



POCITYF

D8.7 Bari Replication Plans and City-Vision for 2050

WP8: Replication Plans and 2050 Vision by Fellow Cities

T8.7: Bari Replication Plans and City-Vision for 2050

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Executive Summary

This document presents the work done so far by the Municipality of Bari in the POCITYF project, divided into chapters that retrace the work phases, the in-depth analyzes and the choices made. The analysis begins with an initial evaluation of the current situation of the city of Bari, its requirements and needs in terms of energy reduction and actions to be performed towards its Smart City Vision 2050. The document continues with a description of all the activities and resources used and exploited thanks to the work carried out in the project, to enrich its know-how and deepen its knowledge about tools and methods potentially useful to be applied also to the context of Bari. Then, the focus is put on the Replication areas selected for the project, and all the related studies and activities carried out until this phase of the project to evaluate the replication potential of the chosen technical solutions if applied to the selected areas.

Work is underway and an action plan and possible strategies to be proposed and implemented in the municipality of Bari are being configured to address the energy crisis, but also the ecological transition. The municipality of Bari is about to join the SECAP and intends to draw up a plan on a metropolitan scale involving the 41 municipalities in a co-design. The SECAP (former SEAP - Sustainable Energy Action Plan) is a document drawn up by the municipalities that sign the Covenant of Mayors for the ways in which the administration intends to achieve the objectives of reducing CO2 emissions.

The POCITYF project is an opportunity for the municipality of Bari to get to know different realities with different constraints, habits and inclinations that have contributed to recognizing an identity, but also a community of intent.

The common goal for the municipalities of the metropolitan city of Bari will be the reduction of CO2 by 55% by 2030 and climate neutrality by 2050. The experiences gained and lessons learned throughout the project will be crucial for the Municipality to improve its current ongoing projects and to plan the activities and initiatives to be performed in the future to meet its objectives described in its Smart City Vision 2050.



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Abbreviations and Acronyms (in alphabetical order)

Abbreviation	Definition
ARCA	Regional Agency for Home and Living
BRT	Bus Rapid Transport
ETTs	Energy Transition Tecnology
FC	Fellow City
ICT	Information and communications technology
LHC	Lighthouse City
MAAS	Mobility as a service
PAYT	Pay-As-You-Throw
PCM	Phase-change Material
PED	Positive Energy District
PPTR	Piano Paesaggistico Territoriale Regionale
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
SECAP	Sustainable Energy and Climate Action Plan
SDG	Sustainable Development Goal
SME	Small and Medium sized Enterprise
VPP	Virtual Power Plant
V2G	Vehicle-to-Grid
WP	Work package



1 Introduction

This document aims to describe the construction process of the replication plan carried out within the POCITYF project funded by the EU Horizon 2020 concerning Smart Cities and Communities. Deliverable 8.7 consists of the detailed description of the replication actions envisaged in the city of Bari divided into ETTs.

The project aims to address the energy transition by fueling and improving the quality of buildings and creating positive energy districts in two lighthouse cities (LC), Évora (Portugal) and Alkmaar (Netherlands) and in six Fellow Cities (FC), Granada (Spain), Bari (Italy), Celje (Slovenia), Újpest (Hungary), Ioannina (Greece) and Hvidovre (Denmark). The POCITYF project born in 2019 immediately identified ten integrated solutions (IS), composed of 73 innovative elements (IE), each corresponding to a technology, a tool or a method. As part of the project, four energy transition paths (ETTs) have been identified to understand the 10 IS and therefore the 73 IEs.

Each of the 73 IEs classified within the four ETTs has been tested in the two LCs and will be partially replicated in the FCs. WP8 is dedicated precisely to the description of the IE replication plan in FCs. The main objectives of WP8 are: to demonstrate the possibility of implementing IE at both the building and district level, creating energy-positive districts and allowing greater self-consumption of energy, and demonstrating the possibility of obtaining energy savings and an increasingly higher share of renewable energy produced locally.

Furthermore, it will be possible to demonstrate services and solutions for the active involvement of citizens that contribute to an ecosystem of innovation that allows citizens to participate in co-design, decision-making, planning and problem solving within smart cities. Within the replication plan it is possible to test business models and investment concepts already used in LHCs, which consider the entire life cycle of the Positive Energy District (PED), and also develop feasibility studies and business plans for IEs, as well as implementing the IEs together with the other FCs so that they are ready for the market through the involvement of local stakeholders by the end of the project, and finally identify any legal and/or regulatory obstacles, security/data protection issues and test the proposed solutions to such obstacles.

This deliverable is structured in five sections. The first describes in general the theme of the document, the basic information and the objectives, the second offers a framework and an overview of the activities present in the Municipality of Bari as FC, and presents the areas of the Municipality of Bari that have been identified as a replication area, selecting the IEs that Bari FC intends to replicate and justifying their reasons and defining the challenges and obstacles foreseen for the consequent replication activities. The third section describes the governance and administrative processes related to the planning of replication activities, the organization of the internal working groups involved in planning the replication activities and the local stakeholders involved. Additionally, this section describes the IEs chosen to be replicated and the processes that led to the selection of these IEs for replication in Bari FC. Finally, Section 4 provides a final summary of solution implementation planning, final selection of IEs to replicate, and replication project. The financial aspects of the implementation of the Replication Plan are partially addressed.



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



2 Benchmark Framework

2.1 General description of the city

Bari is an Italian city located on the Adriatic Sea, it is the capital of the Puglia region and the capital of its Metropolitan Area. It is the second most important economic center of the mainland of southern Italy after Naples, and is known for its port and as a university city, as well as for the city of San Nicola. The city itself has a population of approximately 324,198 inhabitants, in 2022, on 117 square kilometers, while the rapidly growing urban area has 653,028 inhabitants on 203 square kilometers. The Metropolitan Area has about 1 million inhabitants and 41 municipalities. Modern residential areas surround the center of Bari, the result of the disorderly development of the 1960s and 1970s that replaced the old suburbs that had developed along roads extending outward from the gates of the city walls. Furthermore, the outer suburbs developed rapidly in the 1990s. The city has a redeveloped airport named after Pope John Paul II, the Karol Wojtyła airport, with connections to several European cities.

In its vision of smart city, the municipality of Bari wants to be a green, sustainable and accessible city for all, a hospitable city in which to study, work and create numerous opportunities for free time.





Figure 1 Overview of the historic center

In pursuit of these goals, in recent years the municipality has focused on six of the 17 UN Sustainable Development Goals [33]: SDG 7 - Affordable and clean energy, SDG 8 - Decent work and economic growth, SDG 9 - Businesses, innovation and infrastructure, SDG 11 - Sustainable cities and communities and SDG 12 - Responsible consumption and production, SDG 13 - Fight against climate change. As a further commitment, in 2011, the municipality of Bari joined the Global Covenant of Mayors [34] by committing to reduce its greenhouse gas emissions by 20%. The main goal for is to be climate neutral by 2050, although there are other major sectoral goals such as having all electricity and heating sectors free of fossil fuels by 2035 and a fossil fuel free transport sector by 2050. Below is a description of the current status of the municipality of Bari as a smart city in terms of energy, environment, mobility/transport, economy, mobility, ICT (Information and communications technology), social situations and governance.

Bari has as general objectives for 2050 the 5% reduction of emissions for public buildings,



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a 30% reduction in polluting vehicles and incentives to use electric and non-polluting vehicles, the creation of smart grids in the less efficient neighborhoods of the city, the protection and restoration of ecosystems through urban reforestation, the use of permeable and photosensitive materials, the accumulation and reuse of solar energy to power all the twilight lighting systems the increase in door-to-door separate waste collection with a drastic reduction in the amount of waste to be disposed of through educational and incentive policies, involvement and sharing in all choices regarding energy in order to educate citizens about energy saving.



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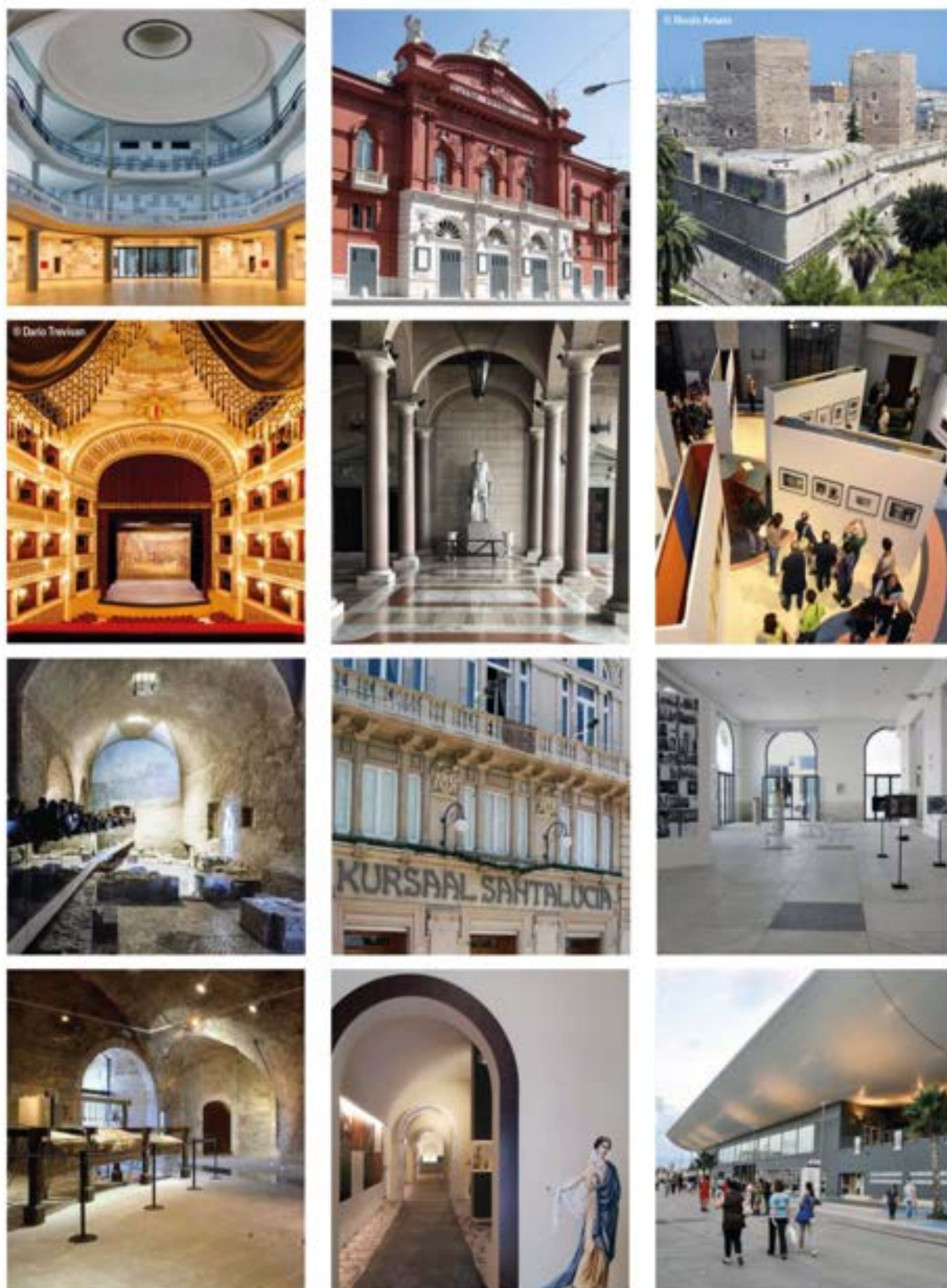


Figure 2 The representative places of the city



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In the Table 1 below we have summarized the state of smart city indicators (energy, environment, mobility/transport, economic, ICT, social and governance) and our vision by topic in view of the ecological transition and awareness of the ongoing climate change.

Table 1 Current state and Bari vision of the smart city indicators

Smart City Indicator	Status Current planning status	Vision Projects in progress
Energy	The municipality of Bari has a number of active sustainable energy initiatives. The following list outlines the status of some of these initiatives: - Solar panels are used in main public buildings such as schools and hospitals in the municipality of Bari and many private companies also use photovoltaic panels. - At the Policlinico di Bari, a 903 kwe vegetable oil trigeneration plant with a 1.2mw absorber was built, the redevelopment of the electrical distribution system and MV / LV cabins, the construction of a new refrigeration plant, the construction of photovoltaic systems, the completion of the monitoring system and installation of a new bus network with supervision of the fire protection network power system, the installation of active and passive recuperators on the AHUs and replacement of AHUs, the redevelopment of thermal substations and primary distribution system. -Another example is the Bari airport which has the following technical characteristics - Installed power of the photovoltaic system: 196.77 kW - Surface occupied on the roofs of the terminal: 1200.8 m² - Number of 210W photovoltaic panels used: 937 - Inclination of the panels on the horizontal: 27 °	• Host efficient and intelligent energy production and consumption practices, while meeting the needs of citizens and businesses. • Reduce CO2 emissions from publicly owned buildings by 5%. • Eliminate the use of oil and fossil fuels in heating. • Imagine an experimental district heating network and offer the possibility of connecting the buildings that want to join the energy pact to the district heating network. • Increase the share of renewable energy sources in the energy mix. • Improve citizens' sense of power over the sustainability of their energy consumption. • Achieve a fossil fuel-free electricity and heat supply by 2035. • Support energy efficiency projects such as low temperature district heating systems, groundwater storage, heat pumps.



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	- Orientation of the panels: -12 ° SOUTH - Annual production of electricity: 270,000 kWh - Fuel oil not burned in one year (estimate): 62,000 kg - Carbon dioxide (CO2) not released into the atmosphere in one year (estimate): 143,000 kg - There is currently no plan to regulate the overall storage of electricity - Throughout Italy, smart meters are being implemented for all families, this should affect reducing peaks in energy consumption. - An anaerobic digestion plant is also being built at the AMIU headquarters on a mandate from the Territorial Agency of the Puglia Region under the 2014-2020 POR PUGLIA. - The composting plant under construction will allow the treatment of household organic waste deriving from the separate collection of the organic fraction from households and commercial users through a process that takes the name of anaerobic digestion, as it takes place without the use of oxygen. - Studies are also underway for the construction of the new "Torre del Diavolo" sewage lifting system (ISF), which will be built in Torre Carnosa, on the southern seafront of Bari.	
Environment	According to Arpa (Regional Agency for the Prevention and Protection of the Environment), the average air quality in the area of the city of Bari is "very good" and the values are all below the threshold identified by the Ministry of the Environment. Emissions that are of particular concern include air pollution from stoves, traffic and shipping, noise pollution from traffic, and pollution from food	• Reduce CO2 emissions using a diversified series of interventions. • Improve air quality by reducing transport emissions, including, but not limited to, increasing the number of bike sharing and car sharing projects, increasing electric mobility actions, improving walking experiences (pedibus for schools) and by bicycle and incentives in the use of



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	waste, electronic waste, and shipping waste. The municipality of Bari provides information on the values on the municipal website.	electric car sharing and in the use of non-polluting means to reach cultural places (biketoart project) as well as kilometeric reimbursement for those who make home-work trips by bicycle (pinbike project).
Mobility/Transport	• The Municipality of Bari has many completed and ongoing projects related to transport and mobility. In particular, the metropolitan city of Bari adopted the PUMS (urban plan for sustainable mobility) in August 2021. • Among the various projects, the metropolitan cycle network is currently being built in batches and has recently been approved by the metropolitan council. • On the trains you can bring your own bicycle for free. A decarbonisation of public transport is underway • Furthermore, the executive design is underway for the BRT (Bus Rapid Transit) in Bari which will consist of 4 lines of fast electric buses that will connect the city from north to south and from east to west. • A downgrading of the Bari ring road SS16 is also foreseen, which will be a new median of the cycle connection and two super-tracks are also planned: Bari-Modugno and Bari-Santeramo. At the moment there are no active velostations but the reactivation of the existing one at the central station is planned and the design of new velostations for sharing vehicles in various strategic points of the city such as	• Increase the number of electric vehicles in the city, electric cars in the municipality's car park and of e-bikes and electric scooters~. • Reduce energy consumption in transport. • Work on involving citizens and their mobility choices based on sustainability. • Design an infrastructure for electric vehicles by increasing the number of charging stations for electric vehicles. • Increase the km of cycle paths and their quality, safety and comfort. • Supporting bike sharing and car sharing projects and velostations in the city.



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	park & ride or university centers (Primus Project) the administration is working to increase the presence of electricity columns throughout the urban area.	
Economic	Over the last few years, the municipality of Bari has acquired a series of loans that have enabled the implementation of a strategy that aims at an urban regeneration of the waterfront and the suburbs not only from an urban point of view, but also from a social and economic point of view. Furthermore, social housing constitutes a considerable percentage of the housing stock which is being increased with ever higher standards of efficiency. The training bodies present in public and private cities also participate in this transformation process and collaborate with a view to researching and facilitating processes at the urban level.	• To improve the possibility of access to more sustainable forms of transport for all citizens. • Activate mechanisms to encourage the use of sustainable vehicles even for citizens with low incomes (Pin bike). • Implement policies to limit the costs of public transport and the purchase of sustainable means (state incentives for sustainable mobility). • Promote the growth of local companies by supporting training courses to allow them to face and learn about administrative procedures and provide technical knowledge useful for the evolution of the territory. • Facilitate companies working in the field of sustainable mobility through incentives. Encourage proposals for citizens to adopt and manage green spaces by citizens. • (Creative Regeneration Project). • Encourage greening and urban forestry projects (Bosco Sociale di Loseto) that involve citizens in planning and management.
ICT	The municipality of Bari has been working a lot in recent years on technological innovation, giving citizens the possibility of accessing a series of services through the SPID (digital identity). In addition, the Municipality has developed an app dedicated to Mobility that allows citizens to find their way around and choose which means to use and buy travel tickets online or pay for parking their car. In addition, the Municipality has also developed an app to solve widespread critical	• Increase a fiber network in the municipality of Bari with fast Internet. • Digitize all maps so that they can be made available to citizens on the municipal egov site. • Make available on the M.U.S.I.C.A. the data collected.



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	issues in the city that can be reported directly by citizens (App Barisolve). In addition, the BariPartecipa platform was also developed which allows citizens to keep up to date on ongoing projects and propose new ones.	
Social	The quality of life in the city of Bari is on average good. The welfare system is well integrated and works in the municipalities, giving support to the most critical situations.	• Improve the physical living conditions of citizens by providing sustainable mobility options - Strengthen the economic power of citizens by giving the opportunity to participate in public life by proposing social projects (Progetto Ortodomigo) - Improve the experience of children and families by creating a network of school communities. • Support the growth and power of local businesses by networking them. • Support green projects managed and proposed by citizens.
Governance	Participatory processes and citizen-led initiatives play an important role in municipal policy. The development of the BariPartecipa Platform will make it easier to update on the status of projects in the city and on the possibilities and will also allow citizens to make concrete proposals for new projects.	• Make citizens aware and proud of belonging to a territory. • Support citizens in their choices regarding mobility and energy sources. • Facilitate the participation of citizens in political life and make them aware of the possibility of influencing decisions which concern the production and consumption of energy.

2.2 Defined Replication Areas

The replication areas in the municipality of Bari are the area of the historic center which includes numerous public buildings of extreme artistic and cultural value, the area of San Cataldo and Fiera del Levante, which constitutes another historical core of the city and which is currently the district where the greatest number of technological experiments take place, in addition of course to the Polytechnic pole, and finally the San Girolamo area with its new waterfront which requires redevelopment of the existing public housing.



The Fiera del Levante area lends itself as a place to meet and compare with other entrepreneurial realities and with technical interlocutors who can give further suggestions to the project.

In this period, much more than at other times, estimating the cost of energy is essential and reducing consumption as much as possible and providing information to citizens on how to save on energy.

The main objectives that the Municipality of Bari proposes are:

1. To install more energy solutions in the area, including those related to reducing consumption, increasing self-consumption and increasing renewable energy;
2. Promote the development of legislation that creates opportunities and good business cases;
3. Involve more people in the project to create positive energy communities.

This is a challenge and a huge opportunity to imagine energy independence.

2.3 Envisioned Replication Area and city needs towards Smart City

Below are the technological solutions from the municipality of Bari

ETT1
Surely // Most probably // Maybe

Table 2 Innovative Elements (technologies) chosen and description of the reasons

IS- 1.1		
	Technology	Motivation
IE1.1.1	PV glass	The Municipality of Bari is interested in using photovoltaic glass in the energy requalification of the buildings in the replica areas.
IE1.1.2	PV canopy	The municipality of Bari is interested in the replication of the photovoltaic canopy for charging stations for electric vehicles that could be integrated into the PRIMUS project which plans to place some mixed stations for bike sharing and scooter sharing in some strategic points. Furthermore, the Municipality of Bari has recently activated the possibility of using the car sharing service.
IE1.1.3	PV Skylight	The municipality is interested in experimenting with the PV Skylight solution in public buildings and residential building renovations. The idea is to illuminate previously dark spaces such as stairwells, service compartments and internal connecting paths to buildings.



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IS- 1.2		
	Technology	Project
IE1.2.1	Smart Lamp posts with EV charging and 5G functionalities	The municipality of Bari is replacing traditional lamps with smart lamps, the goal is to use them for all projects under construction, and to achieve total replacement by 2030.
IE1.2.10	Solar screen (previously Solar Roads)	The Municipality of Bari is interested in carrying out solar road experiments in new park projects and for the maintenance of public spaces.
IE1.2.11	V2G (Smart charging and V2G system connected to energy trading platform)	The municipality of Bari is interested in experimenting with this type of system in the Fiera del Levante area.

IS- 1.3		
	Technology	Project
IE1.3.2	PAYT	The Municipality of Bari is interested in experimenting with this type of incentive method to allow citizens to understand how important the reduction of the quantity of waste produced can be.
IE1.3.4	Circular economy building practices	The municipality of Bari is included in some food policy circuits to trigger virtuous processes for the recovery of foodstuffs and the fight against waste. In addition, the administration has carried out some important projects over the years, including the organic school canteen, the Bari Social Food program to combat food waste, policies on urban and educational gardens (Creative Regeneration and Educational Gardens) and solidarity measures on social food distribution.

ETT2

Surely // Most probably // Maybe

IS- 2.1		
	Technology	Motivation
IE2.1.2	Micro-grid controller platform	The municipality of Bari is interested in an experimentation on the Microgrid controller, in particular the tests can be carried out in the presence of new parking areas covered with photovoltaic panels whose energy can be used to power the lighting and the electric charging columns for cars and bicycles.
IE2.1.6	City Energy Management System	The municipality is collecting a series of data through the MUSICA portal that may be useful for managing the control of energy dispersions starting from public buildings and subsequently requesting the sharing of data to citizens.

ETT3

Surely // Most probably // Maybe



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IS- 3.1		
IE X.X.X	Technology	Motivation
IE3.1.1	EV charging management platform	Enel x has entered into an agreement with the Municipality of Bari for the installation of electric columns for car recharging. There are currently 25 charging points which will be implemented up to 50.
IE3.1.5	Smart Lamp posts with EV charging and 5G functionalities	The municipality envisions being able to use smart street lights in upcoming projects that can provide free Wi-Fi, power to electric vehicles, video surveillance and LED lighting.

IS- 3.2		
	Technology	Project
IE3.2.1	EV sharing	The Municipality of Bari is investing in increasing the sharing of electric mobility vehicles in the replica area and beyond. The imagined project concerns the implementation of charging stations for intelligent control and intelligent charging of e-buses, together with e-sharing between cars and bicycles.
IE3.2.3	Energy producing noise cancelling screens (previously Solar road)	The municipality of Bari intends to experiment with solar road in future projects.

ETT4

Surely // Most probably // Maybe

IS- 4.1		
IE X.X.X	Technology	Motivation
IE4.1.1	Digital transformation in Social Innovation	The municipality of Bari is working hard on social innovation by providing citizens with participation tools.
IE4.1.3	Tourist apps	The Municipality of Bari is implementing Bari Guest Card which is the tourist app of the city.
IE4.1.4	Cultural experiences market (mobile app)	The municipality of Bari would like to implement apps for the cultural market experience.
IE4.1.5	Mobile apps on energy consumption	The municipality of Bari would like to experiment with the possibility of launching an app for controlling energy consumption.

IS- 4.3		
	Technology	Motivation
IE4.3.1	City Urban Platform	The municipality has developed a platform for citizens to participate proactively.



IE4.3.2	Wi-fi data acquisition systems	The municipality is working to increase the areas where free wi-fi is available.
IE4.3.5	Citizen Information Platform	The municipality is working on the implementation of information functionalities within the platform.
IE4.3.6	Data acquisition systems	The municipality is interested in creating a data acquisition system to be related.
IE4.3.7	City Data Hub	The municipality is interested in the construction of a City Hub.

2.4 Challenges & Barriers

Bari has the opportunity through the Pocityf project to take a step forward to achieve a horizon towards the energy sustainability of buildings.

For a correct legislative framework, reference was made to the legislation that regulates energy communities in Italy.

In 2019, the European Union concluded the approval of the legislative package "Clean energy for all Europeans" (CEP - Clean Energy Package) [1], consisting of eight Directives that regulated issues energy, including: energy performance in buildings, energy efficiency, renewable energy, market electric.

The EU directives, established by the CEP [1], seek to put in place adequate legal frameworks to enable energy transition and giving a leading role to citizens in the energy sector. The directives should be followed by national laws on the respective issues. The deadline for the transposition of the directives from EU member states and, consequently, for the drafting of national laws, was in June 2021. Among the different topics of interest, we will examine here only two of the CEP directives:

- The Renewable Energy Directive (EU Directive 2018/2001 [1]), which contains the definitions of collective and community self-consumption of Renewable Energy (CER);
- The Directive on the internal electricity market (EU Directive 2019/944) [26] which defines the Citizen Energy Community (CEC).

Article 21 of the Renewable Energy Directive (2018/2001) [1] defines collective self-consumption built inside a building, thanks to a system that supplies electricity to more than one consumer ("one to many"). The classic example is that of a multi-unit building with a system in the common area, in able to satisfy the energy needs for both condominium and unit users autonomous. When collective self-consumption transcends the scope of a single building or condominium, we can consider it an energy community. The Directives, although they have different definitions, both define the energy community as a "legal entity" based on "open and voluntary participation", whose primary purpose it is not the generation of financial profits, but the achievement of environmental, economic and social benefits for its members or partners or to the territory in which it operates.



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To ensure the non-profit nature of the energy communities, participation is not allowed in quality of community members, energy companies (suppliers and ESCOs) who can, instead, provide supply and infrastructure services.

The main differences between CERs and CECs are:

- a) The CER is based on the principle of autonomy among the members and on the need for proximity with generation plants. The CER can manage energy in different forms (electricity, heat, gas), provided that they are generated from a renewable source.
- b) The CEC does not provide for the principles of autonomy and proximity and can only manage the electricity produced both from renewable and fossil sources. CECs are given the option of configuring as real distributors, as owners or managers of the distribution network, or as closed distribution systems (SDCs).

The CEC is allowed to exchange the electricity produced with the members of the community even without being near the plants or downstream of the meter itself; in CERs, members must be located near the production plant (in Italy, downstream of the MV / LV substation) Unlike CERs, CECs are not subject to the obligation to use electricity produced from renewable sources The CEC does not provide for limitations on the legal form of the energy community: this can therefore also be configured as a small-medium enterprise. CERs must not be for profit. The tariff schemes, the benefits of shared energy, the incentives and the tax system will be different in the two cases

Although Italy has not yet promulgated the national law for the transposition of the Renewable Energy Directive (EU Directive 2018/2001 [1]) and the Internal Market Directive for electricity (EU Directive 2019/944 [26]), it has an experimentation phase.

To date, the Italian regulation on collective self-consumption and energy communities renewable consists of Article 42-bis, and is inserted in the Milleproroghe Decree (converted into law no. 8/2020 to 29 February 2020 [27]). The current regulation tries to collect useful data and elements the implementation of the Directives, as well as allowing investments given the objectives established in the Integrated National Plan for Energy and Climate (PNIEC [28]).



3 Processes towards the implementation of the Replication Plan

3.1 Governance and administrative processes for planning solutions

For the planning and implementation of smart city measures in the municipality of Bari it is necessary to follow some administrative and bureaucratic procedures. The procedures may vary depending on the type of intervention chosen for the smart city. There is generally a recurring administrative process that must be adapted and deepened according to the complexity of the project. The procedures become more complex if the interventions are financed by external bodies and therefore require monitoring and control procedures.

The Municipality of Bari sets aside money in its budget to work towards its CO2 emission reduction targets. The municipality provides a three-year work plan that can be partially updated during construction in which the budgets for individual objectives and intervention priorities are identified. The process typically follows the following steps:

- collection of projects
- selection by project objectives
- identification of funds to be able to draw on
- meetings between the competent offices of the municipality
- identification of the administrative procedure to be adopted
- preparation of the feasibility project by the competent office to be submitted to the municipal council for approval
- any reconfiguration of the project due to observations that emerged in the process
- approval in the council.

Any intervention envisaged by the Municipality must comply with all the regulations in force at the municipal, regional and national level. Among the most important regulations to be taken into consideration are the City Building Regulations, the urban plan, the landscape plan that apply to smart city projects. Projects may include:

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

For this type of intervention, the interventions must be reported to the Municipality and in some cases specific authorizations must be requested before proceeding with the work.

3.2 Work Groups supporting the planning processes

In order to identify the most suitable and feasible interventions in the replication areas, the city of Bari has involved some stakeholders in the design including energy bodies,



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suppliers, researchers from the Polytechnic of Bari, companies that deal with consulting in the field of data management.

During the project, expert technicians who work with energy infrastructures will be supported so that the chosen measures are actually feasible.

Table 3 - Bari FC work structure

General	FC manager	Luigi Ranieri (Mayor's staff)
	Member from R&D - academia	Prof. Riccardo Amirante
	Member from lobby groups	/
	Assessor / Municipal in charge	Assessor Eugenio Di Sciascio Department of Digital Transformation and Civic Services Assessor Giuseppe Galasso Department of Infrastructure, Public Works, Sustainable Mobility and Accessibility

3.3 Local Stakeholders' engagement

In order to take into account the needs and wishes of citizens and local stakeholders in planning the POCITYF Replication Plan, Bari FC supported the creation of a network of stakeholders that helps to disseminate information on the project and studies the chosen solutions and implements by involving other citizens in the area in the replication as well, for example by sharing news on social media, inviting neighbors and friends to events and participating as volunteer representatives in different circumstances.

The main objective of the Bari citizen involvement strategy is to make citizens more aware and autonomous, also improving the use of digital tools for their involvement and to improve their participation in decision-making processes.

The tools to involve citizens in the process will certainly be there

- Bari Participate Platform
- Citizenship awareness initiatives (eg. Events in the Urban center)
- Creation of a citizen advisory committee on public mobility with representatives of various citizens' associations to support the decisions of the city council on this issue
- Organization of initiatives in which to promote the project and create a network with new stakeholders in the area

In addition, the municipality of Bari has activated a consultation for mobility that deals with representatives of associations that deal with mobility to give indications on how to implement the solutions.



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Table 4 - Bari ecosystem working group

Ecosystem	Stakeholders' Group	Relevant POCITYF non- members (with which LHs and FCs are in contact with)
Bari	Energy Utilities	Azienda Municipale Gas Spa (AMGAS) (Municipal company of natural gas distribution) [2] Engie [3]
	Consumers	Amtab SpA [4] Cotrap [5] AMIU Puglia [6]
	Technology and Services providers	Helbiz [7] Bit mobility [8] Vento/TIER mobility [9] SITAE/VAIMOO [10] Almaviva [11] SIT [12] MEIT [13] Selferg Srl [14] LM-Impianti Srl [15] EnelX [16] La nuova energia - Apulian production district [17]
	Policy-making bodies and Governance	Metropolitan City of Bari [18] Apulia Region [19]
	Citizens	Citizens of Bari
	Representative citizen groups	Urban civic networks of Bari [20] The municipality of Bari includes 5 sub-councils named "Municipio", one per each Neighborhood as follows: Municipio 1 Municipio 2 Municipio 3 Municipio 4 Municipio 5 City council of citizens interested in contributing to decisions on the environment - [21] Polytechnic of Bari [22] University of Bari [23]



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These images were captured during the meetings made with the stakeholders.

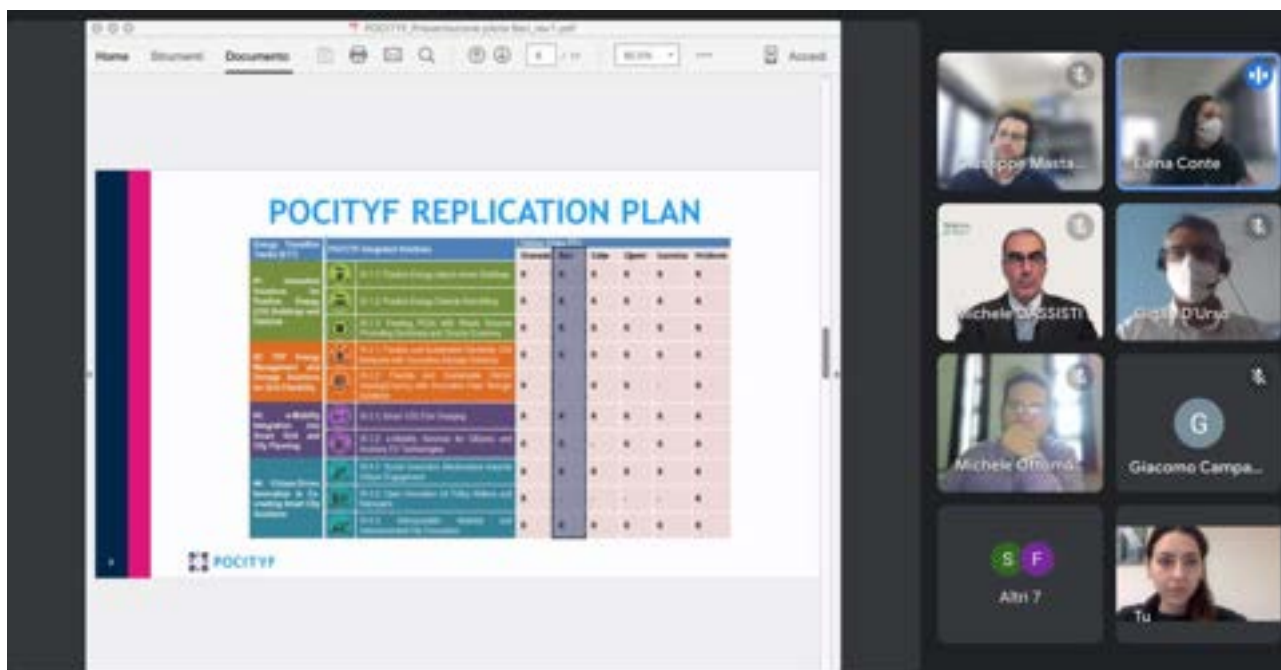


Figure 3 Images relating to online meetings with stakeholders

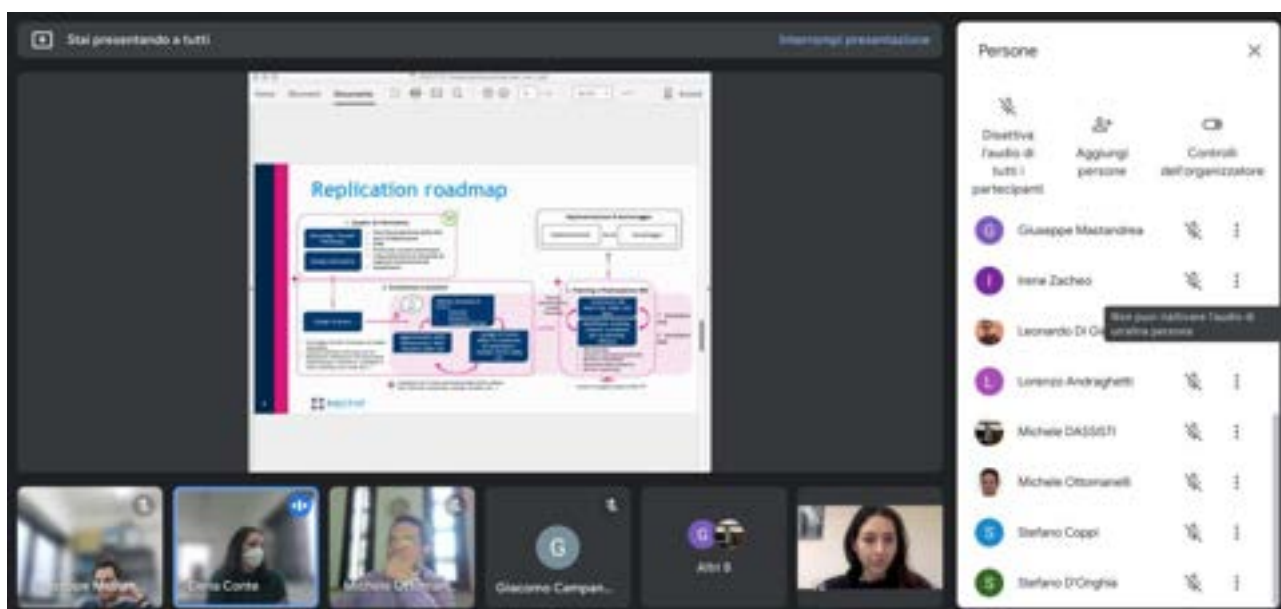


Figure 4 Images relating to online meetings with stakeholders



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Figure 5 Images relating to online meetings with stakeholders

Moreover, it was possible to present the POCITYF project to other local stakeholders during the Bari Smart City conference 2022 [35]. The presentation focused on the project and its ISSs, with the main objective to collect feedback and expressions of interest by new stakeholders, in different fields and areas.



Figure 6 Presentation of POCITYF project during the Bari Smart City conference 2022



3.4 Replication Tools utilization

Some tools to acquire and improve the know-how and experience necessary for planning replication activities have been identified and developed and will be modified by the Bari working group to better adapt to local needs.

3.4.1 Workshops

During the project the municipality participated in numerous workshops. The workshops were aimed at exchanging knowledge between LHs and FCs and were very useful for sharing knowledge. Furthermore, a seminar was organized to plan the involvement of citizens in the project by providing indications, support, suggestions, models, useful for identifying the best communication strategy with citizens. Furthermore, legislative aspects and issues relating to the actions planned both in LH and in FC were addressed. There were held also other workshops in collaboration with similar EU smart city projects (SPARS [29], ATELIER [30], MAKING-CITY [31], etc.) which provided further insights from other cities and their partners.

In addition, a workshop for local stakeholders was organized by the FC Bari working group in order to present and promote the POCITYF project, its objectives and proposals for innovative approaches to achieve them. The workshop also sought to strengthen communication with local stakeholders, especially the citizens of Bari.

The workshops have proved to be efficient tools for the transfer of knowledge and others will be organized in the remaining two years of the project to deepen the knowledge and technologies to be adapted in the best way to the context. Furthermore, the municipality has undertaken to include the presentation of the POCITYF project in all events concerning smart cities in order to implement the network of stakeholders.

3.4.2 Knowledge Transfer from LHs

The experiences and case studies shown by the LHs are an example for FCs who are preparing to undertake a similar path. It is important to understand the approach and the ways in which difficulties and challenges have been overcome, also learning from the mistakes made. The comparison with the other FCs was useful and profitable and will be even more so as the solutions and methods of implementing the plan are studied in depth. In fact, cities can support each other and constantly confront each other on the issues of the replication plan.

3.4.3 Factsheets

The replication activities are based on the knowledge of the innovative elements (technologies, concepts, solutions) that in some cases have already been used by the LHs and also by some FCs. Each partner has proposed and tested some technologies that have been proposed for FCs. The technologies must be known in order to be then tested for which in-depth information sheets are being drawn up for each technology so that cities can better understand how they work. Each sheet contains information that generally



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describes the product / solution, its intended use, essential technical information (e.g. dimensions, power ...), estimated costs.

In this way, the FCs can inform themselves about the available possibilities and transmit the knowledge to the relevant local stakeholders to implement more suitable solutions with respect to the local context and allowing them to make alternative proposals, for improvement or in line with those described.

3.4.4 Synergies with other SCC EU projects

There are numerous projects proposed by the European community in which the municipality is trying to participate precisely to think in an integrated way with respect to different issues, going outside the box and proposing a global vision that relaunches the city as a pole of innovation and experimentation.

3.4.5 Work groups

For the efficient management of the project it was necessary to structure a work team covering a wide range of knowledge and skills. The whole project is divided into a series of sections which some members of the group deal with jointly. This approach means that everyone has reference tasks but that everyone knows what the other is doing and that there is always communication and exchange between the members of the group.

3.4.6 ICT Tools

For the purposes of the project it was necessary to use the Teams platform which allowed all members to share files and access common archives. This especially during the covid period was necessary in order to proceed with the evolution of the project.

It will also be useful to use the tool developed within the project, to geolocalize any localization of the solutions when possible. Through the tool it will also be possible to deepen the solutions and it could be useful to make the tool interactive to citizens so that they can make comments or request information about the technologies or membership for the creation of any positive districts or simply for the request for localization of services.

3.4.7 Questionnaires

As part of the project, the municipality of Bari has prepared two questionnaires regarding the innovative solutions to be developed. The first of these was aimed at citizens, who were presented with the most important solutions for each ETT, selected by the FC Bari working group. The questionnaire investigated the interest and support of citizens for the innovative solutions chosen.

The questionnaire in the municipality of Bari was very successful and about 100 citizens showed interest in the topics and in being contacted.

The score for *Community Identity* was close to 6, suggesting that citizens of Bari have a sense of attachment towards the area where they live.



Table 5 - Survey Results - Bari

Bari	Dimension	Mean value (1 to 7)
	Utilitarian Value	5,3371
	Social Value	4,6587
	Environmental Value	6,4191
	Seeking Information	5,0792
	Using & Managing	5,3495
	Sharing Feedback (to the provider)	3,8494
	Helping (other consumers)	5,0924
	Advocating	5,7241
	Awareness of Consequences	6,0363
	Community Identity	5,5503



Figure 7 - Survey Results Graphic - Bari

A more complete version of the questionnaire was given to local stakeholders, containing all the solutions. The stakeholders identified at the moment deal with electricity, natural gas, public transport, waste treatment, and have been involved to receive their opinion



on solutions and possible implementations. In the coming months it could be useful to administer new and more specific questionnaires to stakeholders that will be planned on specific issues.

3.5 Integrated Solutions' evaluation criteria in coherence with the Propagation KPIs

In order to evaluate the quality of the implementation of the integrated solutions for the smart city chosen by the city of Bari, 2 KPIs were selected: the Propagation KPI, P.1 Social Compatibility and P.2 Technical Compatibility.

Social compatibility is an external KPI, while technical compatibility is an internal indicator. The purpose of the external indicators is to assess the state of the city context and determine how the solution is consistent with that context. It is a KPI that evaluates the social and environmental context so it depends a lot on the mentality, tradition and habits of citizens. The evaluation of the internal indicator refers to the technical compatibility. It represents the level of compliance of innovative solutions with all technical requirements. Therefore, for innovative solutions selected for the FCs, compliance with specific European and national regulations and standards must be verified.

Table 6: The two most important Propagation KPIs.

Propagation KPIs	Description	External / Internal KPI
P.1 Social compatibility	Indicator P.1 Social compatibility aims to show the extent to which an innovative solution is mentally and socially accepted in the Bari community. This is essential for the replication dimension, as community acceptance is one of the most critical requirements for implementing a specific solution in the city of Bari.	External KPI
P.2 Technical compatibility	Indicator P.2 Technical compatibility represents the level of compliance of innovative solutions with all technical requirements. Therefore, for selected innovative solutions for the city of Bari it is necessary to check compliance not only with European but also with specific Italian regulations and standards.	Internal KPI

The selected KPIs were chosen to have two reference measures with respect to an external and an internal issue in order to easily evaluate the process



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The city of Bari made an initial selection of technologies based on its specific situation and the immediate possibility of foreseeing an implementation of the same.

The municipality selected the solutions based on the maturity of the technical solution, the geographical situation and the energy needs and energy sources present, and the possibility of implementing technical solutions taking into consideration the operating modes of the urban ecosystem. It is not possible to hypothesize implementation without taking into account the starting point and the possibilities that realistically there may be for changing the network.

In fact, it should not be overlooked that the city is still lacking some necessary infrastructures that are being built in recent years. So it would be unrealistic to imagine an energy revolution without first making sure that you have a core network that supports a change in energy management. Product efficiency, market availability, on-site experience on installation methods, services and procurement options for spare parts, handling and durability were considered in the selection of specific IEs.

The feasible design solutions have been included in a provisional list that will change following a more detailed assessment of the technical information and local requirements and limitations. The list will be further influenced by the analysis of the legislation relating to the implementation of innovative solutions.

Service providers, city representatives and all other relevant stakeholders were involved in the replication activities to assess the potential of the solutions, their possible application and scalability in the city of Bari. The Citizen Engagement Plan, which includes a general strategy and stakeholder approach, includes citizen engagement initiatives and thematic groups.

To begin to understand the real feasibility, it was useful to involve the main local stakeholders in the decision-making process to evaluate possible changes and improvements in terms of energy flows, materials and ICT solutions. Citizens were also involved in the process, but also tourists and city users who are end users of the services.

A parametric assessment of the energy needs is in progress as the energy consumption in the replication areas for which a comparison was made is not known. Based on the results of the methodology, the final selection of the IE will be made. As regards the compliance with the project IE, the relevant legislation will have to be studied in depth. Surely the law on construction, the law on the protection of cultural heritage, the law on the promotion of the use of renewable energy sources, the regulation on self-supply of electricity from renewable energy sources will have to be taken into consideration. The products must be manufactured according to European standards and also respect Italian standards. The rules regarding the products must be respected both at national and European level.



4 Building up the Replication Plan and City Vision 2050

4.1 Building up the Smart City Vision and Plan

For the Smart City vision and replication plan, the Municipality of Bari has adopted an all-encompassing approach that will relate and address energy issues, environmental protection, the theme of climate change and ecological transition, as well as economic development and well-being. which are issues to be addressed at the metropolitan and regional level in relation to spatial planning of the environment. The Municipality of Bari aims to innovate public spaces from a technological point of view, improving the lives of citizens, preserving characteristic traditions and improving the quality of life also through direct consultation with citizens.

The Municipality of Bari aims to prepare a Metropolitan SECAP that looks at the planned development of the entire metropolitan city, its priorities and strategic objectives. The Replication Plan consists in the hypothesis of a procurement strategy, use of energy, introduction of renewable energy sources and measures to reduce energy consumption and increase the energy efficiency of the entire local community with the following objectives:

- reduction of costs or maintenance of energy devices in buildings and public bodies such as schools, nursery schools, health centers, etc. and management of these costs;
- introduction of renewable energy sources in areas where it is technically feasible, geographically possible and economically justified;
- introduction of energy efficiency in public buildings, public companies and public institutions;
- ensure the highest possible level of sustainable transport and reduce the negative effects of transport on the environment;
- work on the concept of MAAS Mobility as a service and on a metropolitan ITS system • minimize the use of non-renewable resources;
- introduction of energy accounting, energy monitoring and management, including preventive energy maintenance of devices and systems for the supply and use of energy in public buildings, institutions and companies and institutions;
- reduction of the final energy consumption of all consumers in the local community, including public lighting and video surveillance also through immediate and punctual communication on energy issues;
- promote, educate and raise awareness among public sector employees, citizens, pupils, students and others in the direction of efficient use of energy, energy efficiency and renewable energy sources;
- Involvement of all stakeholders from the local community in joint efforts to increase energy efficiency and the use of renewable energy sources;
- encourage investments in the energy requalification of buildings (in Italy the Bonus 110[24] is currently active, which encourages the energy conversion of private buildings);
- comply with the objectives of the operational programs for the protection of ambient air from PM10 pollution (OP PM10) and the reduction of greenhouse gas emissions - in this



regard in the city of Bari a project has been prepared for the construction of 4 power lines BRT and promoted sustainable mobility through the provision in the city of scooters (already present), bicycles and cars (arriving) in sharing;

- fulfillment of the international commitments deriving from the Community Directives on the efficient use of energy and renewable energy sources.

4.2 Final selection of technologies and assets to be included in the Replication Plan

4.2.1 Definition of the main technical specifications linked with the Replication Plan

The technologies were evaluated based on their suitability and the real potential for replication. The suitability of a given technology was considered with respect to various factors including the current network, therefore the possibilities of modifying it and implementing it, the characteristics of the local climate, geographical and geological conditions, etc.

The technology of photovoltaic panels and solar collectors were found to be appropriate to the local climate and in fact they are already being used. Among others, the new ministerial incentives are encouraging the installation of panels and a series of interventions such as the solar coat or the replacement of more efficient fixtures and systems that reduce energy consumption. The heating and cooling of buildings is currently carried out using natural gas or with heat pumps. The suitability of the technology will be assessed by estimating the expected annual energy production and the payback period, but certainly some interventions will be carried out as many plants have obsolete and energy-intensive technologies.

The proposed technologies must be compatible with the existing infrastructures in the city. Much of the city is heated by natural gas. This distribution system will remain in use for a certain transition period, but could be replaced in the future so a transition with the new technology must be imagined which must be able to connect to existing systems. Another thing to observe is the capacity of the existing distribution networks. In many cases, in fact, networks need to be created or strengthened.

A network that is able to absorb and re-circulate the stored energy should be designed. Possibly also providing for community solar parks, thus overcoming the present technical limits.

Bari has chosen to give priority to innovative solutions that are relatively simple to install or implement and that do not require excessive adaptations of the existing infrastructure, avoiding complicated or time-consuming procedures. Solutions of this type usually require low investments. More complex and more expensive solutions are typically more efficient but require more careful planning and are adopted at a slower pace.

Once the technology has been chosen, it is advisable to check its presence on the local market and that there is good know-how for maintenance and management, a service provider is required that has all the knowledge and equipment necessary for installation, operation, maintenance and quality. The assessment of the technology and its possible implementation also affects the financial aspect of the implementation.



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4.2.2 List of POCITYF ISs selected to be replicated

The selection of suitable technologies is still provisional at present because it was deemed necessary to check the real possibilities of implementation. The technologies were selected following assessments of the state of existing technologies and the state of the infrastructure. In the remaining two years of the project, further information and experiences on the solutions will be found, and some choices may be refined. The list below is presenting the solutions chosen so far.

Table 7 Solutions chosen by the municipality of Bari

ETT#1: Innovative Solutions for Positive Energy (CH) Buildings and Districts	
Selected Innovative Elements (IEs)	
IS-1.1: Positive Energy (stand-alone) Buildings	
IE 1.1.1	PV glass
IE 1.1.2	PV canopy
IE 1.1.3	PV skylight
IS-1.2: Positive Energy Districts Retrofitting	
IE 1.2.1	Smart lamp posts with EV charging and 5G functionalities
IE 1.2.10	Solar screen
IE 1.2.11	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	
IE 1.3.2	Pay-as-you-throw (PAYT)
IE 1.3.4	Circular economy building practices
ETT#2: P2P Energy Management and Storage Solutions for Grid Flexibility	
Selected Innovative Elements (IEs)	
IS-2.1: Flexible and Sustainable Electricity Grid Networks with Innovative Storage Solutions	
IE 2.1.2	Micro-grid controller platform
IE 2.1.6	City Energy Management System
ETT#3: e-mobility Integration into Smart Grid and City Planning	
Selected Innovative Elements (IEs)	
IS-3.1: Smart V2G EVs Charging	
IE 3.1.1	EV charging management platform
IE 3.1.5	Smart lamp posts with EV charging and 5G functionalities
IS-3.2: E-mobility Services for Citizens and Auxiliary EV technologies	
IE 3.2.1	EV sharing
IE 3.2.3	Energy producing noise cancelling screens (previously Solar road)
ETT#4: Citizen-Driven Innovation in Co-creating Smart City Solutions	
Selected Innovative Elements (IEs)	
IS-4.1: Social Innovation Mechanisms towards Citizen Engagement	
IE 4.1.1	Digital transformation in Social Innovation
IE 4.1.3	Tourist apps
IE 4.1.4	Cultural experiences market (mobile app)
IE 4.1.5	Mobile apps on energy consumption
IS-4.3: Interoperable, Modular and Interconnected City Ecosystem	
IE 4.3.1	City Urban Platform
IE 4.3.2	Wi-fi data acquisition systems
IE 4.3.5	Citizen Information Platform
IE 4.3.6	Data acquisition systems
IE 4.3.7	City Data Hub



4.3 Designing the replication of ISs

4.3.1 Planning the implementation of the selected ISs in the defined Replication Areas

The design of the replication plan is at a preliminary feasibility stage. To imagine the replication plan, the most familiar and most potentially applicable solutions have been identified, but some experimental solutions are being evaluated that the administration would be interested in knowing.



Figure 8 Replication area in Bari

For these areas a hypothesis of localization of the solutions has been prepared. A cartographic representation of the positions will be prepared with the help of the Replication Tool, currently they have been identified on orthophotos. The implementation of other IEs was considered more generally, at the level of entire replication areas. As already mentioned, photovoltaic solutions will be an important part of the replication activities in Bari. In a subsequent version, photovoltaic shelters will be located which can be placed in correspondence with city car parks. Subsequently, other areas will be hypothesized to be implemented on an experimental basis. The solutions will be implemented in municipal-owned buildings, among these it would be interesting to experiment with new management systems. An important objective is the management of energy at the city level and the control of consumption but it is necessary to develop a calculation model based on some typological cases, the solution is still under study. A city energy management platform could certainly support the process.

The three replication areas that Bari decided to test in the POCITYF project are detailed below. They are three areas of the city with different characteristics and different constraints.

4.3.1.1 San Girolamo area



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The first, the area of San Girolamo has no particular constraints and the buildings on which to hypothesize energy redevelopment are owned by ARCA, the autonomous body that manages public housing. The replication area is inserted in the so-called "coastal territories" identified by the PPTR (*Piano Paesaggistico Territoriale Regionale*), the regional landscape plan (art.142 paragraph 1 letter a of the cultural heritage code) consists of the strip of territory 300 m from the sea line.

Depending on the needs, photovoltaic systems that can be built with external connection works are allowed and must occupy the entire surface of the available roofs, the systems must be placed only on the upper parts of the buildings.



Figure 9 Identification of PPTR constraints





Figure 10 Localization of the surfaces to be used for the systems

Surface: 4.210 m²

Installed electric power: 300 kW

Annually production of energy: 375.000 kWh

Estimation of the costs: 500.000,00 EUR



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Figure 11 Views of the replication area 1



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



4.3.1.2 Historic city center

The second area is the historic center. Within this perimeter the municipality owns some buildings on which it intends to carry out energy efficiency works.

In perspective, it will be possible to think about how to make all private individuals contribute to creating efficiency works that make the "historic center system self-sufficient", but currently, given the constraints present, an evaluation in this regard is complex.

The involvement of owners for private individuals is necessary in an energy efficiency process of the whole which involves an awareness of part of the systems of the need to adopt from obsolete and energy-intensive systems. It is necessary to develop a feasibility project to be submitted to the superintendency in order not to multiply the application procedures, but to propose guidelines for interventions.



Figure 12 Identification of PPTR constraints





Figure 13 Localization of the surfaces to be used for the systems

Surface: 3.089 m²

Installed electric power: 100 kW

Annually production of energy: 125000 kWh

Estimation of the costs: 166.000 EUR



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





Figure 14 Views of the replication area 2

4.3.1.3 San Cataldo area

The third area is that of San Cataldo which has the Fiera del Levante area within it consisting of Pavilions that are not owned by the Municipality, except one (Pavilion 169), but which are the subject of a feasibility study to start experimentation internally, which concern not only the efficiency of the systems present, but also experiments concerning mobility with autonomous driving and a social lab. In addition, the exhibition center has applied to host the "House of emerging technologies" and has started a collaboration for the experimentation of drones for territorial control and 4.0 delivery. In addition, an experimental home automation project is underway with AMT for the intelligent building automation. As part of the MONKEY project ("MObility Network: KEY smart solutions), whose objective is to create integrated tools to make existing ones more efficient and operational for the management of urban mobility, and to stimulate the development of new applications and solutions in the Smart City area also by private stakeholders at the service of citizens. It also develops MAAS¹ (Mobility as a service)¹, the further objective of the project is to complete the transition to digital and improve the efficiency of the local public transport service, the central element of the project, ITS-Intelligent transport system solutions will also be tested within the exhibition center. Furthermore, thanks to the participation to other recent European Research and Innovation projects related to Enhancing Integration and Interoperability of Cooperative, Connected and Automated

¹ Whose goal is to provide users with a system that integrates the entire offer of active mobility throughout the city through a single gateway, allowing the user to choose, among the services available, the most advantageous ones in terms of costs and lead times mileage.



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Mobility (CCAM) eco-system, the district will be subject to experimentation for connected mobility.

The mentioned area also falls within the so-called "consolidated city" for which the surface modification projects also in this case require authorizations from the superintendency, which hopefully will be less restrictive than those envisaged for the historic center.



Figure 15 Identification of PPTR constraints





Figure 16 Views of the replication area 3



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Surface: 8.237 m²

Installed electric power: 300 kW

Annually production of energy: 375.000 kWh

Estimation of the costs: 500.000 EUR





Figure 17 Views of the replication area 3

4.3.2 Social acceptance considerations

In general, citizens have reacted positively to the project and are interested in studying the issues further. Citizens know quite well some solutions that are also used in Italy: for example, low-throughput windows are used, solutions for thermal insulation of the building envelope are used, photovoltaic panels on private buildings. Many of these measures are subsidized by the State Bonus 110 [24], so they are increasing. The current energy crisis is also providing the opportunity to change one's needs and expectations. In a large segment of the population there was evident poverty from an energy point of view and an impossibility in imagining a possible change in their status, which is why many cannot afford the implementation of technologies. This is also why the state has chosen to meet citizens and businesses who decide to work in view of an increasingly necessary and desirable energy transition. In fact, awareness is growing even in the poorest segments. This refers to the fact that energy saving and rational use of non-renewable resources and the implementation of renewable sources in everyday life are necessary. This type of approach is applied in schools to make the new generations understand immediately the importance that the choices of each individual can bring to the community.

Through the activities of the POCITYF project, further stimuli will be possible at the level of an integrated solution of energy challenges in the wider urban community and a global systemic orientation to achieve the objectives of smart cities.

For some years now, tourism in the city has been an economic lever of which citizens are



aware. It is important to work on communication and better direct assistance for tourists and city users.

4.4 Financial estimation and resources allocation of the Replication Plan

The financial evaluation of the replication activities has not yet been fully developed as the solutions are still taking shape and must be implemented. However, some elements can be evaluated. The surfaces of the photovoltaic canopies to be hypothesized in the car parks or the surfaces of the panels to be installed on the roofs and the installed power, the estimated installation costs and the expected annual production of energy can be hypothesized.

4.4.1 Estimation of needed financial resources and economic sustainability of the Replication Plan

The city of Bari is experiencing a moment of transition in which it is experimenting with some solutions and making choices to minimize energy consumption given the particular historical moment due to the energy crisis.

Currently there are very high consumptions due to heating and cooling systems which are now outdated, windows with low energy performance, and lighting systems that use lamps with high consumption. At the moment, the Municipality is gradually proceeding to install one of the heating and cooling systems, inserting photovoltaic panels where possible and replacing the lighting bodies. The solutions are economically sustainable as they use European community and ministerial funds that jointly encourage the ecological transition.

Additional funds may be allocated to implement and test project solutions. As far as suppliers are concerned, the municipality is required to carry out public tenders for the award of works and supplies, defining minimum requirements. For the energy efficiency of school buildings it has adopted a collaboration with Engie until 2032 which allowed for long-term planning. The funds used for this type of work are PON Metro [32] funds.

4.4.2 Exploitation of resources deriving from ongoing and already planned projects

As regards the funding resources, the offices are carrying out a survey of the resources present and those that may be found and those already allocated.

4.4.3 Holistic cross-ETT-sectional feasibility study

In addition to the energy efficiency of buildings, it was thought to promote the inclusion of photovoltaic shelters in municipal-owned car parks or in any case managed by the municipality to allow a reduction in consumption and their energy self-sufficiency. In fact, the shelters could power both the lighting system and the irrigation system and any charging stations for electric cars and e-bikes.



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The use of canopies with integrated photovoltaics in the parking areas is a technical solution of ETT1 for the direct acquisition of the electricity that is fed into the grid. The same amount of electricity is then used by the network to cover the needs of the car park and electric mobility: e.g. parking lighting, ramp management, automatic cash register operation, electronic charging stations (connection to ETT3). Part of the electricity is also destined for neighboring buildings. For the management of electricity, various ETT2 technological solutions are implemented (routers, management platforms, etc.). In addition, ETT4 ISs allow users to monitor the occupancy of parking spaces, electronic charging stations, etc. via app. The municipality of Bari has for years started an energy efficiency process of school buildings which has brought benefits both from the point of view of reducing energy consumption, but also of reducing CO2 emissions.



Figure 18 Schools where energy efficiency interventions have been carried out



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Table 8 Electricity produced and CO2 avoided

Name of school	Adress	Electricity produced per year (kWh) 2021	Tons of CO2 avoided per year 2021
ARCOBALENO	via Dalmatia 1, Santo Spirito	5692	3,02
WALT DISNEY	via delle Azzalee, Santo Spirito	7778	4,12
BONGHI	via Lucca 15, Santo Spirito	0	0,00
FALCONE	via Catino 9bis, Santo Spirito	18562	9,88
IGBAL MASIH	via Catino 48, Santo Spirito	28086	14,89
DUCA D'AOSTA	via Duca d'Aosta 2, Palese	23027	12,20
MARCO POLO	Via M. Polo zona 167, Palese	23798	12,57
FRACCACRETA	via Volpe 15, Palese	33447	16,67
FRACCACRETA - succursale	via Vittorio Veneto 50, Palese	6180	3,49
A. MORO	via Dalmatia 81/8, Santo Spirito	0	0,00
A. MORO - succursale	via delle Azzalee, Santo Spirito	23502	12,46
CIRIELLI	via Molise 6	5667	3,00
PETRIGNANI	piazza Romita 6	10528	5,58
DON MILANI	Via delle Regioni (2° Plesso)	30978	16,42
CIRIELLI	via Molise 4	13633	7,23
LOPODOLO	viale Lazio 8	7156	3,79
FALCONE - BORSSELLINO	via Cassala	28571	15,14
B. GRIMALDI - NUOVA BREDA	via Cacudi 1	33280	12,34
E. DI FANO - COMPARTO B	trav. Via Don Gnocchi 13	25182	13,35
LOMBARDI	via Lombardia 2	23771	12,60
UNGARETTI	via Don Gnocchi 18	28522	15,12
San FILIPPO NERI 2	via Lembo 3	7949	4,21
San FILIPPO NERI 1	viale Salandra 18	16158	8,56
S. TAURO	via Tauro 2	23937	12,63
A. CARRANTE	via Cantante 30	20044	10,62
MONTELLI	via De Gemmis 13	25234	13,37
MONTELLI	via Bartolo	27247	14,44
S. GALEI	via Di Tullio 67	15178	8,06
S. MASSARI	via Petrucci 80	33500	17,54
N. ZINGARELLI	via Pansini 3	26675	14,14
T. FIORE	via King 38	25754	13,65
Via DELLA RAI	via Della RAI, Ceglie del Campo	6226	3,30
CARMELA CINGLIO	via Valenzano 1, Losato	6438	3,41
MONTESSORI - NICHOLAS GREEN	via Vittorio Veneto 189, Carbonara	16369	8,66
A. DIAZ	via Vittorio Veneto 88, Carbonara	24723	13,10
DON MARIO D'ALESSIO	via Pepe 2, Carbonara	16025	8,49
DI VENDRE	via Di Vendre 21, Ceglie del Campo	22621	11,99
Santa RITA	Via del Monastero	23087	12,24
S. DI MARINIS	via Colonna 1, Carbonara	26249	13,93
A. MANZONI - A. LUCARELLI	via Quaranta, Ceglie del Campo	26427	14,01
ex O. N. M. I.	via Viterbo 4	8516	4,51
LOMBARDO RADICE	parallela via Peucetia	6439	3,41
Lascito RANIERI	via Caldarola 24	16330	8,65
Padre PIO	via Appulo 23	6945	3,68
ACQUARO - MORELLI e SILVATI	via Morelli e Silvati, Torre a Mare	13528	7,17
Plesso S. FRANCESCO - JAPISIA 1	via Peucetia 50	16607	8,80
DON ORIONE	viale Japigia 140	20643	10,94
S. RODARI	via Caduti Partigiani 25/1a	25512	13,52
S. MAMELI	via Martiri della Resistenza 2, Torre a Mare	27001	14,33
MARCO D'AOSTA	via Oberdan 8	28765	15,25
S. VERGA	via P. Carabelliese 34	24505	12,99
S. VERGA (succursale)	via Archita, Torre a Mare	14818	7,85
IL GLIONE BIANCO	viale Einaudi 15	6754	3,58
MAHTA GHANDI - S. REDAIND Murat	via Uffiliani 1	23090	12,34
S. REDAIND (succursale)	via Onofredo 8	23895	12,66
E. DE AMICIS	via Redauid 189	23714	12,57
C. DEL PRETE	corso B. Croce 96	26720	14,16
MONTE SAN MICHELE	corso De Gasperi 345	27724	14,69
CASTROMEDIANO	piazzale Pugliese	13336	7,07
S. LA FERZA	via Zanardelli 16	26734	14,17
S. SANTOMAURO	via Vessallo 16	17115	9,07
MICHELANGELO	viale Einaudi 1	27435	14,54
BALLILA	tango Carabelliese 1	20898	11,08
PRINCIPESSA DI PIEMONTE	Via Bovio, 43/A	13549	7,18
S. MARCONI	via Skanderberg 2	7912	3,88
S. MARCONI	via Skanderberg 2	20708	10,98
C. PERONE	via Nicotri 5	19968	10,58
San GIOVANNI BOSCO	Piazza Redentore 185	24769	13,13
R. MORO	via Ravanas 1	6223	3,30
I/28 - SAN GIROLAMO	strada San Girolamo	14908	7,90
C. COLLODI	via Brigata Regina 27	26048	13,81
MELO DA BARI	via Maggiore Tomite 13	30359	15,49
C. LEVI	via Babudri 1	28236	14,97
E. DUSE	trav. Via Tomasalocchio	22153	11,74
S. MAZZINI	via Suppa 7	7215	3,83
San NICOLA	tango Urbano II 1	7626	3,88
S. MODUGNO	via Pannari 6	7101	3,76
S. CARDUCCI	piazzetta don Sturzo 63	7118	3,77
		5.423.128	294,26



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In addition, the municipality is working on a conversion of street lighting lamps and new timed traffic lights that allow fluid traffic and consequently reduce the stalling of cars for long periods and therefore reduce emissions.



Figure 19 Installation of new traffic light systems

Among the public buildings owned by the municipality, energy efficiency works are planned. Below is a list of the first selected properties on which feasibility studies are underway. The table shows the currently estimated costs for the interventions.

Table 9 Municipal property sites to be made more efficient

Town Hall	Structure	Address	Surface mq	Capturing surface mq	Number of panels	Power kWp	Estimated cost of the system €
I	Municipio I	Via Trevisani	142	79,2	40	16	37.440,00 €
III	Municipio III	Via Ricchioni	180	79,2	40	16	37.440,00 €
I	Ripartizione Personale	Via Ballestrero	110	59,4	30	12	28.080,00 €
I	Ripartizione Anagrafe	Largo Fraccacret a	116	59,4	30	12	28.080,00 €
I	Ripartizione Polizia Municipale	Via Aquilino	258	99	50	20	46.800,00 €



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Figure 20 Municipal property sites to be made more efficient

In addition, the municipality has signed an agreement with Enel x to install 78 charging stations for electric vehicles spread throughout the municipal area. The electric charging stations are owned by Enel X Mobility: the agreement with the Municipality was signed with a 2011 protocol for the European "Smart city" initiative. Of the 42 new ones that will be introduced, eight will be of the Hpc type: they guarantee ultra-fast charging of 350 kilowatts. Fourteen will instead be Pump, that is with a fast recharge of 50 kilowatts (the waiting time ranges from 20 to 40 minutes) and another 20, finally, of the Pole type, slower, of 22 kilowatts and a waiting time of 45 minutes to two hours.



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Figure 21 Sites where charging stations for electric cars have been installed

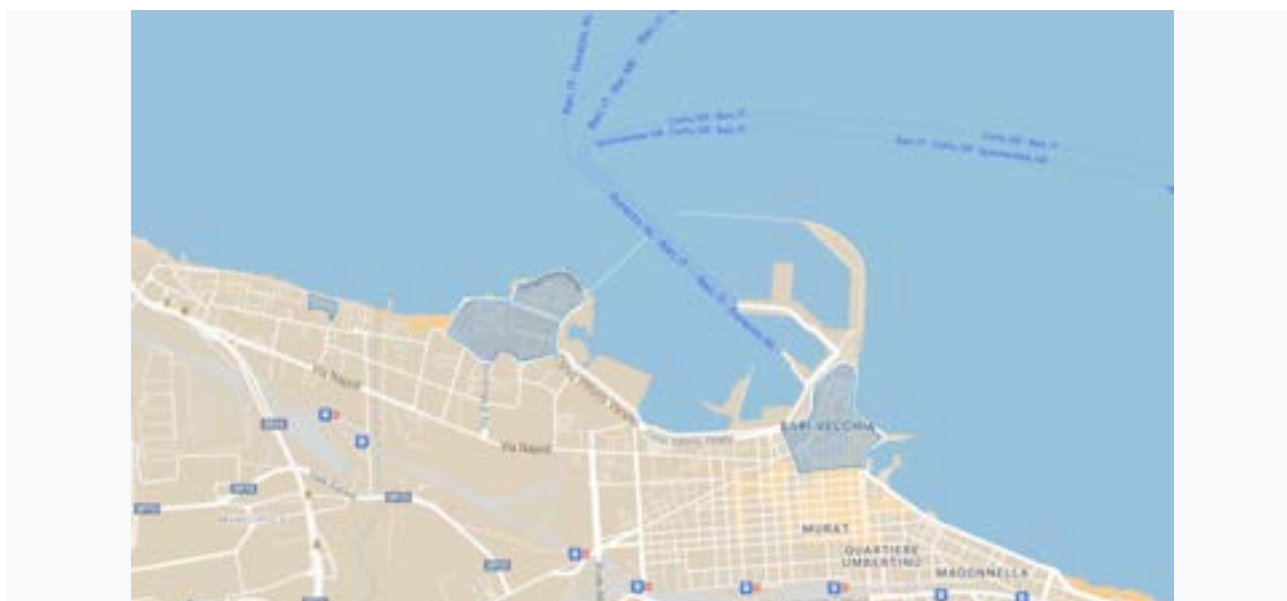


Figure 22 Sites where other technologies will be implemented

In the replication areas, door-to-door collection will be tested, the lamps currently present will be replaced with high-efficiency and energy-saving lamps, the first experiments of tourist apps will be developed, and the city energy management platform will be tested



4.5 Long-term planning towards a Smart City Vision 2050

Bari took the first steps towards the smart city several years ago by joining the SEAP in 2011. Now the goal is to draft a new document that provides guidelines for the SECAP contributing to the transition process of smart cities which will be the basis for the preparation of the replication plan, as part of the POCITYF project, as it will comprehensively address the key aspects that will support the requirements of Smart City Vision 2050.

The Replication Plan provides activities that coincide with the vision of the development of the city and also correspond with the climate objectives of the nation up to 2050. The main objective for Italy, as envisaged by the Paris Agreement, is to achieve net zero emissions by 2050. One of the key measures is the improvement of energy efficiency and thus the reduction of the use of energy and other natural resources. The replication plan drawn up within the POCITYF project will be proposed as a strategic document for the sustainable development of the city of Bari and will support the SECAP process. Some solutions are already in place while the POCITYF project is taking place, as part of the activities planned in the Municipality. The technologies to be implemented will be monitored and funds will be raised to do so. Particular attention will be paid to innovations in the field of citizen involvement solutions that are already being worked on through some programs.

Bari aims to become a model for the municipalities of the metropolitan city in terms of know-how and possibilities. Therefore, the idea is to overcome territorial fragmentation through the synergistic approval of 41 municipal SECAP, with individual actions, calibrated on the characteristics of each municipality, but by adopting an integrated approach to creating common strategies and goals on a metropolitan scale. The replication areas provide innovative solutions adapted to certain conditions that depend on the functioning of the entire city. The areas analyzed were chosen because they were representative, to give an example and to develop effectively replicable solutions.

The SECAP will have lines of intervention thus configured:

1. **Governance:** which will provide for a survey of existing projects, will provide for the homogenization of the strategies and minimum standards to be pursued, adopting a common project management center that pool skills and resources.
2. **Energy efficiency of buildings:** Guidelines for pursuing efficiency standards for public buildings that are common and replicable. Experimentation of energy communities that can be autonomous
3. **Distributed energy and renewable sources:** exchange system between energy systems (bus shelters, shelters for parking lots)
4. **Smart grid:** provision of a connectivity network that can support emerging projects and technologies
5. **Transition towards electric mobility:** Development of electric mobility projects that provide for the diffusion of electric vehicles: e-bikes, electric cars and buses (the project of the four BRT lines envisaged by the Metropolitan PUMS is in progress)



6. **Water and Waste:** implementation of a system that prevents hydrogeological risk and global warming with a soil de-waterproofing program, waste-water purification and recycling. Door-to-door collection and implement the quality of the waste-sorting through incentive and reward mechanisms with the aim of a real circular economy.
7. **Communication and dissemination** of measures, projects and incentives and funding present so that all metropolitan realities can access them through a single consulting and project verification center.

The metropolitan city of Bari is preparing, together with the 41 municipalities that have signed it, a document to outline the objectives and address climate change and the energy transition. It is a cultural revolution that will determine a different approach to problems, systemic and shared between the various municipalities that can together contribute to the resolution of common problems each with their own resources, but also by pooling funds and skills that will be equally distributed.

It is an innovative integrated and synergistic approach to territorial planning. A series of public events has been promoted entitled "Table of Talents and New Generations" [37]. The table was attended by representatives of subjects and social formations expression of youth movements, schools and/or active citizens - through ideas, projects and proposals - for the implementation of the activities of the Bari Metropolitan Strategic Plan 2030 (PSM Ba2030) [38]. The contributions and reflections that emerged were fundamental to define a programmatic framework of interventions for the metropolitan area, from now until 2030, in relation to the 11 specific themes that make up the PSM Ba2030 [38]. The vast area of the strategic axis n.10 "Ecological Transition and Contrast to Climate Change" has strong integrations with all other areas of specialization of the Strategic Plan of the Metropolitan City of Bari, therefore confrontation and interdisciplinarity have represented the main pillars of the structure of the various thematic tables of this axis, supported and amplified by insights on the radical transformation of the energy system, the development of a system based on the principles of the circular economy and good water management, as well as raising awareness of environmental issues among citizens of all ages and all professions. The collaboration and cooperation between the citizens active in the search for "change" has activated an important critical and creative process for the construction of concrete key actions, in line with the strategic guidelines, to promote the ecological transition of our territory.



5 Conclusions

The experience of participating in a European project and being able to share experiences and difficulties with other cities is certainly formative for a reality like the one of Bari that still has a lot to learn. However, the comparison is also useful to understand that some foundations for the change and evolution of the city must be implemented and it is necessary that citizens are aware of and part of the change. The city is made up of people, not just buildings for which it is necessary to be aware of the changes taking place and try to support them and, in some cases, to reduce their effects. A holistic vision is needed that encompasses different sectors that are closely related to each other.

For these reasons, in this first phase of creation of the Replication Plan of Bari, the focus was put into finding effective ways to involve as many local citizens as possible, via a series of dedicated initiatives. Moreover, the local stakeholders were involved and their feedback on the technological solutions was collected, in order to eventually start a collaboration thanks to a first round of dedicated events (i.e. kick-off meeting of Bari work group, participation to the Bari Smart City Conference, etc.), with the objective to continue working in the future and concretize the plans reported in the Replication Plan.

In the next stages of the work towards Bari's Smart City Vision 2050, some further analysis of the solutions selected to be potentially replicated will be made. Moreover, all the knowledge and tools known thanks to POCITYF will be further analysed, as more information will come also following the progress of the demonstration activities in the LHCs, and more in-depth exploited to widen the Municipal SECAP Bari is willing to sign. Other feasibility studies will be performed and funding opportunities will be investigated, with the aim to reach Bari's objectives in terms of GHG emission reduction, RES utilization, local stakeholders and citizens engagement.



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