expected in the next version of the Replication Plan.

4.4.2 Exploitation of resources from ongoing and planned projects

A variety of projects are ongoing or already planned in AGC whose resources could be exploited to support the implementation of POCITYF solutions. Already mentioned are the two local citizen group 'projects' which have been implemented, in part, with POCITYF support, Avedøre Energy Community and Avedøre Green City.

The municipality of Hvidovre decided in 2019 to launch the Green City Fund (mentioned in Section 2.4) to support local initiatives, mainly within the themes of circular economy, increased biodiversity, sustainable transportation, and the UN SDGs in general.

The fund has paved the way to a more effective engagement of citizen initiatives. Via the fund, several citizen groups from the PED have been able to raise money for their projects – both with and without ISs from POCITYF.

It has been of immense importance that the citizens of Avedøre Green City are able to be shown that their engagement in specific projects have had a concrete outcome. One of the best examples of an inspiring and concrete outcome is the EV charging station at the local high school, now present in the PED with inspiration and support from POCITYF. This lies at the centre of our value-based design, where initiatives often come from citizens, and acted upon with their engagement.

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Two EU projects are also currently running with some degree of focus in AGC:

- W4RES,[31] a 3-year-EU-funded project, which aims at scaling-up the involvement of women in the market deployment and uptake of Renewable Heating and Cooling solutions via replicable support measures tested and validated across 8 European countries.
- ELENA-supported investment programme,[32] called Avedøre Green City, aims at upgrading the existing district heating system, renovating the social housing buildings and more.

Other projects which are currently running or planned to run close by AGC include, but are not limited to:

- district heating to the entire municipality – especially the parts heated by natural gas,
- low temperature and digitalization of the district heating,
- energy check and energy optimization of housing and businesses,
- PV's on the rooftops – especially in the business area Avedøre Holme,
- a library of electrical bikes for the citizens - meant to inspire the transformation from fossil cars to bikes,
- electrical busses for public transportation,
- fossil free vehicles and machinery at the municipality and businesses,
- faster introduction of electrical vehicles with the citizens and employees including more EV charging stations,
- and Green Tech Island[33] - a project to create the biggest industrial site in the Northern Europe and making it sustainable and innovative at the same time.

Both the identification of other exploitable projects and research into how each project can be exploited for the purposes of Hvidovre FC's Replication Plan will be included in the next draft.

4.4.3 Holistic cross-ETT-sectional feasibility study

Discussions regarding the interesting IEs are a continuous part of the AGC Steering Committee and Avedøre Energy Community meetings. IEs which have been implemented or are in the later processes of being implemented, have been through a SWOT-adjacent discussions,[34] often in both the AGC Steering Committee and Avedøre Energy Community. Concrete data is being processed and will be included in the next RP. Like the economic studies mentioned in Section 4.4.1, they have been more ad hoc than systematic. However, it is planned to perform SWOT or PESTEL analysis for all relevant IEs with the stakeholders in AGC on a more systematic level.

4.5 Long-term planning towards a Smart City Vision 2050

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As a project aimed at creating smarter and more sustainable cities, POCITYF aligns well with the Smart City Vision of Hvidovre Municipality. POCITYF has already supported meaningful citizen-driven initiatives, which will have lasting effects for both the replication area and Hvidovre Municipality. If POCITYF is to be successful in setting up more IEs in the replication area and support further social/institutional adoption, Hvidovre FC's team will need to improve on the following before the next phase of the replication plan:

- Increase the people reached.
- Expand the network of actors (i.e., reach more organizations in the replication area and increase number of democratic processes).
- Utilize current platforms in AGC and Hvidovre Municipality for strategic communication and dissemination.
- Expand upon communication and dissemination platforms in AGC and Hvidovre Municipality (e.g., the Ambassador Group).
- Find further synergies between POCITYF and Hvidovre Municipality (i.e., practices, solutions, departments, institutions).
- Secure financial resources and momentum to ensure the project's economic sustainability.

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5 Conclusions

This document is the first version of Hvidovre's Replication Plan and City Vision for 2050. The aim is to present the work that Hvidovre FC has completed in the context of POCITYF by September 2022. This document will be updated and published in its final form in September 2024.

The work done in defining the city framework in conjunction with smart city indicators, lays a clear groundwork for creating a plan and identifying IEs which will contribute to the goals of Hvidovre Municipality as a whole. But more work needs to be done in identifying potential areas of synergy within Hvidovre Municipality, as an organization and a geographical area.

A clear strength of the work completed so far in Hvidovre FC is the process of engaging local stakeholders. The AGC Steering Committee, Ambassador Group, Working Groups, and communication in general, creates four different modes of engagement - allowing citizens of all interest levels to get involved in the POCITYF project. Especially the AGC Steering Committee is essential to a sustainability path towards a smart city, also after POCITYF has terminated. Efforts to expand and optimize the level of citizen engagement are planned, and any results will be published in the second version of the Replication Plan.

From early on, Hvidovre FC had a strong collaboration with local stakeholders, which has resulted in a fruitful and well-founded collaboration. But it also means, that many of the initial considerations about the implementation of interesting IEs have not been systematically discussed. As a result, we now plan to integrate systematic feasibility studies earlier in the process, when working with new IEs. In combination with a more detailed description of exploitation possibilities and further studies to assist the financial sustainability of a Smart City Plan, these feasibility studies should serve as a strong tool for the AGC Working Group and Hvidovre FC as a whole.

Overall, Hvidovre FC has been successful in both setting up processes and structures to support the long-term role out of the IEs and starting to implement some of the IEs. It will be exciting to expand upon the work already completed for the next version of the Replication Plan.

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