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D8.5 Granada Replication Plans and City-Vision for 2050

WP8: Replication Plans and 2050 Vision by Fellow Cities

T8.3: Granada Replication Plans and City-Vision for 2050

Authors: José Santiago, Laura Silva, Gonzalo Esteban, Manuel Perez, Tommaso Giomi, Manuel Ibañez.

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In case you want any additional information, or you want to consult with the authors of this document, please send your inquiries to: info@pocityf.eu

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v	Date	Beneficiary	Brief Description	Author
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0.2	19/09/2022	Gracity, Dipgra, Itec	1st draft completed	José Santiago (Gracity), Laura Silva (Itec), Gonzalo Esteban (Dipgra), Manuel Perez (Dipgra), Tommaso Giomi (Itec), Manuel Ibañez (Dipgra)
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Executive Summary

The present deliverable describes the work done under 'Task 8.3 – Replication Plans and 2050 vision creation to support the six Fellow Cities (FCs)', which has the final target the development of Granada's Replication Plans.

To achieve a change in energy consumption, cities must transform, integrate and efficiently manage all energy consumption systems. This project aims to replicate the activities of the Lighthouse Cities (LHCs), as well as to share their experience and knowledge to the fellow cities.

This document is the first version of the Granada Replication Plans and City Vision for 2050, which is being developed in the frame of POCITYF project. The presented results try to give an answer to the challenges that Granada has to overcome to transform itself into a Smart City and succeed in the achievement of Granada Smart-City Vision.

The selected innovative solutions to be replicated in Granada are aligned with the objectives of its strategic plans in order to continue the actions already planned in the near future, which will contribute to the ultimate goal of making Granada an environmentally sustainable, climate-friendly, economically and technologically competitive, liveable, transparent and socially innovative city. This document has the aim to present the work performed by the Municipality of Granada in the frame of POCITYF project until September 2022.

The baseline for the development of the Granada Replication Plans starts from the city vision set in the Granada Smart City 2020 Strategic Plan. A city framework of Granada has been defined with relation to the smart city indicators, identifying the city needs and key priority areas and in alignment with Granada's Strategic Plans for sustainable urban development, energy and mobility. Besides the expectations from POCITYF solutions in addressing these needs were identified. The final version of the Replication Plans will be delivered as an updated version of this document in September 2024 at the end of POCITYF project.

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Abbreviations and Acronyms (in alphabetical order)

Abbreviation	Definition
BEMS	Building Energy Management System
BIPV	Building Integrated Photovoltaics
BMS	Building Management System
CEMS	City Energy Management System
CENER	National Centre for Renewable Energy
CIPs	City Information Platforms
COAAT	Official Granada Architects Association
DHC	District Heating and Cooling
EDUSI	Integrated Sustainable Urban Development Strategies
EMFAF	European Maritime, Fisheries and Aquaculture Fund
ERDF	European Regional Development Fund
ESF	European Social Fund
EV	Electric Vehicle
ETTs	Energy Transition Tracks
FCs	Fellow cities
FV	Photovoltaic
GHG	Greenhouse Gas
HEMS	Home Energy Management System
HVAC	Heating – Ventilation - Air Conditioning
ICT	Information Communication Technology
IE	Innovative Element
INECP	Integrated National Energy and Climate Plan
ISs	Integrated Solutions
ITeC	Institute of Construction Technology
JTF	Just Transition Fund
KPI	Key Performance Indicator

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LHCs	Lighthouse Cities
MDB	Municipal District Boards
PEB	Positive Energy Buildings
PED	Positive Energy Districts
PEG2007	Granada Strategic Plan 2007-2013
RES	Renewable Energy Source
RP	Replication Plans
SCC	Standard Contractual Clauses
SUDS	Sustainable Urban Development Strategy

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1 Introduction

Smart cities shape their future by leading in technology adoption, resource efficiency and citizen/stakeholder engagement. On this basis, the POCITYF smart city project mobilises two Lighthouse (LHCs) cities (Evora-PT and Alkmaar-NL), and six 6 Fellow (FCs) cities (Granada-ES, Bari-IT, Celje-SI, Ujpest-HU, Ioannina-GR and Hvidovre-DK) which already share knowledge and coordinate their efforts, to shape their own, unique bold city visions by taking care of their cultural heritage. By demonstrating in overall 10 integrated solutions (ISs), comprising 73 individual innovative elements (technologies, tools, methods), rooted under existing City Information Platforms (CIPs), POCITYF quantifies their value, and connects interests of many different stakeholders in innovative business models, allowing for upscale and replication of those solutions. To achieve this, POCITYF works along 4 Energy Transition Tracks (ETTs), encompassing the ISs according to the role each one serves for: positive energy blocks (ETT#1), grid flexibility (ETT#2), e-mobility integration into the grid and city planning (ETT#3) and citizen-driven innovation supported by the integration of innovative apps into enhanced City Information Platforms (ETT#4).

This deliverable will provide the preliminary Granada feasibility studies and replication plans for all 4 POCITYF ETTs and the respective IS categories which has shown interest. Political, Economic, Social, Technology, Environmental and Legal analysis will be carried out to determine the uniqueness and the context of Granada city through the active participation of local authorities and the involvement of identified key stakeholders. Moreover, a preliminary roadmap toward the bold city vision of Granada for 2050 will be defined.

Granada Smart City Strategic Plan defines 8 objectives framed in the different Smart Areas to develop its vision for the future. These objectives aim to develop a transparent and efficient local government, to modernise e-government and promote citizen participation in decision-making as well as in the use of the resources that the city makes available to citizens, to promote the use of sustainable modes of transport, to improve accessibility and mobility and to reduce environmental pollution in the city by relying on the use of new technologies.

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2 Benchmark Framework

2.1 General description of the city

Granada is a Spanish city and municipality, but also the capital of the province with the same name, located in southern Spain. The province of Granada has an area of 12,633 km², which represents 14.42% of the Andalusian territory and 2.5% of the Spanish territory. The area of the capital covers 88 km², which only represents 0,7% of Granada's provincial area, but this is more than a quarter of its population. The total number of inhabitants of the province of Granada is 921,338, the Granada metropolitan area has a population of 529,678 people while the municipality of Granada has 231,775 inhabitants in 2021.

The municipality of Granada is located in the centre of its metropolitan area, a demographic entity that includes the city of Granada and 34 neighbouring municipalities. This metropolitan area has 972.6 km² and can be understood in two senses, in a formal sense, as an entity of the Local Public Administration, or in a conceptual sense, as a demographic phenomenon, constituted by the agglomeration that transcends a group of neighbouring municipalities, with Granada as its centre, which overflows its initial territorial space, constituted by its municipal area and extends outwards to generate a new urban reality, susceptible to specific valuations and interpretations.
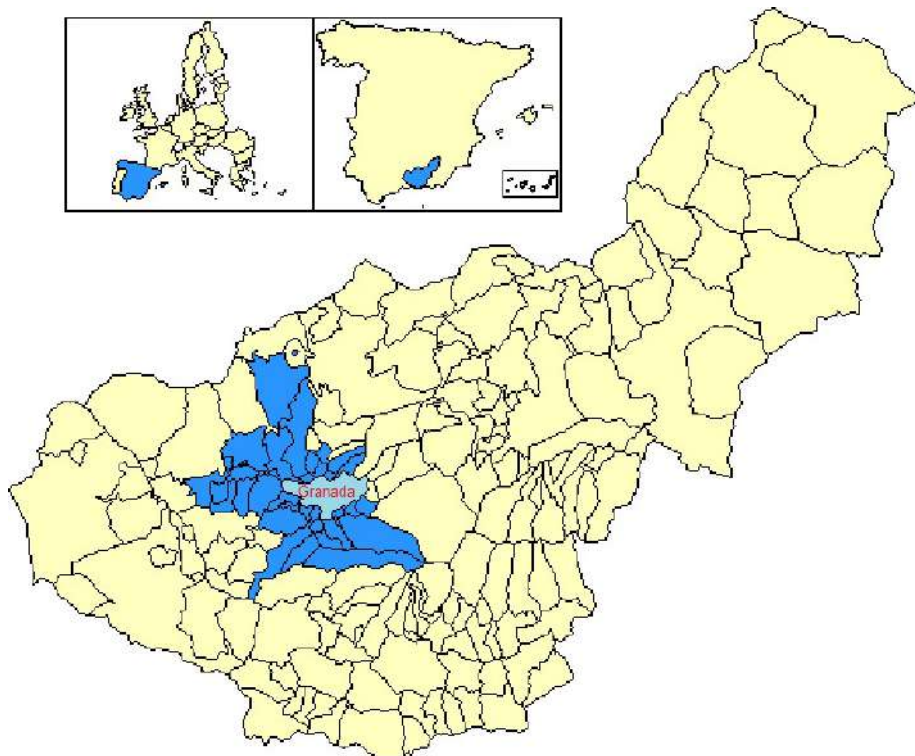
Figure 1. Metropolitan Area of Granada Location

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The Metropolitan Area of Granada (Figure 1) aims to manage different aspects of common interest, coordinating services and actions to meet the new needs resulting from the greater integration among their municipalities, such as public transport services (e.g.: unifying the taxi service), or the supply of drinking water and the maintenance of the sewage and wastewater treatment network.

Figure 2. Highlights of the city

The city of Granada is characterized mostly by its historical profile and has different areas of Cultural Interest such as "Realejo", "Albaicin" or "Sacromonte" neighbourhoods, including several patrimonial buildings. The Alhambra - Generalife complex was declared a Cultural Heritage by UNESCO in 1984, the declaration being extended in 1994 to include the Neighbourhood Albaicín - Sacromonte, for its value as a distinctive testimony of the Islamic culture in the Iberian Peninsula (Figure 2). As for its urban layout, the city is divided into historical and newly developed neighbourhoods.

2.2 Characterisation of the Climatic conditions of Granada

Below are graphs (Figure 3 to Figure 10) showing temperature and precipitation in Granada for all the seasons: Autumn 2021, Winter 2021/2022, Spring 2022 and Summer 2022.

2.2.1 Temperature and precipitation

- Autumn 2021
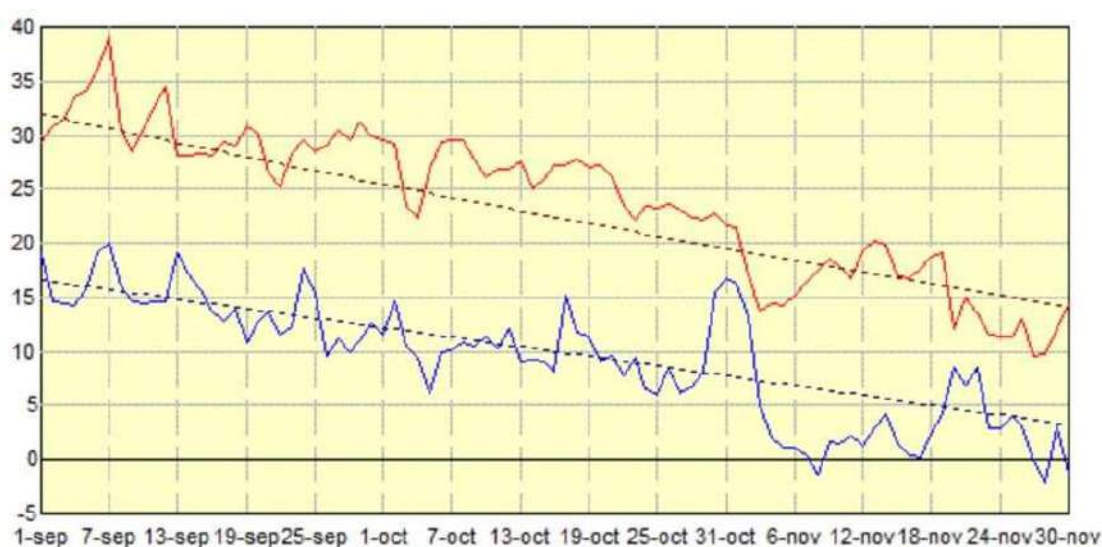
Figure 3. Maximum and minimum temperature (°C) in autumn 2021

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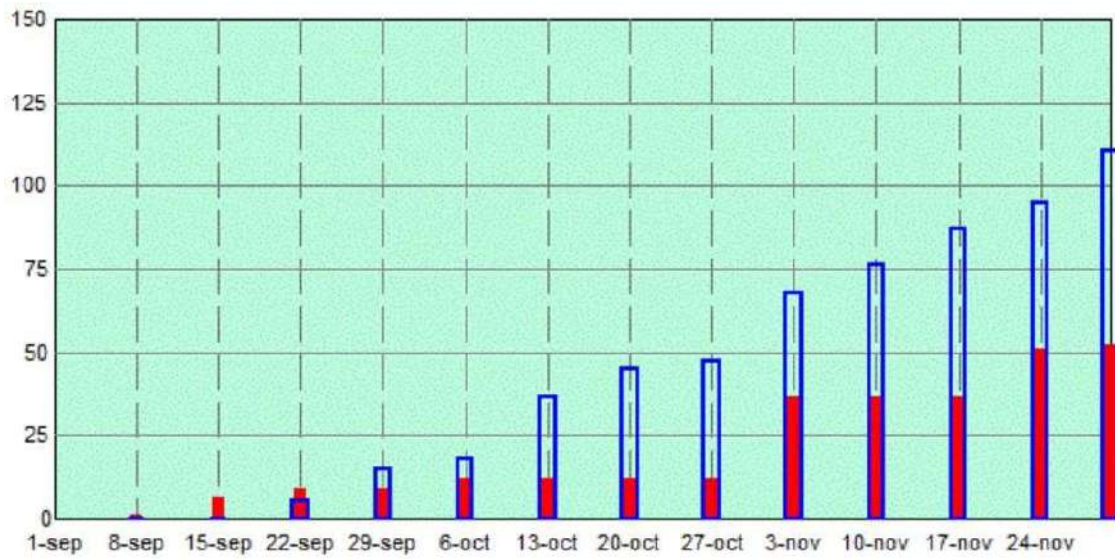
Figure 4. Accumulated rainfall in litres/m2 in autumn 2021

- Winter 2021/2022
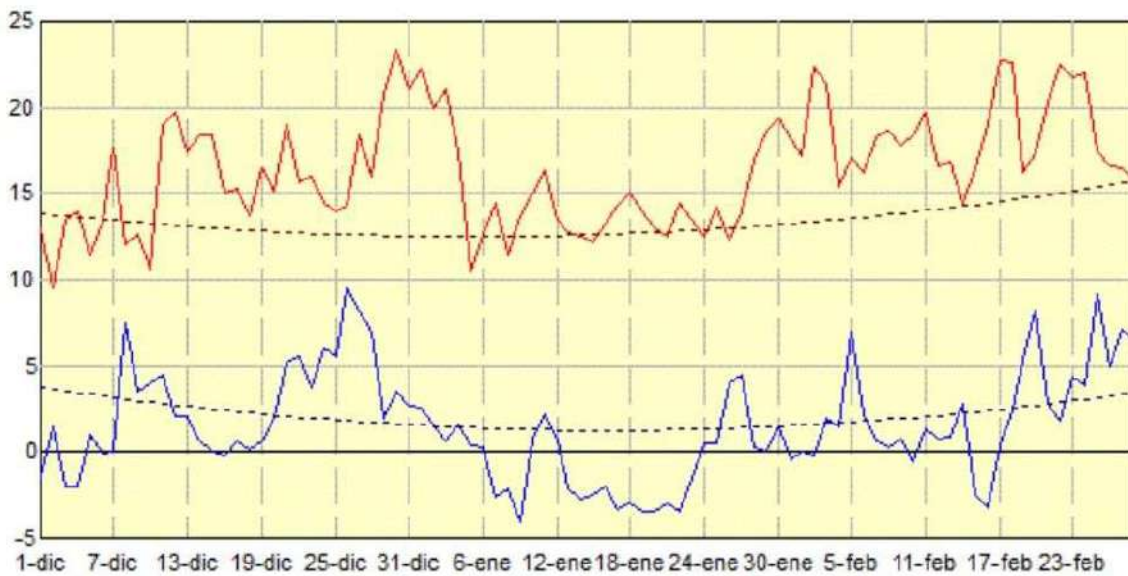
Figure 5. Maximum and minimum temperature (°C) in winter 2021/2022

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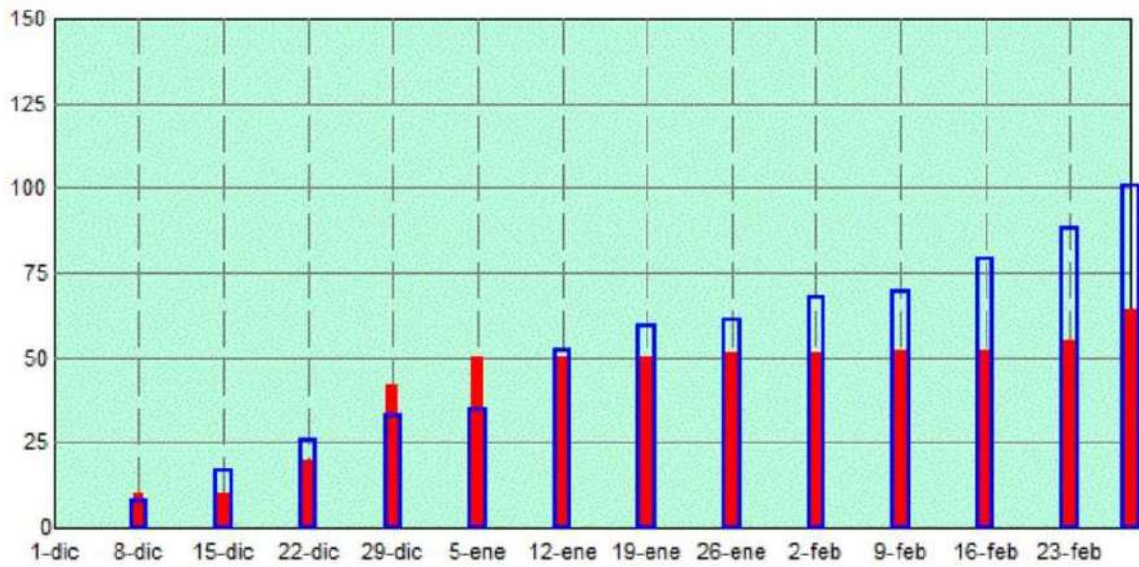
Figure 6. Accumulated rainfall in litres/m2 in winter 2021/2022

- Spring 2022
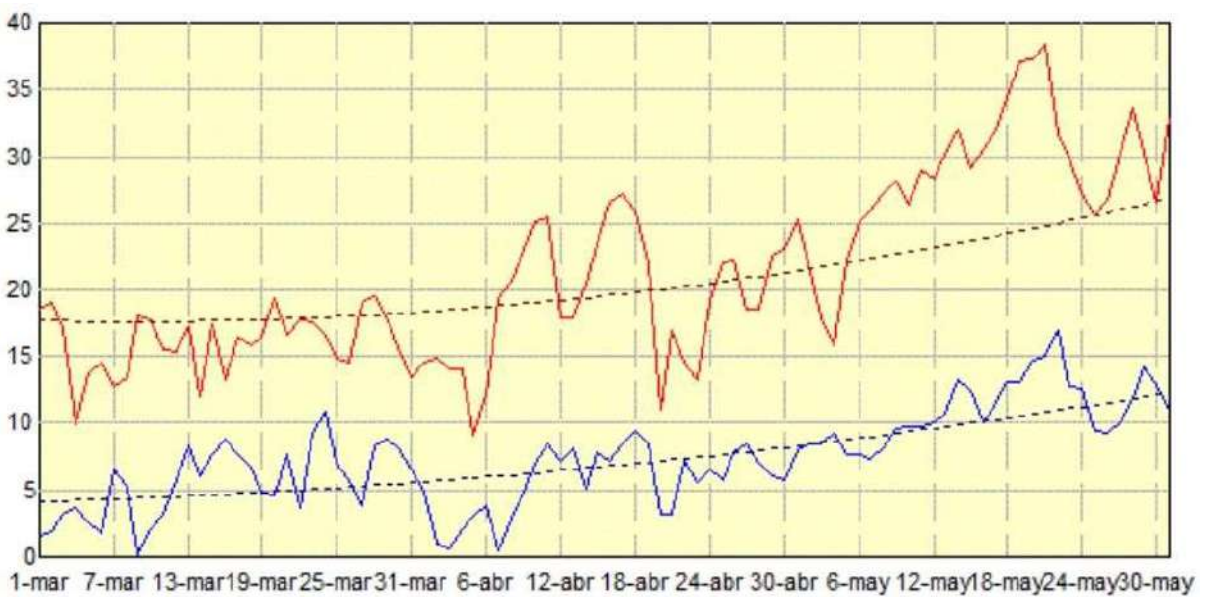
Figure 7. Maximum and minimum temperature (ºC) in spring 2022

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Figure 8. Accumulated rainfall in litres/m2 in spring 2022

- Summer 2022

Figure 9. Maximum and minimum temperature (ºC) in summer 2022

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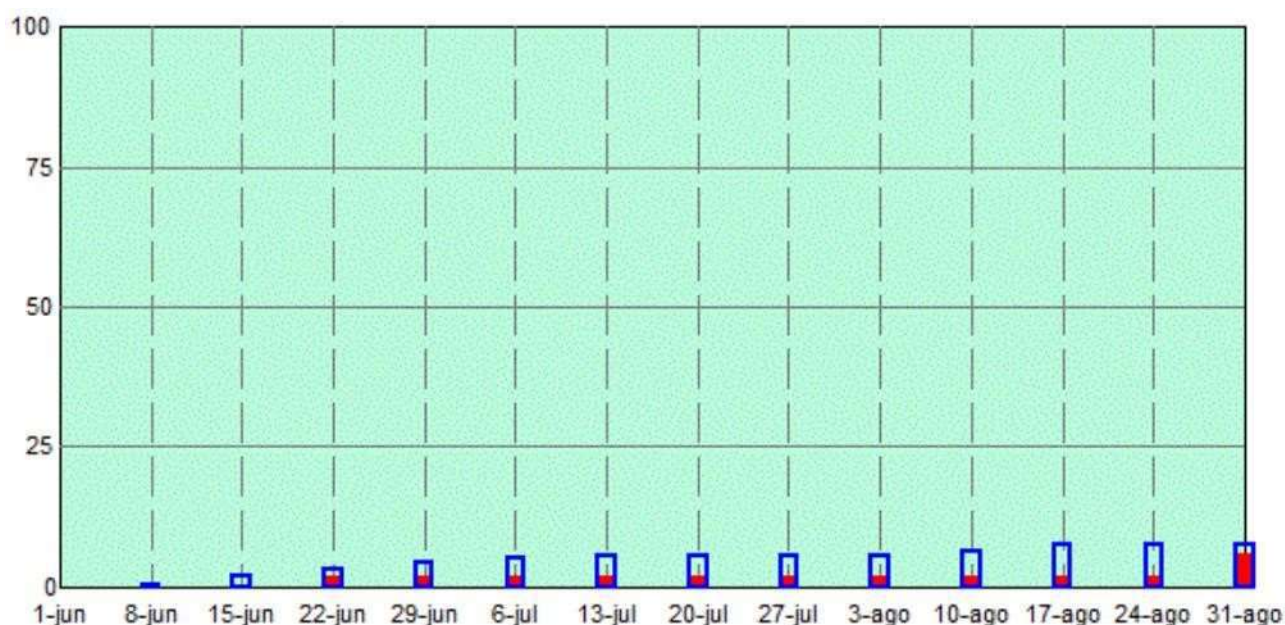
Figure 10. Accumulated rainfall in litres/m2 in summer 2022

2.3 Background of Granada Smart City Vision

In 2005, the city of Granada underwent a change in its urban and territorial management. From that year onwards, a governance system was introduced to direct the future of the city based on strategic planning and the efforts were focused on determining the actions to be carried out in the near future and thus the Granada Strategic Plan 2007-2013 was developed.

However, due to the fact that today's societies are in continuous evolution, a re-evaluation of the city was necessary in 2014, considering the citizen participation. During this adaptation period, taking into account regional, national and European publications in terms of regulations and urban plans, was approved the Granada Strategic Plan 2020 [1]. This plan included actions aimed at meeting objectives framed in 6 pillars among which we find the development of Granada as a Smart City.

In addition, a Sustainable Urban Development Strategy of Granada [2] was carried out in January 2016. Through this plan, a response was also given to the challenges and problems of the urban area through several lines of action, among which was the development of the current Granada Smart City 2020 Strategy [3], which was published in 2017.

The Municipality of Granada is member of the following national and international organizations:

- Spanish Network of Cities for the Climate. The Network was created from the need detected among the municipalities to coordinate in the fight against climate change and its effects, that increase the vulnerability of their localities and directly affect the population.

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- Global Covenant of Mayors. The vision of the participating territories for the year 2050 is to: accelerate the decarbonization of their territories, strengthen their capacity to adapt to the inevitable effects of climate change and enable their citizens to have access to secure, sustainable and affordable energy sources.

- Local Agenda 21. The program was created to promote sustainable development, that is, to ensure that the development of cities is based on a balance between economic and social development and environmental preservation, giving great importance to citizen participation in decision making.

- Smart Cities Spanish Network. The requirements for joining the network are: 1) to have a strategic plan with specific actions aimed at promoting innovation and the use of new technologies to build Smart Cities, and 2) to make the city's resources and experiences available to the rest of the members to promote the exchange of experiences and joint work.

2.4 Smart City Indicators

A series of indicators from different areas are presented that help to conceptualize the situation of the city. The selection of these indicators is conditioned firstly by their relevance, and secondly by the availability of information at the municipal level. In some cases, in which there is no data at the municipal level, data at the provincial level is presented to show the estimated trend in its area of belonging.

2.4.1 Sociocultural area:

2.4.1.1 Healthcare delivery

Main information about healthcare at municipal and regional level can be found in Table 1.

	Granada (City)	Andalusia	Ref. Year
Primary care centers	331	1510	2021
Population/Centre A. Primary	700,2	5641,1	2021
Number of pharmacies	536	3875	2021
Inhabitants per pharmacy	1718,9	2186,4	2021
Beds in public hospitals	1825	15239	2016
Beds in private hospitals	302	5245	2016
Total beds (Pub. Priv.)	2127	20484	2016
Hospital beds/inhabitants	110,4	409,5	2016

Source: Department of Health and Families. Regional Government of Andalusia, IECA

Table 1. Main Health Services Indicators

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2.4.1.2 Quality drinking water

Access to drinking water in households.

In the municipality practically only 0.03% of households in 2011 (These are the most reliable data for this level of disaggregation.) do not have access to running water supply. About waste water in home, only 0.14% of all homes in 2011 did not have wastewater evacuation [4].

Water treatment

The Municipality of Granada and its metropolitan area has a very good situation, with an almost total coverage and being a reference. Unfortunately, the same cannot be said for other areas of the province, especially small scattered municipalities. Granada and its metropolitan area have two Wastewater Treatment Plants (WWTP) [5]:

- The West Station, which collects water from approximately 223,000 equivalent inhabitants - the "equivalent inhabitant" is considered to be the pollution generated daily by each inhabitant.

- The South Station (known as the South Biofactory) which collects water from approximately 425,000 equivalent inhabitants.

2.4.1.3 Individuals' health monitoring

Together with the coverage established by law and agreements with other countries, in Andalusia all people are guaranteed vital emergency benefits, regardless of their legal situation. With regard to the general coverage of the population, in Andalusia the public coverage is 99.6, and includes the complete Portfolio of Services for all persons legally residing in Spain [6].

The administrative management system for healthcare in Andalusia is highly technological, so there is an advance-integrated system that allows access to the complete medical record whenever it is from the public healthcare system.

2.4.1.4 Quality food

Regarding child nutritional status, there are no data at the municipal level, so it is necessary to use the indicators of the autonomous community provided by the 2016 ANDALUSIAN HEALTH SURVEY.

Regarding the population aged 2 to 15 years (and with the IOTF Criteria) there are the following prevalence:

- 19.7% overweight (21.2% boys and 18.1% girls)

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- Obesity of 11.3% (12.2% boys and 10.3% girls)

Regarding the population over 16 years of age, 56.1% had a higher weight than normal (considering both overweight and obesity) [7]:

- Men 60.9%

- Women 51.4%

2.4.1.5 Education indicators

Table 2, Table 3, Table 4 and Table 5 give statistic information about the main data about educational levels [8]:

	Granada Province
In population aged 0-2 years	97,00%
In the population aged 3-17	39,60%

Source: Department of Health and Families. Regional Government of Andalusia, IECA

Table 2. Average Schooling

	Granada Province
Public/Concerted	95,7%
Private	4,3%

Source: Department of Educational Development and Vocational Training

Table 3. Child schooling according to type of Center

	Andalucía	Granada Province
Public centers	11,8	11,0
Private centers	13,3	13,5
Total	12,1	11,7

Source: Department of Educational Development and Vocational Training

Table 4. Average number of students per teacher in non-university education

	Number	%
Can't read or write	2.941	1,2
Less than 5 years of schooling	15.680	6,5

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More than 5 years of schooling but without completing elementary education	22.762	9,5
Completed elementary education	39.867	16,6
Pre-university degree	30.221	12,6
Medium or higher vocational training	18.973	7,9
UniversityStudies	65.291	27,2
Doctorate	6.115	2,5
notapplicable	38.110	15,9
Total	**239.959**	**100,0**

Source: Population and Housing Census. 2011. In INEbase.

Table 5. Population over 16 years of age by level of studies completed (2011) in Granada City

2.4.1.6 Crime rate

Data regarding crime rates is shown in Table 6 [9]:

	January-March 2021	January-March 2022	Variation % 2022/2021
1.- Intentional homicides and consummated murders	0	1	100
2.- Intentional homicides and attempted murders	1	2	100
3.- Serious and less serious crimes of injuries and riotous brawl	17	27	58,8
4.-Kidnapping	0	0	0
5.-Crimes against freedom and sexual indemnity	18	26	44,4
6.-Robbery with violence and intimidation	68	105	54,4
7.- Burglaries with force in homes, establishments and other facilities	132	104	-21,2
8.-Theft	493	835	69,4
9.-Vehicle theft	32	31	-3,1
10.-Drug trafficking	62	63	1,6
Other criminal offenses	1.518	1.886	24,2
TOTAL CRIMINAL OFFENSES	**2.341**	**3.080**	**31,6**

Source: Crime Statistics Portal.

Table 6. Balance of crime in Granada City. 2022 - 1st Quarter

2.4.1.7 Population indicators

Among the data related to population, it is worth to mention:

- Population density: 2,644.51 inhabitants/km² [10]

- Relative variation of the population in ten years (%). 2011-2021: -3.5 [11]

2.4.1.8 Civic engagement

Voter participation in last municipal election (percent of eligible voters) In 2019 was 60.76% [12].

Below is a series of indicators from the Department of Citizen Participation of the Granada City Council. It must be taken into account that 2021 was still conditioned by the pandemic, so it is expected that the figures in years without anomalies will be higher [13].

- Sessions of the district municipal boards: 82

- Activities of the district municipal boards: 37

- Requests processed by the district municipal boards: 934

- Registration office procedures: 400,277

- Citizen Service Network 010 (calls answered): 151,168

- Activities in civic centers: 1,195

- Citizen participation workshops in civic centers: 122

- Places offered for citizen participation workshops in civic centers: 1,775

2.4.2 Economic area

2.4.2.1 Affordable housing

Information about dwellings is shown in Table 7.

	Number of dwellings	%
Ruinous	375	0,3
Bad	2320	1,7
Deficient	6675	4,8
Good	128275	91,6
No record	2330	1,7
Total	139970	100

Source: Population and Housing Census. 2011. In INEbase.

Table 7. State of the building 2011 in Granada City

2.4.2.2 Job opportunities

Job opportunities information data is given by Table 8 and Table 9.

Firstquarter	43,13
Secondquarter	44,43

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Thirdquarter	44,68
Forthquarter	45,79

Source: Labor Force Survey. In INE.

Table 8. Granada's employment rate in 2021

Firstquarter	23,32
Secondquarter	23,1
Thirdquarter	22,13
Forthquarter	20,35

Source: Labor Force Survey. In INE.

Table 9. Granada's unemployment rate in 2021

Percentage of labour force (LF) engaged in creative industries

According to the Multi-territorial Information System of Andalusia (SIMA), Granada has 630 companies registered in creative activities [11].

2.4.3 Environmental area

2.4.3.1 Green spaces

Green areas per 100,000 (in m2) in Granada: 4,74 m2 (2011) [14].
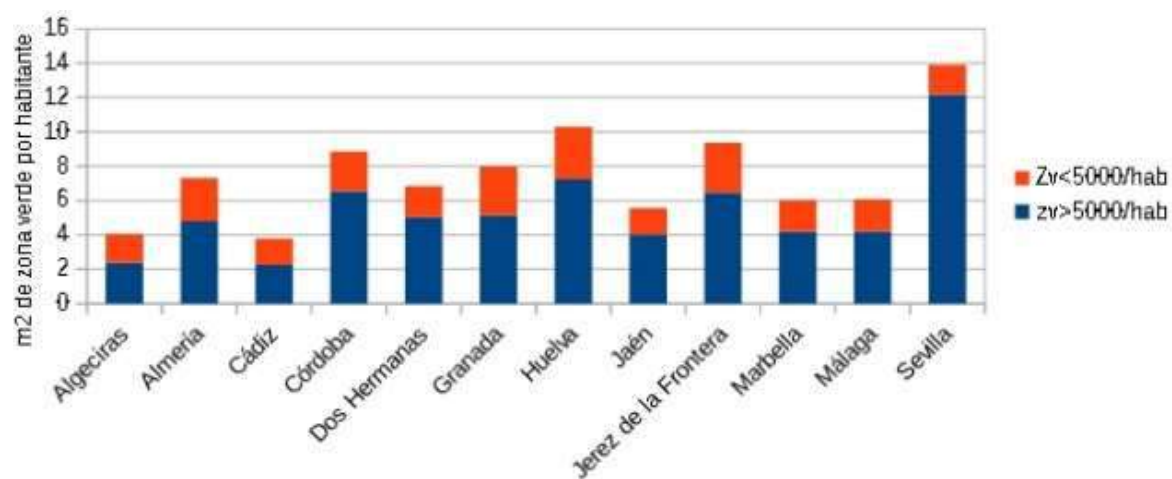
Figure 11. Square meters of green areas per inhabitant, compared with large Andalusian cities. 2013

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2.4.3.2   Air quality and low pollution

Ambient concentration of air pollutants in urban areas

Granada, for various reasons, has the highest levels of nitrogen dioxide (NO_2) in Spain. Granada, having a much lower population than Barcelona or Madrid, has these levels of pollution mainly due to its geographical location, the metropolitan area is surrounded by a Sierra Nevada mountains range that makes natural ventilation by the wind difficult, favouring thermal inversion. This is an important handicap that Madrid or Barcelona and other cities in Spain do not have.

Secondly, the explanation lies in the use of private vehicles to travel in the Metropolitan Area, the use of highly polluting boilers and heating systems in winter (diesel boilers, burning wood, coal, etc.), as well as the agricultural stubble burning.

In 2019, according to the Spanish Air Assessment Report, there were 3 urban areas throughout Spain that exceeded the maximum specified by the World Health Organization (WHO) for NO_2: 40 µg/m^3 [15].

Madrid capital and the Metropolitan Areas of Barcelona and Granada. The mean annual concentrations reached in the worst station located within Granada was 43 µg/m^3 (Granada – North).

Figure 12. Levels of nitrogen dioxide at national level

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It is planned to install 18 air quality measuring devices, which will be installed on the Granada metro stops, with sensors for carbon dioxide, but also for nitrogen oxides, ozone, volatile organic compounds and suspended particles that damage the atmosphere. They also measure temperature, relative humidity, atmospheric pressure and ambient noise. The aim is to measure air pollution and provide data for a much more comprehensive air quality map than the existing one [16].

2.4.3.3 Energy use

The energy use is below characterised by the annual energy consumption, the rate of renewable energies, intensity of primary energy use and sectorial energy intensity (Table 10 to Table 14) [17].

	Final energy per inhabitant	Primary energy per inhabitant
Granada	1,2	1,5

Note: Primary energy consumption includes all renewable Sources.

Table 10. Annual energy consumption per capita in 2020 (Unit: Toe/capita)

		Granada
Thermal use (Ktoe)	Biomass and Biogas	86,8
	Biofuel	32,5
	Solar thermal	4,0
	TOTAL	123,4
Electricity generation (Ktoe)	Biomass and Biogas	1,3
	Hydraulic	10,0
	Eolic	70,1
	Solar photovoltaic	15,6
	Solar thermal	221,4
	TOTAL	318,4
	TOTAL	441,8

Table 11. Renewable primary energy consumption by technology and use

		Granada
Thermal use (Ktoe)	Biomass and Biogas	86,8
	Biofuel	32,5

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	Solar thermal	4,0
	TOTAL	123,4
Electricity generation	Biomass and Biogas	1,3
	Hydraulic	10,0
	Eolic	70,1
	Solar photovoltaic	15,6
	Solar thermal	221,4
	TOTAL	318,4
TOTAL		441,8

Table 12. Renewable primary energy consumption by technology and use

	Primary energy intensity (tep/M€ 2015)	Final energy intensity
Andalucía	108,8	78,9
España	102,7	74,3

Note: Final energy consumption includes all renewable energy sources and non-energy uses.

Table 13. Intensity of energy use

	Unit	Andalucía
Industry	toe/M€ 2010	166,8
Primary	toe/M€ 2010	86,1
Residential	toe/hogar	0,5
Services	toe/M€ 2010	11,5
Transport	toe/M€ 2010	27,1

Table 14. Sectoral energy intensity in Andalucía:

2.4.3.4   Waste generation

Municipal waste collection in the province of Granada 2019 (232,462 inhabitants) [18]:

- Organic - Rest: 111,612.06

- Packaging: 303.32

- Paper: 547.60

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- Glass: 362.81

- Oil: 8.08

- Batteries: 1,63

- Clothing: 42.70

- Total: 126.805,72

Values expressed in metric tonnes (MT)

Generation of radioactive waste

In Granada there are 20 radioactive facilities with technical specifications subscribed [19].

Waste recycling and reuse

Of the total waste generated in Granada, the following is recycled:

- Packaging: 303.32

- Paper: 547.60

- Glass: 362.81

- Oil: 8.08

- Batteries: 1.63

- Clothing: 42.70

- Total: 1200,14

Values expressed in metric tons (MT)

2.4.3.5   Sustainability-certified buildings

Number of buildings with LEED or BREAM sustainability certification in the city

Granada does not currently have LEED or BREAAM certification. The building of the Faculty of Economics, for example, has a B energy rating. To achieve the objectives set, the UGR is carrying out energy efficiency actions such as improving insulation or enclosures.

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Percentage of commercial buildings with a building automation system

Order IET/290/2012 establishes that 100% of meters must be smart and sets a series of deadlines. Likewise, RD 216/2014, of March 28, and the Resolution of June 2, 2015, of the Secretary of State for Energy, establishes the obligation of energy distributors to submit to the CNMC the meter replacement plan for tracking purposes. In 2019, more than 99% of meters were smart meters and integrated into the network. 1% are counters that are difficult to access for reasons not attributable to the distribution companies [20].

Percentage of households (multifamily and single family) with smart meters

The report on the effective integration of meters with remote metering and remote management of electricity consumers with contracted power of less than 15 kW shows that more than 99% of the meters are smart meters [20].

2.4.4 Governance

Presence of demand-based pricing

In the municipality of Granada there are regulated parking areas with limited time and different rates depending on the day and time of parking. There is an application for your mobile phone with which you can renew and pay for your parking without having to go to the zone [21].

Percent of traffic lights connected to real-time traffic management system

Currently, there is no intelligent traffic lights system connected to real time. Granada has a total of 209 traffic lights but they are not connected in real time [22].

Number of public transport services that offer real-time information to the public

- Bus - https://www.transportesrober.com/movimiento.htm

- Regional train - https://www.renfe.com/es/es/experiencias/escapate-en-tren/granada

- Metro - https://metropolitanogranada.es/inicio

- Rapid transit system - https://www.renfe.com/es/es/experiencias/escapate-en-tren/granada

- Sharing modes - There is no specific solution for it in the city. There have been different initiatives (shared car, electric motorcycles, electric bicycles, etc.) and all have failed,

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due to multiple reasons, but among others, vandalism. There is currently a new electric scooter initiative that has just been announced in September 2022

Availability of multimodal transport app with at least three services integrated.

Granada currently has a number of multimodal transit apps with at least three integrated services. Examples of these applications include the following:

- https://moovitapp.com/

- Google maps

2.4.4.1   Internet and Wi-Fi coverage

Internet access at 10Mbps is guaranteed for 98.31% of the total population of the province of Granada, but this does not allow for professional use of the Internet. Broadband at 30 Mbps in the province is quite acceptable throughout the province, with 97.74% of the population enjoying this access, but it is still insufficient for certain important uses, such as quality video calls. Fibre optic or FTTH is the technology that guarantees, with coverage of over 100 Mbps, intensive professional use of the Internet, and in this case, access is guaranteed for 77.08% of the province's population, with Alpujarra and Montes being the most disadvantaged areas [23].

2.4.4.2   Public transport

Non-motorized transport trips of total transport

The percentage of public transport trips to work in the city of Granada is 13.67%. Similarly, the percentage of non-motorized transport trips of total transport is 20.08 % [24].

Integrated fare system for public transport

Public transport in the Granada Metropolitan Area has a new fare integration system through the new transport card. It allows transfers with other metropolitan buses, including Granada city buses. It can be used for all bus journeys within the Granada Metropolitan Area, regardless of the transport company providing the service. In addition, the same card can be used by several people, as it is not personalised [25].

2.4.4.3   Clean-energy transport

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Kilometers of bicycle paths and lanes

The city of Granada has 75 km of cycle lanes and 51 km of pedestrian paths. A map with the exact route and lengths can be found on the official mobility website of Granada's Townhall [22].

However, Granada has no bicycle companies or shared-use scooters.

Bicycles account for 6.12% and personal mobility vehicles for 1.64% of the total number of vehicles used. This represents 7.77% of the total number of vehicles circulating in the capital [22].

Number of EV charging stations within the city:

Granada has 59 electric vehicle charging stations [26].

2.5 Defined Replication Areas

The Replication Area has been defined considering the continuity of the already existing actions started by the Granada Strategic Plan 2020 [1].

A citizen participation process was performed to determine the priorities actions in the city. The outcomes showed that these priorities should be:

- the urban enhancement of Sacromonte and Albaicín neighbourhoods,

- improvement the facilities of the research centres,

- establish an innovation and development model for Granada,

- increase the business presence in the Health Sciences Technology Park,

- promote the railway infrastructure, and

- promote the tourism.

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Figure 13. Replication Areas (Green: Municipality of Granada, Blue: Replication Area)

As shown in Figure 13, It can be distinguished in green, the municipal area of Granada and the replication area in blue. The dimension of this area is 571,971 Ha and there are 96,671 inhabitants, which means 40.70% of the population of the municipality. The replication area is an excellent representation of the essence of the SUDS of Granada city [2], which indeed is called "from tradition to innovation". On the one hand, it is the Albaicín neighbourhood, which is the historical core of the city, having remains of Iberian and Romanian settlements, but also an important development from the Andalusí Arabian period. On the other hand, the Zaidín neighbourhood, which is the newest area in the city, although was born with many social problems, after the implementation of the proper political and social actions, is nowadays one of the main wagers for the growing of the city.

According to the Granada Mobility Plan, the Replication Area is where the highest mobility flows are concentrated (53%) and where a greater increase is expected, motivated by two reasons: the transfer of the Health Sciences Universities, which represents 10% of the university community, i.e. 5,500 people, and as a consequence, the transfer of the New PTS Hospital, from the Beiro District to the Health Campus, which currently serves 131,851 people. At the same time, this is the area where the oldest municipal facilities are concentrated, and therefore less energy efficient.

The innovative solutions identified in the replication plan will support the development of a mobility model able of reconciling transport and mobility needs with the quality of life of citizens, respect for the environment, urban development and the leisure/work and accessibility needs of citizens and visitors.

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2.6 Envisioned Replication Area and city needs towards Smart City

From Table 15 to Table 20 are described the IEs for which Granada is interested and have a description of their motivation.

ETT 1 - Positive Energy Buildings and Districts

IS- 1.1 - PEB or Positive Energy (stand-alone) Buildings		
IE#	IE (Innovative Element)	Motivation
1.1.2	PV Canopy	Granada has a high interest to implement this solution in some municipal buildings. In this sense, a feasibility study was started in order to identify the best places for the installation of PV canopy. According to preliminary results, first buildings to install this technology will be the sports facilities.
1.1.3	PV Skylight	A feasibility study was started in order to identify the best places for the installation of PV Skylight.
1.1.6	Bidirectional smart inverters	The bidirectional inverters are already being used. Next PV installations in the Granada will be provided with bidirectional inverters since they reduce the payback period due to the electricity surplus can be compensated.
1.1.8	BMS (Building Management System)	The BMS will come from an upgrade/integration of the existing BEMS by adding new functionalities. The implementation plan will have two phases: 1) in the municipal buildings, and once it has been tested there, 2) in the primary schools.
1.1.10	HEMS/BEMS (Home/Building Energy Management Systems)	Granada has already developed a BEMS which has been implemented in every municipal building. This system is able to control the HVAC systems through different sensors and actuators and it is currently being improved in order to increase its functionalities.

Table 15. Motivation of IEs selected by Granada from IS-1.1

IS- 1.2 - PED Retrofitting or Positive Energy Districts Retrofitting		
IE#	IE (Innovative Element)	Motivation

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1.2.1	Smart Lamp posts with EV charging and 5G functionalities	Granada is already retrofitting the public lighting by the implementation of a smart lighting system with LED technology. Besides, further studies are being carried out in order to select new points for the implementation of smart lamps with EV charging. A final number of 37 points will be installed (10 fast or medium charging and 27 slow charging).
1.2.3	Smart Distribution Energy System	Future Energy Systems in Granada are expected to be based upon distributed energy generation, real-time demand/response and user engagement for a collective awareness about the value of energy resources. The smart distribution systems of the smart grid will be responsible for intelligent management and operation of energy networks.
1.2.5	Community Solar Farm	Granada is planning to install PV rooftop for self-consumption in the municipal building and schools. These power generation facilities will be created following the 'Community Solar Farm' concept, so the surplus of any installation can be consumed in other municipal building or any other associated consumer.

Table 16. Motivation of IEs selected by Granada from IS-1.2

ETT 2 - P2P energy storage and management

IS- 2.1 - Flexible and sustainable electricity grid networks with innovative storage solutions		
IE#	IE (Innovative Element)	Motivation
2.1.3	Flexibility Control Algorithms	The emerging smart-grid framework requires the development of advanced control algorithms to unlock the deployment of strategies for demand side management capable of optimising end-user consumption pattern profiles and mitigate the uncertainties associated with the expected high RES penetration in the electricity network, among others advantages.
2.1.6	City Energy Management System (CEMS)	The IoT devices consume massive energy constantly, but also produce enormous amount of data that is required to be processed efficiently. Granada is well interested to develop a smart city energy management system that assures the energy efficiency of IoT devices along with data analysis to support decision making and consumption optimization.

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2.1.12	Fuel cells (hydrogen)	Fuel cells and hydrogen are a viable solution for the city of Granada to reduce emissions and realise their green energy transition. However, these solutions have not been implemented yet.

Table 17. Motivation of IEs selected by Granada from IS-2.1

ETT 3 - E-mobility integration into smart grid

IS- 3.1 - E-mobility services for citizens and auxiliary EV technologies		
IE#	IE (Innovative Element)	Motivation
3.1.2	EV charger prototype with PV integration	Granada is quite interested in the implementation of this technology, as first step It is planned the construction of 10 taxi stands which will be equipped with a solar charging point.
3.1.5	Smart lamp posts with EV charging and 5G functionalities	This IE will be developed together 1.2.1

Table 18. Motivation of IEs selected by Granada from IS-3.1

ETT 4 - Citizen-driven innovation in cocreating smart city solutions

IS- 4.1 - Social Innovation Mechanisms towards Citizen Engagement		
IE#	IE (Innovative Element)	Motivation
4.1.1	Digital transformation in Social Innovation	Granada Mejora app gives the citizen the role of act as a "sensor" in order to detect potential issues in the city, and increasing at the same time the citizen engagement to improve the quality of life in their neighbourhoods. By the use of this app, the citizens are directly connected with the responsible in the Town-Hall to solve the issue that they have detected. Also, Granada keeps looking for any other tool able to improve the social innovation.
4.1.3	Tourist apps	Municipality of Granada is well committed with the tourism in the city. In this sense, many web sites and apps are already developed in order to improve the experiences of tourists and to make easy their visit. It is worth to mention the Granada accesible app, developed to facilitate accessible tourism.

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		Nevertheless, Granada keeps going to improving the existing apps and looking for new ideas.
4.1.6	Value based design	This concept is horizontally applied in every project that is started in the city of Granada.

Table 19. Motivation of IEs selected by Granada from IS-4.1

IS- 4.3 - Interoperable, Modular and Interconnected City Ecosystem		
IE#	IE (Innovative Element)	Motivation
4.3.1	City Urban Platform	Granada currently has numerous smart services that can be used by citizens and tourists, which also generate a big amount of data. However, these services are not integrated yet. The next step will be the implementation of a City Urban Platform working as a horizontal system that collects the data generated by each vertical system distributed throughout the city and being managed through a single interface. This horizontal system will integrate this data to allow its study and publication to citizens. In this way, the system will connect each and every one of the city's smart services.
4.3.2	Wi-fi data acquisition systems	Granada has equipped most of the areas of the city with WiFi network. This provides access to the online services that the city offers to its visitors and inhabitants. In this way, WiFi data acquisition systems has already become in the best technology in order to get data from the different systems.
4.3.5	Citizen Information Platform	Granada is developing a portal web that facilitates the citizen participation in the participatory processes of the Municipality of Granada. This website specifically allows: 1) Public exhibition of projects. It should collect the proposals for modification of regulatory projects in public exhibition phase as well as other projects of the City Council such as strategies, plans, initiatives, etc. 2) Participatory budgets: It should be able to develop a participatory process aimed at the approval by the citizens of Granada of part of the municipal budget.

Table 20. Motivation of IEs selected by Granada from IS-4.2

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2.7 Challenges & Barriers

Municipality of Granada has a need to reinforce measures aimed to improve air quality and noise levels in the city. In this sense, the monitoring of the air quality and the energy consumption in public buildings is proposed. To do this, smart sensors to take measures of the level of atmospheric and acoustic pollution will be deployed at strategic points in the city, as well as smart sensors in the interior of public buildings with the objective of determining their energy consumption.

Additionally, through the control of energy consumed in public buildings it is possible to carry out actions that minimize energy losses in situations in which they can be reduced: switching off the lighting when there are no people in the offices, efficient control of heating as a function of the comfort temperature, etc

The objectives are:

- Know in real time the levels of acoustic and atmospheric pollution in the city of Granada.

- Use the information collected from the smart sensors to carry out the necessary actions to ensure that the maximum pollution limits are never exceeded.

- Make decisions that allow the reduction of energy consumption in both public and private buildings.

- Guarantee the future of Granada as a Smart City committed to sustainable development and the quality of life of citizens.

Regarding to the smart lighting measures, the city of Granada has 28,506 public lighting points, 31,474 luminaires (some points have more than one luminaire) and 32,037 lamps (some luminaires have more than one lamp). The type of luminaire implanted in each area of the city responds to aesthetic and functional reasons, having as a fundamental criterion the installation of artistic lighting points in central and emblematic areas of the city and opting for functional lighting points in areas with heavy traffic.

The Municipality of Granada is very committed with the reduction of the energy consumption in public lighting, therefore, optimization and improvement projects are carried out, with an emphasis on energy improvement and efficiency projects, reduction of CO_2 emissions, innovation and development of new lighting technologies, implementation of a smart point-to-point management system, measurements and lighting studies in accordance with new regulations and others whose purpose is the improvement and efficiency of public lighting.

As well, the Granada POCITYF ecosystem partners have been working in legal barriers related to areas of cultural heritage both at local level in the City of Granada, as well as in the province of Granada (Alpujarras area).

The POQUEIRA area is cultural protected, and in the Sierra Nevada Natural Park, as it has important cultural, scenic and environmental values.

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This protection is such that currently the regulations or laws of local councils, cultural and environmental organisations do not allow the installation of renewable energy sources on the roofs of buildings, for example, the installation of photovoltaic solar panels or wind energy installations. The main reason, as stated so far, is the great visual impact on the area, which has remained practically unchanged since the existence of buildings.

On the opposite side of the spectrum to the regulations and laws that limit the installation of renewable energy sources, there are regulations that favour and oblige the reduction of polluting emission sources and reduce the impact on the environment as a whole, such as Directive 2010/75/EU. In the same way, the recent Law 7/2021, which promotes the sustainability of the Andalusian territory, reduces the procedures with the administration for the installation of renewable energy sources.

On the other hand, the notable increase in energy prices means that citizens are increasingly interested in the installation of these renewable energy sources, especially the installation of photovoltaic solar panels. There are numerous enquiries from citizens about the possibility of installing this technology.

For all these reasons, the Provincial Energy Office of the Provincial Council of Granada, as a partner of the European project POCITYF and in collaboration with other companies, has developed a report evaluating the integration of photovoltaic energy in these protected urban spaces of high historical, cultural and touristic value.

The aim of this report is to analyse the best technical solutions available, as well as the urban viability of the proposals for photovoltaic integration in singular public buildings in the municipalities of the Barranco del Poqueira: Pampaneira, Bubión and Capileira.

Subsequently, the aim is to develop specific regulations so that citizens who wish to do so can also carry out this type of installation in their private buildings, respecting the enclave in which they are located and causing the least possible visual impact.

To improve the situation the Provincial Council wants to help to develop a pilot project as a starting point, a series of unique public buildings in the villages of Capileira, Bubión and Pampaneira were selected to carry out a study of the integration of innovative solar installations that minimise the visual impact as much as possible. This study has been analysed the restrictions of municipal and cultural regulations and has been taken into account the fact that the municipalities are located in a protected natural area.

Considering all this, possible promotion of shared self-consumption facilities and/or energy communities at local level was studied. Furthermore, a meeting was held with the regional authority and the assessment of the implementation of BIPV in such areas was performed. The main conclusions of this work are the following ones:

- Regional administration and some local public administrations are worried about possible impact of a huge introduction of PV facilities in the roofs of protected areas. These administrations know that less than 1% of the surface of the autonomous community is

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under protection figures and even with justification technical studies about visual impact they are rejecting possible projects.

- Pilot projects of integration of BIPV with new technologies of POCITYF was suggested to different municipalities of Granada. The idea is to be able to see real impacts of BIPV and be able to produce latter guidelines about the technical aspects that those PV facilities should have to be able to implement those in protected areas.

- As well, one critical issue is the fact that even if the protected areas surface is little, these areas are usually some of the most populated where auto consumption is more feasible, and thus, some of the most interesting areas to implement PV facilities to empower citizenship and reduce network energy loses.

- The Provincial Council of Granada is working now with some municipalities to see possible solutions that could be used both at city and regional levels.

- Recently Spanish government announced that they will change the legislation about PV to take of the limit of PV shared facilities of 500 meters, if this is real, that would give a big impulse to PV facilities in urban areas.

Finally, the need to promote the development of urban heat and cold networks to decarbonize the heating and cooling sector is truncated by:

- Lack of knowledge of the operation and management of these systems.

- Users are not aware of the benefits of HVAC networks. In situations of substitution of the conventional system to an unknown system it is difficult to accept.

- In some areas of the state there is a strong mentality of individual ownership that causes users to be reluctant to depend on an alien system. Urban air conditioning network systems are considered non-transparent because it is difficult to make direct comparisons with other systems (individual systems, heat pumps, etc.). In the case of Granada city, some projects were stopped cause that the legislation does not make it clear who owns the network in different situations. Both the ownership and operation of the urban air conditioning network can be: 100% of the local entity. 100% private. Mixed public-private. In cooperative, with or without the participation of the local entity.

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3 Processes towards the implementation of the Replication Plan

3.1 Governance and administrative processes for planning solutions

The objectives of the Granada Replication Plans are aligned with the Granada Smart-City Strategy [3], which in turn are in line with the objectives of the Granada 2020 Strategic Plan [1] and Granada SUDS [2]. This argument demonstrates the coherence of the RP with the rest of the plans developed for Granada in recent years.

In order to carry out the RP, different areas of the Municipality of Granada, as well as other agents of the city (internal or external teams), will be involved. Consequently, in order to favour the achievement of the planned objectives, a centralised model of vertical management is established, with a clear hierarchical distribution of responsibilities and tasks, but which also integrates horizontal management that allows for joint decision-making, coordination activities and a continuous flow of information between the different areas involved.

To this end, the following structure will be set up, integrating different urban authorities and key actors:

- **Leadership**. Mayoralty-Presidency of the Granada Town-Hall. In charge of promoting the RP and ensuring that the objectives are met.

- **General Coordination**. Department of Economy and Finance. Responsible for the main coordination of the Smart City Strategy. It will have a General Coordination Technical Assistance.

- **Steering Committee**. This committee reports directly to the Presidency and will be responsible for the success of the RP. The heads of the areas will participate in it and will boost to advance in the achievement of the objectives. Where appropriate, it may be involved in the resolution of problems linked to the implementation of the specific lines of action. This committee will meet once a month and its members will be part-time.

- **Technical Directorate**. This directorate is responsible for the management, coordination and monitoring of the initiatives. It will review and control the technical and financial evolution of the RP and the achievement of the milestones set in accordance with the planning established for the lines of action. It will have a manager and team in charge of each Energy Transition Track. The members of the team will meet weekly and will have a full-time dedication to carry out, among others, the following functions:

  o Coordinate the execution of the lines of action.

  o Establish the appropriate corrective measures and actions to mitigate the risks identified in order to achieve compliance with the objectives of the RP, or urge the

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Management Committee to adopt them, when they could affect the objectives of the RP.

- o Clarify any doubts that may arise in the interpretation and execution of the Strategy.

- o To monitor and control technical and financial aspects of the actions included in the RP, including the analysis of productivity and result indicators.

- o Drawing up monitoring reports for the Steering Committee.

- **Strategic alliance**s. In order to ensure the correct leadership and success in the implementation of the RP, there will be the participation of relevant local agents.

The different multidisciplinary teams that will carry out the management, monitoring and evaluation of the actions within the framework of the RP will have extensive experience in the management of funds and will guarantee the integration and coordination within the Granada Town-Hall, ensuring the implementation of the initiatives and the fulfilment of the objectives.

ELEMENTS OF THE MANAGEMENT, MONITORING AND EVALUATION SYSTEM

The criteria for the selection of specific innovative solutions of the RP will be classified in two types: general and specific. The latter will be indicated in the description of each solution in the next chapter and the general selection criteria will include the following:

- **Contribution to different Smart areas**. Degree of contribution of the solution to one or more areas to be developed in a Smart City: Government, Mobility, Sustainability, Social and Economy.

- **Horizontal priorities and transversal objectives**. Degree of contribution to horizontal priorities and cross-cutting objectives. Their consideration will be taken into account in the design of the action, in the execution of the measure and in the expected results, as well as the KPI's.

- **Long-term sustainability**. Financial implications for the Municipality of Granada once the investments have been completed.

- **Simplicity of management**. Concentration of financial resources to reduce the management effort.

- **Implementation risks**. Analysis of the risks associated with the action, in terms of probability and impact on the objectives of the RP, the financial path and the planned schedule.

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- **Integration with other actions and objectives**. Degree of contribution to the objectives and interrelation with the rest of the Granada Strategic Plans.

For the implementation of the RP, the Action Plan will be specified in a Manual of the management, monitoring and control processes of the interventions, which will include the monitoring and evaluation systems, based on indicators. These indicators will, as far as possible, consider at least productivity and result indicators, without prejudice to the use of other complementary parameters. In any case, the indicators shall also consider horizontal principles and cross-cutting priorities

The monitoring and evaluation exercises shall include both continuous evaluation to prevent deviation in time or funding and evaluation of results, which, in any case, will make it possible to know to what extent the expected achievements have been attained and what the causes are.

3.2 Work Groups supporting the planning processes

The Granada working group is made up of the three-way ecosystem: Granada Town-Hall, Granada Provincial Council and ITeC. Covering the needs of the city with the knowledge of the technical team of the Town-Hall, knowledge at the provincial level of the projects that can serve us as a guide thanks to DIPGRA and technical support in the construction sector by ITeC.

This group is also comprised by the stakeholders interested in the meetings carried out. Once the POCITYF presentation meeting was done and the ecosystem received feedback from the participants, it was the time to establish roles in the working group by asking one by one their permission. The roles are explained in following Table 21.

FC Manager	José Santiago	Granada Townhall
Member from R&D -Academia	Laura Silva	ITeC
Member from Lobby groups		ACTISA
Assessor- Municipal in charge	Agustín Belda	Technical Director of Urban Planning
ETT1		
Field Expert	Luis Fialho	UEvora
Enterprise	José María Jiménez	ONYX
Citizen	Alvaro Fernandez	CooperaSE

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ETT2		
Field Expert	Rafa Bahamonde	Turning Tables
Enterprise	Blanca Sintas Checa	Grupo Cuerva
Citizen	Francisco Javier Porras	ZENCER
ETT3		
Field Expert	Sara Herrero	AEDIVE
Enterprise	Salvador Mansilla	ACTISA
Citizen	Jose GDM	Asociación AUVE
ETT4		
Field Expert	Esteban Romero Frías	MEDIA LAB UGR
Enterprise		WINECTA
Citizen		Juntas de Distrito

Table 21. Granada's ecosystem working group

3.3 Local Stakeholders' engagement

LOCAL STAKEHOLDERS MEETING

The municipality of Granada organised the first local stakeholders meeting on 23th of march 2022, in which relevant regional companies and institutions where involved, to present the current state of the Granada's Replication Plan and to inform about the last advancements. In Figure 14 there are some screenshots from the meeting. Besides the different ISs of POCITYF developed in the LH cities were also introduced to the attendees, giving some insight on the whole package of ISs in which POCITYF is working at the moment as well as the potential improvement of the replication plan.

During the meeting, the Granada ecosystem engaged the group asking all attendees to give their opinion on the current state of the works, being open to suggestions/improvements that they might think about, and giving them additional contact channels to get their feedback. Specifically, they were encouraged to participate in the "power and interests stakeholder" survey, explaining that this survey is a good tool to give us further input for the RP.

Moreover, a representative from CENER institution mentioned about their EU projects such as STARDUST, or EXCESS (Especially circular economy and zero net energy new neighbourhood

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NIVALIS in the metropolitan area), because they are open to collaboration and synergies with our project. As well the COAAT - Official Granada Architects Association - (URGE URBACT Project) are open to create synergies. Within this project a social building has already been refurbished in Granada City, with important impacts. Moreover, the coordinator of URGE project mentioned that they are studying the possibility of favouring circular and innovative materials through economic incentives from the municipality of Granada.

Figure 14. Screenshots of the local stakeholders meeting

The attendees had an active participation and we received different ideas to be implemented in the project and the next events. In general terms, all stakeholders are interested with this kind of meetings and they are open to collaborate with Granada Ecosystem and eager to keep being informed so they can give us feedback.

CITIZEN ENGAGEMENT MEETING

POCITYF is being presented to the Granada citizens through the Municipal District Boards (MDB) of the city. First presentation meeting was held face-to-face in the North District on 4th of May 2022, as you can see in Figure 15, but also a digital POCITYF presentation, including the advancement in the Replication Plan, was disseminated among the managers of each MDB. Then, MDB managers can use this digital document to present to the citizens the RP and the ISs in their periodical

meetings. It is planned to organise at least one face-to-face meeting in every MDB during the life of project and give to the MDB managers periodical information about the project to be disseminated among the citizens.

For this first citizen engagement meeting, we took the opportunity to be held just after the participative process for the new Urban Development Plan of Granada. Therefore, we were able to increase the number of attendees and get a higher impact. The participative process of the new Urban Development Plan has been subcontracted by the Municipality of Granada and it is currently being carried out by specialised company. This activity is going to be done in the 8 MDB of Granada in order to reach the entire municipality.

In the participative process were identified the main priorities for the citizens in every neighbourhood and there are quite some related to POCITYF project among them, such as:

- Bad quality electrical network due to vandalism, and bad quality electricity service in this neighborhood.

- Energy Poverty.

- Low public transport connection to the neighborhood, need to redesign the bus lines

- Need of safe active mobility infrastructure extension.

- Need of refurbishment of Public Lighting with LED energy saving technology as in other neighborhoods.

- Pacification of Schools surroundings at the rush hours, promotion of better signaling and safe school routes.

- They need more awareness about environmental issues to all citizenship, and more knowledge on actions they could do.

- But in all of these aspects security and employment are the two main worries in this neighborhood, and these have to be taken into account to promote any other policy a Fair Energy Transition.

During the meeting POCITYF and the current state of Granada replication plan was presented, giving insight of the last advancements, and possible PV plan on public buildings rooftops. As well speaks about "GRANADA MEJORA" APP for citizen participation. Nevertheless, in the neighbourhood the average age is quite old and a good part of the citizenship rather prefer events as this one. In any case, the district manager invites all citizens represented in the meeting to active participate in the plan, as for example with the needs already detected in the previous section. Some of the citizens are interested in the creation of energy communities or shared PV auto consumption in the neighbourhood.

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Figure 15. Presentation of POCITYF in the "North" MDB

3.4 Replication Tools utilization

3.4.1 Workshops and Capacity Building

From the beginning of the project, periodical workshops have been organized for coordinating and monitoring the Replication Strategy of the FCs. Granada has participated in these workshops, highlighting the related to the LHs-FCs Knowledge Transfer which had an important impact in the progress of the Granada Replication Plan.

A summary of the workshop held is shown in the next table:

Workshop	Date
Knowledge Transfer, Évora	26th October 2020
Knowledge Transfer, Alkmaar	16th March 2021

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Synergy with IRIS and RESPONSE projects	May 2021
Knowledge Transfer (Topics: procedural, legislative and problems solved)	20th December 2021
Synergy with SPARCS project	February 2022
Regulatory framework	14th April 2022
Feasibility Study	17th May 2022
Knowledge Transfer (Topics: latest demonstrated solutions)	7th July 2022

Table 22. Replication Tools' workshop and dates

Granada's ecosystem also participated in periodic WP8 meetings with the aim of coordinate actions, present foreseen activities and subsequent steps, timelines, milestones, discussion on risks and knowledge sharing amongst the FCs themselves.

The participation in periodic H2020-SCC01 Task Group Replication facilitated knowledge sharing between EU SCC projects, including information on commonly used roadmaps, tools and assessment metrics.

3.4.2 Knowledge Transfer from LHCs

As far as possible, taking into account the agendas and availability of personnel, the Granada ecosystem team has participated in the knowledge transfer seminars that have been carried out by the project's working groups. In a way, this is the core of the project's work dynamics, and this is the formula that provides the most value for Granada's ecosystem, and that allows us to guide the action of the CFs. This type of meeting is not only a unidirectional or passive process from the LHs to the FCs; a working space is created in which, together with the transfer of real experiences in the implementation of technical solutions, new ideas, shared challenges and innovative approaches emerge.

3.4.3 Factsheets

Although the general definition is clear, it is necessary to clarify the meaning of factsheets specifically in this project: They are the documents that collect the most relevant information of each IE individually, both in terms of objectives, the potential for use, as well as more technical data or associated costs.

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They have a dual purpose: to be a communication document between project partners and to be a dissemination document, especially useful to be able to consistently transmit knowledge to stakeholders and even to a part of the population, those with a higher degree of knowledge.

Although some solutions are not entirely new to the team or stakeholders as they have been proposed, they are a valuable resource, making tangible many issues that initially have a low degree of concreteness, and thus allowing for greater understanding of their potential.

They have been used both in the meetings with stakeholders and in the dissemination session to the population. We highlight that, regarding the stakeholders, they were particularly interested, requesting access to them.

3.4.4 Synergies with other SCC EU projects

Granada has been participating in various European projects for several years. These projects are fundamental in contributing to the municipality's goals of reducing its impact on the environment and moving towards a Smart City model.

Below there is a list of the projects in which the city has participated in recent years and a brief description of each project.

Color Circle   (https://www.interregeurope.eu/colorcircle/)

URGE   (https://urbact.eu/urge)

OPTITRANS   (https://www.interregeurope.eu/OptiTrans/)

Excess   (https://positive-energy-buildings.eu/)

EERADATA   (https://eeradata-project.eu/)

S3UNICA   (https://www.interregeurope.eu/s3unica/)

HYPERION   (https://www.hyperion-project.eu/)

THE 3Rs   (http://www.the3rproyect.com)

SOLAR PROYECT   (http://www.solar-erasmus.eu/)

GreenVolve   (Greenvolve (greenvolve-project.eu)

COLOR CIRCLE

The technical solutions of the POCITYF project are largely part of the circular economy (in design and implementation), and their character as experimental solutions in new territories would be directly related to the objective of the Color Circle project, to facilitate the transfer of knowledge between the world of academia and research and the needs of local entities and local productive fabric. For a 2050 plan, the connection between university and local needs is key.

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There are two major actions within the Color Circle project:

> 1. A regional mapping of the situation of the province in terms of Circular Economy is being carried out, which includes the energy issue, this will allow establishing strategic lines for the development of the Circular Economy.

> 2. An action plan is being drawn up, which seeks to establish and consolidate a mechanism for collaboration between the University and local entities, so that the knowledge generated at the University of Granada is more accessible to local needs, mainly to through a system of scholarship holders in the territory and the creation of a space to combine needs and scientific production.

URGE

Granada City Council participates in the URGE project, currently underway. The Sustainable Construction Cluster of Granada, a key organization in the provincial sector, also participates.

This project revolves around the circular economy in the construction sector, a large consumer of raw materials. The circular economy still has a long way to go in this sector, both in design, use of materials, construction and demolition. This project aims to help reduce the gap in the implementation of the principles of the Circular Economy in the sector.

The technician responsible for the city council of Granada has made a presentation of the POCITYF Project, in order to establish the appropriate synergies.

OPTITRANS

Metropolitan BIKE LANE infrastructure under public procurement process (by provincial government), further bike lanes to be implemented in 2022 and coordinated with Granada Town-hall.

EXCESS - USER-CENTRIC FLEXIBLE ENERGY HOMES

EXCESS will lead four innovative demonstration projects, introducing technical solutions that enable buildings to produce more renewable energy than they consume over the course of a year. By implementing demonstration projects covering the Nordic, continental, oceanic and Mediterranean climate zones, EXCESS aims to test, validate and share BEP solutions with potential for replicability across Europe.

The Spanish demonstration case is located in the metropolitan area of Granada, between the municipalities of Gójar and Dílar. Located in the foothills of the Sierra Nevada, the region is characterised by a mild Mediterranean climate.

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The demonstration building is part of the wider NIVALIS development project, the first zero-energy district planned in Spain, designed as a "smart and healthy solar city" that prioritises ecological sustainability, energy self-sufficiency and electric mobility.

The project neighbourhood is advancing in achieving all regional and local permits to be able to start the construction of the site, that is foreseen for 2022.

THE 3R´s PROYECT

This is an Erasmus + project in which the Granada Provincial Council's Energy Office participates. In this project, different contents are being created on a 0 Waste way of life, with different groups of the adult population as a target group, both in written format and as a podcast. These contents can be useful to increase the awareness and commitment of citizens in other projects with similar themes such as POCITYF.

SOLAR PROJECT

This project works to promote Integrated Food and Energy Systems for climate-smart agriculture.

Following the methodologies of the Erasmus + projects, a methodology is developed to introduce SOLAR competences in the curricula, as well as the learning materials developed in accordance with this curriculum. It will mean an increase in capacities to be able to incorporate new sustainable energy solutions to the agricultural environment, and in turn will increase the awareness of the population in general.

GREENVOLVE PROJECT

Greenvolve project aims to incorporate knowledge on green city as well as competences on active citizenship by focusing on two main pillars: 1) Green city elements and 2) Public consultations and other forms of city engagement. Exactly the same as in POCITYF ETT4.

3.4.5 Work groups

The work team has gradually been structured, but with some delay due to administrative and contracting issues, which have led to a certain delay in some activities. Nevertheless, the Granada Ecosystem has been created, counting with different periodic meetings, regular communication via email and phone, and shared online working spaces. At the beginning of the project there have appear some delays to form the group, but finally it is working properly now aiming to achieve a better coordination.

If we speak about the working groups with local stakeholders, the people to participate in each one of them have been already selected based inter expertise and their knowledge of the local

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situation, this is especially important to intensify the work with the working groups of each ETT, in the coming phase it is necessary to intensify the rhythms and take accurate steps to achieve the objectives.

3.4.6 ICT Tools

In addition to the use of Teams with the POCITYF consortium, the Granada ecosystem has used the SLACK platform as the main communication tool. To send surveys we have used Google Forms, whose link has been distributed through different channels, especially email.

It should also be noted the use of common internal work tools such as Google Drive.

Speaking about awareness to local stakeholders and general public, the presentations and documents of LHCs have been shared among stakeholders, and the preparation and first trials of "GRANADA MEJORA" and GRANADA DECIDE" APPs have been launched. In the next steps of the project, these will gain more and more content and will be improved.

As well, waiting for POCITYF factsheets to be able to distribute those, as well, other factsheets to be included those of Greenvolve project to promote in the participation process

Finally, POCITYF technology map to be used in the implementation of the plan as well

3.4.7 Questionnaires

In our case, a questionnaire was carried out at the beginning of the project to the interest groups that had little impact. But later two surveys have been carried out, one on the interest groups and their level of influence and the other on citizen participation, in both cases a detailed analysis of the data must be made so that conclusions can be drawn that can be used for the following phases of the process. However, and as a first point, the fact of making a questionnaire has allowed at least to provide specific information on the planned technical solutions, motivate to reflect on it and maintain a certain degree of commitment.

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

Granada Smart-City concept consists of the development of a city that applies ICTs to improve the quality of life and accessibility of its citizens and tourists and ensures a sustainable economic, social and environmental development, which is continuously being improved.

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The replication solutions selected within the framework of POCITYF allow multidisciplinary interaction of citizens and tourists with the city of Granada. In this way, Granada will be adapted in real time to the needs of their citizens in a cost- and quality-efficient manner.

Social Compatibility Propagation (P.1)

The Granada Smart-City concept changes the existing relationship model. From an economic point of view, it gives way to the collaborative economy; in social terms, it allows new forms of citizen participation, and at the municipal level it facilitates the adoption of more agile and transparent urban policies.

This new relationship model opens the door to more fluid communication between all stakeholders (citizens, companies, institutions, visitors, investors, etc.) and, in turn, deepens its integration with other cities and other territorial scales.

Since 2005, the Municipality of Granada has always included the insights of the citizens for the development of its Strategic Plans by using surveys, forums, etc. The elaboration of this Replication Plan is no exception, and it is based on the participative outcomes which were obtained for the development of the Granada Smart-City Strategy [3]. Then, citizen participation was counted on through a public survey published on the Town-Hall's website and which was widely disseminated through different official media in order to have the largest number of participants.

The most relevant problems identified by the Granada citizens (Figure 16) are shown below.
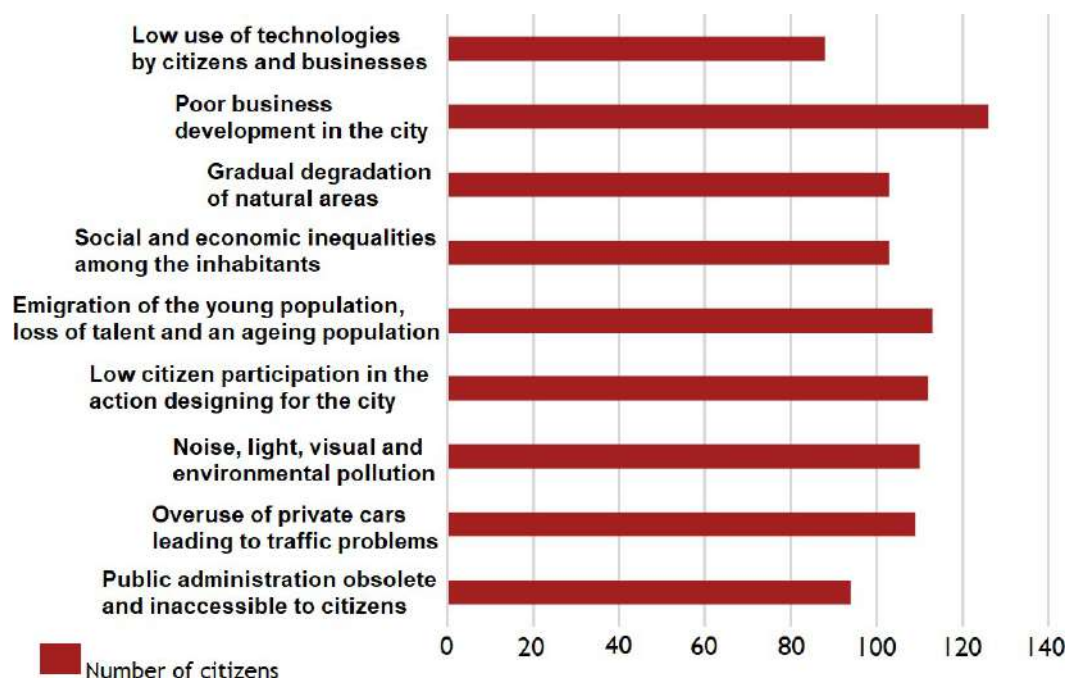
Figure 16. Most relevant issues in Granada for the citizens

On the other hand, in relation to the challenges to be faced by Granada (Figure 17), the following are identified as the most relevant:
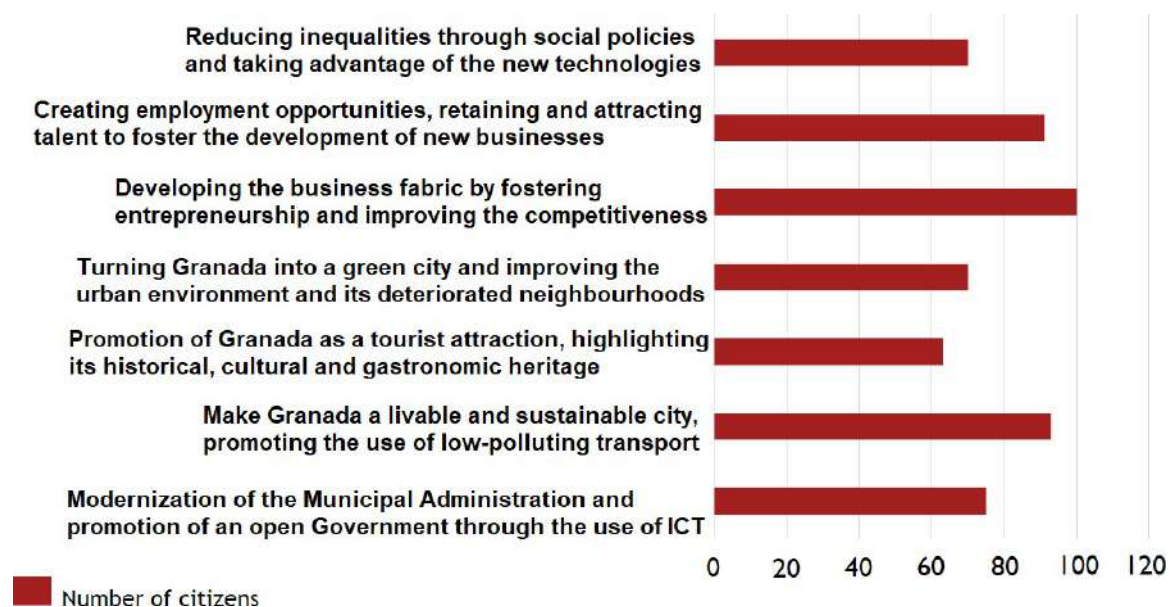
Figure 17. Most important challenges to be addressed for the citizens

Technical Compatibility (P.2)

The key to achieve the goals set in the Granada Smart-City Strategy is the use of technology as a disruptive factor, which makes possible to collect large amounts of data, to be processed and shared in real time in the form of relevant information, generating added value.

The digital revolution makes it possible to expand and enrich the information provided to citizens and organizations; it enables synergies and interoperability within the city itself and with other services and supra-municipal systems (transport, energy, health, etc.) and drives innovation with activities such as open data, living labs and tech hubs.

However, although digitization is an essential component of the process, a Smart City cannot be created solely by deploying sensors, networks and data analytics to improve the efficiency of its services. The Smart City model implies a new way of living, managing, connecting, consuming and enjoying urban space.

These factors enhance the need to develop strategic planning processes to improve management systems in order to meet the needs of the citizens. Therefore, through this RP and following the guidelines of the National Smart Cities Plan, the Innovative Solutions to be replicated in the city of Granada have been selected looking for the best achievement of the Granada smart city objectives and at the same time, covering the needs of the citizens and the city itself.

4 Building up the Replication Plan and City Vision 2050

4.1 Building up the Smart City Vision and Plan

Granada aims to be a sustainable and liveable city with a high quality of life in which its citizens are an active part in the decision-making process, and in which economic development is promoted through new technologies and innovation.

This bold vision implies a future for the city in which its development is boosted towards:

- **A sustainable and livable city**. This point suggests the priority to make Granada a city with a high level of well-being and quality of life, where its inhabitants can enjoy their day-to-day life without any mobility issue or pollution, offering citizens attractive alternatives for getting around the city but also shifting their mobility habits to sustainable transport ways.

- **Open and transparent local administration**. Granada must be a participative city in which citizens support decision making and where they can find transparently out the initiatives carried out by the local administration.

- **A city which supports the economic development**. Granada's future lies in supporting and boosting the potentially most attractive economic sectors, using innovation and ICTs to retain talent and attract investment, and to consolidate Granada as a benchmark in the technology sector in general, and in particular in the biotechnology sector.

- **New technologies and innovation as a lever for the development of Granada**, both on the supply side, by modernising the local administration and using these technologies in the services that the City Council provides to citizens, and on the demand side, by training companies and citizens so that they can make proper use of these services.

In this way, the Granada Smart-City Strategic Plan [3] defines 8 strategic objectives (Table 23) framed in the different Smart Areas to achieve its vision of future. The selected IEs of POCITYF have being selected to progress in the achievement of this vision.

STRATEGIC OBJECTIVES	SMART AREAS
O1 Promote the information society and the use of new technologies by citizens, integration of municipal services in order to improve their usability and supporting the digital training of the citizens.	Governance
O2 Exploit the data received from all the Smart Systems of the city and process this information in a proper way to facilitate decision-making and improve the municipal services.	

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O3 Commitment to the modernisation of the Local Administration that allows public services to be offered to citizens through ICTs, simplifying procedures with the Local Administration and increasing the degree of citizen satisfaction.	
O4 Promote sustainable mobility ways and taking advantage of the benefits offered by new technologies, as well as the implementation of the sustainable urban mobility plan in order to reduce traffic congestion and parking problems in the city.	Mobility
O5 Reduce the levels of noise and air pollution in the city.	Sustainability
O6 Increase citizen engagement in the design of public initiatives and improve the levels of transparency of Granada's Town-Hall.	Social
O7 Development of technological measures that make possible to build a city that closer to its citizens, without social inequalities and that strives for integration and personal development.	
O8 Promote the development of the local businesses by promoting the city's strategic sectors such as biotechnology and tourism, which allows retain talent and attract investors by leveraging innovation and new technologies and modernising traditional sectors such as commerce, with the ultimate goal of revitalising and developing Granada's economy.	Economy

Table 23. Strategic objectives and Smart Areas

In the tables below, the strategic objectives of the Granada Smart-City plan are related to the selected Innovation Elements of POCITYF, which are specified in this Replication Plan. In this sense, the coherence with the already defined policies is shown in Table 24, Table 25, Table 26 and Table 27.

ETT 1 - POSITIVE ENERGY BUILDINGS AND DISTRICTS

IS- 1.1 - PEB or Positive Energy (stand-alone) Buildings

IE#	IE (Innovative Element)	O1	O2	O3	O4	O5	O6	O7	O8
1.1.2	PV Canopy					V			
1.1.3	PV Skylight					V			
1.1.6	Bidirectional smart inverters					V			
1.1.8	BMS (Building Management System)		V			V			

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1.1.10	HEMS/BEMS (Home/Building Energy Management Systems)	V	V			V			
IS- 1.2 - PED Retrofitting or Positive Energy Districts Retrofitting									
IE#	IE (Innovative Element)	O1	O2	O3	O4	O5	O6	O7	O8
1.2.1	Smart Lamp posts with EV charging and 5G functionalities	V	V		V	V			
1.2.3	Smart Distribution Energy System		V			V			
1.2.5	Community Solar Farm					V	V	V	

Table 24. Alignment of selected IEs from ETT 1 and Granada's Strategic Objectives

ETT 2 - P2P ENERGY STORAGE AND MANAGEMENT									
IS- 2.1 - Flexible and sustainable electricity grid networks with innovative storage solutions									
IE#	IE (Innovative Element)	O1	O2	O3	O4	O5	O6	O7	O8
2.1.3	Flexibility Control Algorithms		V			V			
2.1.6	City Energy Management System (CEMS)	V	V			V			
2.1.12	Fuel cells (hydrogen)					V			

Table 25. Alignment of selected IEs from ETT 2 and Granada's Strategic Objectives

ETT 3 - E-MOBILITY INTEGRATION INTO SMART GRID									
IS- 3.1 - E-mobility services for citizens and auxiliary EV technologies									
IE#	IE (Innovative Element)	O1	O2	O3	O4	O5	O6	O7	O8
3.1.2	EV charger prototype with PV integration				V	V			
3.1.5	Smart lamp posts with EV charging and 5G functionalities	V	V		V	V			

Table 26. Alignment of selected IEs from ETT 3 and Granada's Strategic Objectives

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ETT 4 - CITIZEN-DRIVEN INNOVATION IN COCREATING SMART CITY SOLUTIONS									
IS- 4.1 - Social Innovation Mechanisms towards Citizen Engagement									
IE#	IE (Innovative Element)	O1	O2	O3	O4	O5	O6	O7	O8
4.1.1	Digital transformation in Social Innovation	V		V			V	V	
4.1.3	Tourist apps			V					V
4.1.6	Value based design			V			V		
IS- 4.3 - Interoperable, Modular and Interconnected City Ecosystem									
IE#	IE (Innovative Element)	O1	O2	O3	O4	O5	O6	O7	O8
4.3.1	City Urban Platform	V	V	V					V
4.3.2	Wi-fi data acquisition systems		V						
4.3.5	Citizen Information Platform	V		V			V	V	

Table 27. Alignment of selected IEs from ETT 4 and Granada's Strategic Objectives

As can be seen, there are Strategic Objectives that express the desire to develop a transparent and efficient local government, to modernise e-Government and to promote citizen participation both in decision-making and in the use of resources that the city makes available to citizens. These objectives are consistent with the Innovative solutions developed in POCITYF, which, through ICTs, aims to consolidate Local Government and a modern, efficient and transparent Administration that fosters the citizen-Government relationship.

Related to urban sustainability and mobility, Granada has set objectives for the sustainable development of a city that promotes environmental conservation, a low-carbon economy and improved mobility and accessibility. The Granada Smart City Strategic Plan establishes, among its objectives, the intention to promote the use of sustainable transport modes, improve accessibility and mobility and reduce environmental pollution in the city by relying on the use of new technologies. Therefore, in terms of sustainability and mobility, this RP is in line with the strategic objectives set for the city in the plans developed previously.

In the social field, Grenada has set the goal of reducing social inequalities and promoting the integration and digital training of the citizens through ICTs and innovative solutions. Besides, in the economic field, the objective is to develop a local economy based on innovation, research and new technologies.

Therefore, the Replication Plan has been designed to achieve Granada's Smart-City vision: a sustainable and liveable city in which the citizen is an active part of its services and in which

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economic development is promoted through new technologies and innovation. Always in accordance with and respecting previous strategic plans and national and European policies.

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

Next Smart City projects in Granada must go one step further and become into realities with an impact on municipal management and citizens' lives. The use of technology in the different municipal services (known as "vertical measures") still has an important impact in the city, but in general terms, it is necessary to make the leap towards a horizontal vision in the city management that facilitates synergies among municipal services and the participation of all the city's stakeholders, composing what is known as the Granada ecosystem. This is the great challenge to be reached.

In this sense, Granada has defined a roadmap with 4 phases, which does not have to follow a sequential order, to become a Smart City:

- Vertical measures. This involves the introduction of innovative technologies in the different urban services (water management, waste management, mobility, etc.). These solutions are generally promoted autonomously by each management area of the Granada's Town-Hall and with the collaboration of the corresponding urban services companies.

- Horizontal measures. The second stage is characterized by a horizontal vision. Both in terms of services and in terms of physical and technological infrastructures.

- Connected vision. In this third phase or layer, the objective is to have the city interconnected with the involvement and participation of the entire ecosystem. Once the city has digitalized the services and implemented a horizontal solution, it is the time of interconnecting the city, the citizens, urban services, universities and, in short, the entire local network. The aim is to have interoperable platforms and common interconnected infrastructures.

- Smart vision. In the final phase, managers make predictive decisions based on data analysis and have a developed ecosystem of innovation.

Granada is currently at level 1, the city has numerous vertical resources to provide service to citizens and tourists and to collect data, but these are not integrated. Therefore, the selection basis of a determined ISs must be rely on the shifting from level 1 to level 2 in order to move towards smart management, but also progressing with development of new vertical measures.

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Therefore, given the current status of the city and its vision for the future, the proposed technical solutions are mainly focused on the integration of all Smart Areas, which currently operate independently, to achieve a connection and subsequent joint exploitation of the data generated.

The horizontal measures will allow the analysis and process of the data generated by each vertical system in order to improve the efficiency of the resources available in the city. This is because the analysis of this data allows the continuous optimisation of the municipal services that Granada makes available to its citizens and tourists according to their needs.

This Replication Plan promotes solutions to support the consolidation of a holistic vision of the Granada's smart initiatives.

4.2.2 List of POCITYF ISs selected to be replicated

As mentioned previously, the ISs select to be replicated in Granada are the following:

ETT 1 - POSITIVE ENERGY BUILDINGS AND DISTRICTS

IS-1.1 - PEB or Positive Energy (stand-alone) Buildings

IE-1.1.2	PV Canopy
IE-1.1.3	PV Skylight
IE-1.1.6	Bidirectional smart inverters
IE-1.1.8	BMS (Building Management System)
IE-1.1.10	HEMS/BEMS (Home/Building Energy Management Systems)

IS-1.2 - PED Retrofitting or Positive Energy Districts Retrofitting

IE-1.2.1	Smart Lamp posts with EV charging and 5G functionalities
IE-1.2.3	Smart Distribution Energy System
IE-1.2.5	Community Solar Farm

ETT 2 - P2P ENERGY STORAGE AND MANAGEMENT

IS-2.1 - Flexible and sustainable electricity grid networks with innovative storage solutions

IE-2.1.3	Flexibility Control Algorithms
IE-2.1.6	City Energy Management System (CEMS)
IE-2.1.12	Fuel cells (hydrogen)

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ETT 3 - E-MOBILITY INTEGRATION INTO SMART GRID

IS-3.1 - E-mobility services for citizens and auxiliary EV technologies

IE-3.1.2   EV charger prototype with PV integration

IE-3.1.5   Smart lamp posts with EV charging and 5G functionalities

ETT 4 - CITIZEN-DRIVEN INNOVATION IN COCREATING SMART CITY SOLUTIONS

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-4.1.6   Value based design

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

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

At the end of POCITYF, the implementation of the Replication Plan has to continue progressing. In this sense, Granada will have to overcome different barriers depending on the existing legislative framework, the status of the city, the political context and the particular circumstances (level of progress, type of projects being addressed, etc.). To this end, six common areas of work are identified to move from planning to implementation:

- Ensure clear leadership and an organization with the capacity to execute and with a cross-cutting vision of the initiatives defined. It is the mayor who must exercise leadership, given that he/she is the one who has the capacity to set the local agenda and allocate the necessary resources. It is also essential to promote a transversal organization that facilitates the achievement of synergies between services.

- Having a shared and consensual vision of the city and a long-term strategic and action plan. The city cannot be transformed in a municipal mandate and it is therefore necessary to seek consensus, even formulas for collaboration between city councils, which allow challenges that are difficult to overcome in the short term (such as investment in infrastructure). The citizens must always be at the centre, collaborating and participating.

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- Advance into a new model for the relationship between government and business, supported by an evolved legal framework. The new model must facilitate the integration of services, the development of long-term relationship schemes and the incorporation of payment according to the level of service based on the fulfillment of indicators, instead of a fixed amount based on the resources dedicated.

- Incorporate open, standard, horizontal and interoperable technological solutions, with a scalability that even allows it to be applied to other cities. Flexibility is a necessary condition for integrating the set of smart systems into a city management platform that provides intelligence and the capacity to dynamize its relationship with citizens and companies, laying the basis for the creation of an innovative ecosystem.

- Promote financing models with private participation. Private companies guarantee faster progress in the transformation of services and provide specific skills and knowledge that municipalities do not always have.

- Develop sustainable business models. The future Smart City platforms will generate valuable information that allows more traditional business models to evolve in two directions:

- Improving city management, moving towards services managed on the basis of usage, quality or savings indicators that allow a greater efficiency and return on investment.

- Making information available to third parties (open data), opening up new models based more on the participatory economy and entrepreneurship. This is the "economy of data".

4.3 Designing the replication of ISs

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

The scope of the Replication Plan is to bring Granada closer to the goals defined in its Smart City vision. In order to do so, the replication of ISs and IEs defined in POCITYF have been analyzed and the basic selection criteria have been developed. We have focused on the solutions that best fit in the Granada context, both from a technical and socio-economic point of view.

The Replication Plan for Granada applies to a very large area, which includes almost the entire city centre (see Figure 13 in Section 2.5).

Within the ISs identified by the Granada ecosystem as the most suitable for the development of the city, there are some that have general application to the entire area and others that are more specific or even relative to a single building.

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A third type of ISs will produce digital tools with the aim of improving citizen engagement, social relations in at-risk neighborhoods, the usability of the city by tourists, and the digitization and smart management of city data, especially regarding energy consumption

Some solutions for stand-alone buildings, such as PV Canopy and Skylight, feature technologies already present in the area, with which local companies and citizens are already familiar.

Solutions with district or city-wide application need a longer design time than building interventions, not to mention the longer implementation time and the higher costs.

Most of the digital IEs are based on the update of existing services that the municipality is already providing, which will be implemented in the near future after POCITYF project end.

The four PEBs on which IS 1.1 **PEB or Positive Energy (stand-alone) Buildings** will be applied are within the Replication Area, along a line from the city center to the Zaidín district (Figure 15).
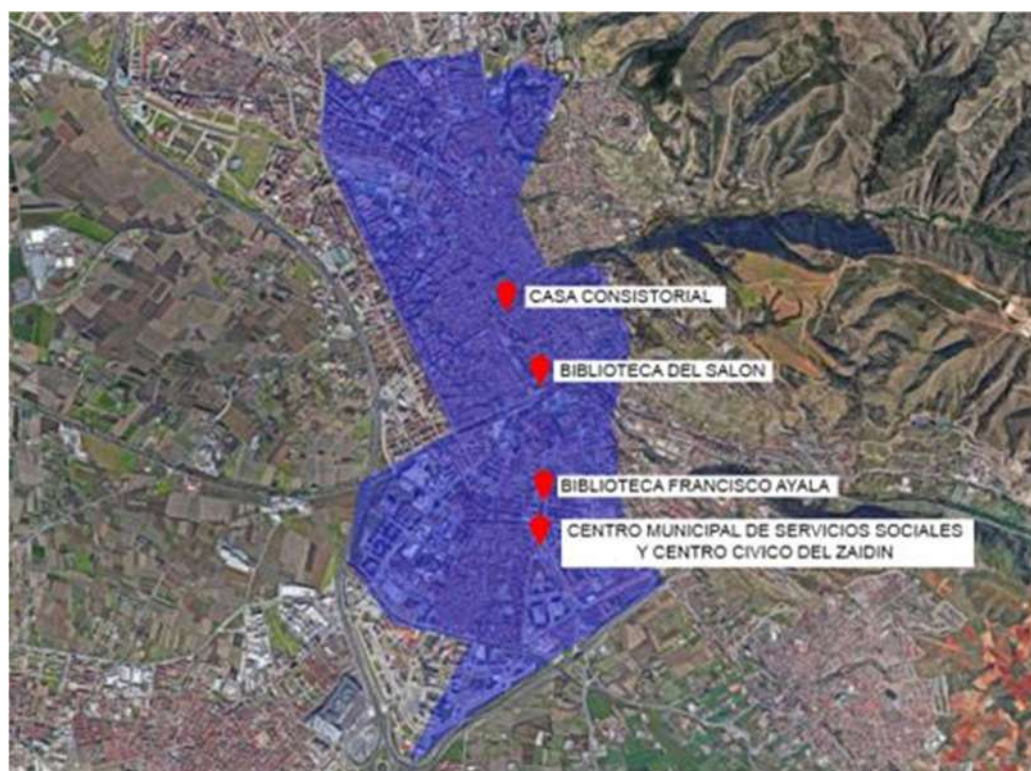
Figure 18. Stand-alone Buildings. In blue the Replication Area

The Municipality of Granada is carrying out retrofitting works to improve energy performance of some of the public buildings of the city.

In most cases, these are passive measures, which aim to improve structural and morphological problems in the building, or relate to the state of conservation. But, also updating old HVAC systems and the electrical installation of these buildings.

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The IEs that have been studied within the POCITYF project, on the other hand, are generally active measures, aimed at increasing energy production or better managing its use, since these are critical in order to achieve positive buildings.

In this sense, the first step in order to achieve positive energy buildings and districts is to focus the effort on achieving near zero consumption buildings. Then, once the impact of the buildings has been reduced, the next step for Granada is to make them energy positive.

CASA CONSISTORIAL (PEB1)

The building located in Plaza del Carmen hosts the City Hall. Originally from the 17th century and rebuilt at the end of the 19th century. In the mid-1970s, a major refurbishment was carried out, which consisted of increasing the building's initial height by two storeys to make room for offices.

The building is currently in a good state of general conservation, although it has obsolete and energy inefficient installations, as the roof is not thermally insulated in its entirety and the window and window frames do not have the appropriate insulation and water tightness elements.
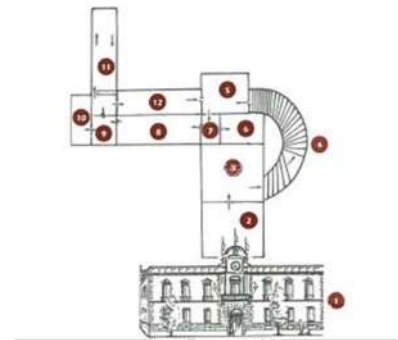
Figure 19. Casa Consistorial – External view and schematic Plan and facade

There are obsolete air-conditioning installations and low thermal insulation of walls and roof. However, a BEMS is implemented in order to optimize operational control.

The measures to improve energy efficiency already envisaged by the Municipality of Granada are:

- Roof insulation, currently absent and easily realized without changing the external appearance of the building

- Windows, air tightness improvements, replacing existing windows and doors that do not have an adequate thermal behavior

- LED lights, to decrease the electricity consumption due to the actual lighting system

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With the POCITYF project the aim of the Municipality is to extend these measures, adding various IEs to further improve the building's energy behavior with the final goal of making it energy positive. Most of the new foreseen measures tend to:

- Walls insulation, which could present the problem of the conservation of exterior façade

- Update and automatization of the HVAC system with the improvement of the BEMS

- As a Heritage protected building, PV cannot be installed on the roof. The creation of the Community Solar Farm will give the possibility to use renewable electricity also in this type of building where the energy production is harder.

BIBLIOTECA DEL SALON (PEB2)

Figure 20. Biblioteca del Salon – external and internal views

This building is located in Paseo del Salón and dates back to 1917. It hosts a public library and in the years was object of several refurbishments.

It consists of a single body distributed in a ground floor and a semi-basement with a tower in the access area. The roof is not thermally insulated, and the carpentry is made of wood with single glazing that is not sufficiently watertight. The air conditioning installations are 10 years old and have a low level of operational control.

The plans of the Municipality foresee the implementation of different solutions to improve the behavior of the building:

- Roof insulation

- Update electrical installation

- Replace windows

- LED lights

The extension of these measures considering the POCITYF IEs can consider the application of these measures:

- Walls insulation,

- Update and automatization of the HVAC system with the improvement of the BEMS

- BIPV, as for the Casa Consistorial, the heritage legislation doesn't give the permission to install PV on the roof. BIPV solutions can be an opportunity to look for.

BIBLIOTECA FRANCISCO AYALA (PEB3)

Figure 21. Biblioteca Francisco Ayala – External and internal views

Building located in Plaza de La Hípica, built in 2010, it hosts a public library.

Recently retrofitted, it consists of a single storey building for the reading rooms and two floors for the office area and toilets, currently in a good state of general conservation. The air conditioning installation has a low level of operational control.

Municipality already implemented an advanced air conditioning control system in order to improve the energy efficiency of the building.

Within this project, the Granada ecosystem is planning to install these IEs:

- Rooftop PV, in order to produce the energy necessary to the required supply of the building and to involve the building in the community solar farm.

- Energy management system, that will be able to control able to control the HVAC systems through different sensors and actuators and it is currently being improved in order to increase its functionalities.

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CENTRO MUNICIPAL DE SERVICIOS SOCIALES Y CENTRO CÍVICO ZAIDIN (PEB4)

Figure 22. Centro Municipal de servicios sociales y Centro cívico Zaidín – External views

Building located at C/Andrés Segovia, 60. In the same building, with two floors and a semi-basement, are located the offices of the Zaidín Social Services Centre, the Civic Centre of the same District and the Isidro Olgoso Municipal Theatre.

Built in the mid-1990s, the building has undergone some minor alterations throughout its life. Currently, it is in a good general state of conservation and the roof has thermal insulation. The roof is mostly made of aluminum with double glazing, without thermal break and lacks adequate watertightness. The air-conditioning system has a low level of operational control.

The existing plans from the Municipality intended to tackle the emergencies in this complex to reduce relative energy consumption with the following actions:

- Replace windows,

- Reduce thermal bridges, present throughout the structure that compromise the energetic and health performance of the structure.

The scope of the POCITYF intervention on this building is to make the measures already provided for by the municipality more comprehensive and effective through the implementation of energy positive solutions:

- Rooftop PV, in order to produce the energy necessary to the required supply of the building and to involve the building in the community solar farm.

- Walls insulation, in this case should not have the problem of the conservation of exterior façade as the building is not protected by heritage protection regulations

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- Energy management system, that will be able to control able to control the HVAC systems through different sensors and actuators and it is currently being improved in order to increase its functionalities.

Once the reduction of the energy consumption in buildings has been addressed, particularly in the HVAC systems, it is necessary to make decisions on the rest of the thermal demands for the transition towards the green energies.

Granada is interested in assessing the most efficient solutions at the District Level, such as heating and cooling networks (DHC with renewable energies). However, the current Spanish legislation is not still enough appropriate to foster the deployment of DHC networks, or at least in the south of Spain where Granada city is placed, the municipality of Granada will remain expectant on the evolution of the national legislation, to start a techno-economic analysis of a low temperature smart grid in the Granada context. Besides, Granada will keep engaged with the potential of the energy savings offered by DHC technologies, and in this sense, the public administrations have a key role supporting private initiatives and funds, since they are an essential stakeholder in the deployment process of the future DHC networks.

In general, in the center and south of Spain there is not a great culture of heating networks, as it is perceived as a huge and difficult investment with a great impact on the population. Although there are many public and public-private networks in Northern Europe that can be analyzed through the ROKWOOD 27 project, there is much resistance to this model in Granada. Similarly, at the level of heating networks, the technology is very advanced, but cooling networks are more innovative, with more expensive equipment and much more difficult to implement.

Other evidence that is in study process is the WEDISTRICT project 28, where it will be tested a New District of heating and cooling in the technological area of Alcalá de Henares (Spain) in the R&D center of the company CEPSA, integrating three different technologies of solar thermal energy, low emission biomass boilers and thermal storage (based on molten salts and water tank) together with renewable cold technologies (for generation of cold water and cold air through renewables).

The result will be one of the leading "solar DHC laboratories" in Europe led by DH Eco Energies.

We also find some examples of suppliers already operating in Spain, in cities such as Barcelona or Zaragoza, where the actors of the service are clearly specified: the Regulator, which is the public authority responsible for regulating the service, and the System Operator, which is the company designated by the regulator to manage the service.

At present, the heat and cold distribution network is regulated by concessions; as these infrastructures require high investment by the system operator, they are established for long periods that allow for a return on investment. Once this period is over, the infrastructure reverts to the government.

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Most of the current barriers to the development of DH/DHC systems are found in the first phase of projects, in the approach and proposal phase. These barriers come from different contexts and can be legal, technical, economic, institutional, social and cultural.

In the case of Granada city, there are mostly legal and economic. At the moment, besides Granada's interest, the current legislation makes impossible to create a DHC, due to problems regarding the regulations of property and economic funds for the works

Granada is also interested int the possibilities offer by thermal storage systems to reduce the primary energy consumption. Solutions like hydrogen Fuel cells are a viable solution for the city of Granada to reduce emissions and realize their green energy transition. However, these solutions have not been implemented yet.

At the district level, Granada is planning to reconfigure the city's electricity production and distribution system, with measures ranging from one-off interventions to large urban structures.

Granada is already retrofitting the public lighting by the implementation of a smart lighting system with LED technology. Besides, further studies are being carried out in order to select new points for the implementation of smart lamps with EV charging. A final number of 37 points will be installed.

The type of luminaire implanted in each area of the city responds to aesthetic and functional reasons, having as a fundamental criterion the installation of artistic lighting points in central and emblematic areas of the city and opting for functional lighting points in areas with heavy traffic.

The increase in electricity production will take place by installing PV ROOF and PV Canopies on all municipal buildings and schools. The total power expected to be installed on the approximately 200 buildings identified is 4MW (Figure 23).

These power generation facilities will be created following the 'Community Solar Farm' concept, so the surplus of any installation can be consumed in other municipal building or any other associated consumer.

The Smart Distribution Systems of the smart grid will be responsible for intelligent management and operation of energy networks.
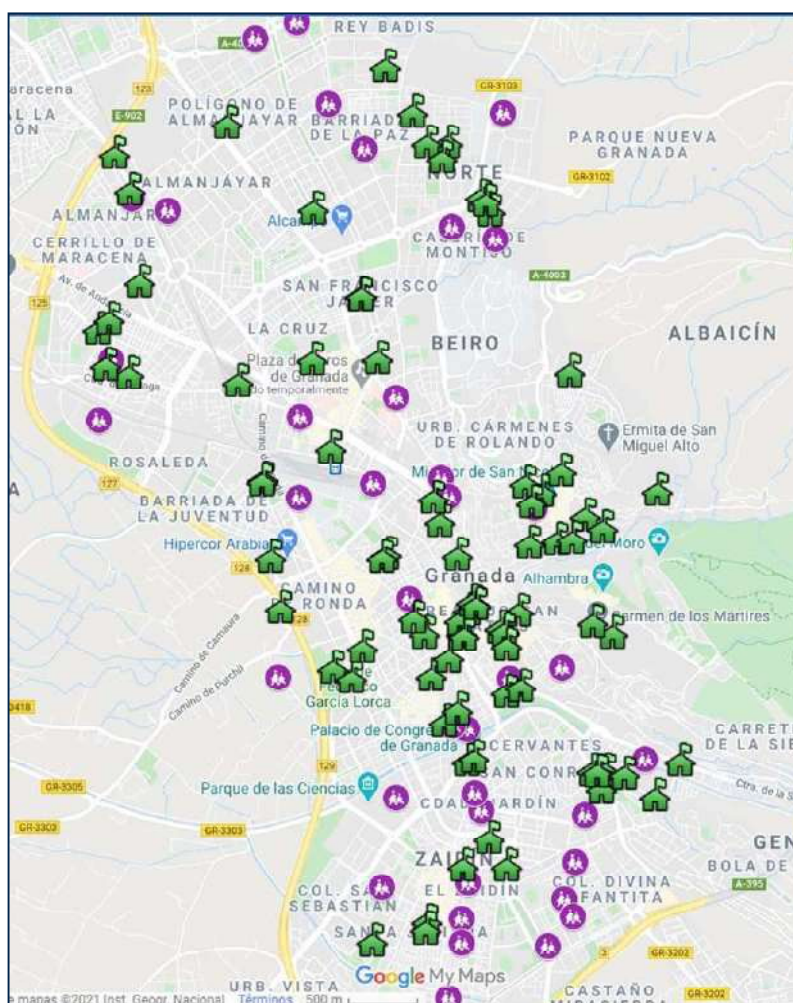
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Figure 23. Municipal building and schools for PV rooftop installation

Granada relies heavily on the development of digital tools to improve the quality of life in the city.

Apps already in operation, such as 'Granada Mejora', give the citizen the role of act as a "sensor" in order to detect potential issues in the city, and increasing at the same time the citizen engagement to improve the quality of life in their neighborhoods. Through POCITYF, an attempt will be made to improve the functioning of this app. Also, Granada keeps looking for any other tool able to improve the social innovation.

Tourism is a major focus of the municipality. For this, a number of apps are already in use, one of them being 'Granada Accesible'. Through POCITYF, efforts will be made to improve the offer and functionality of existing software.

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CITY URBAN PLATFORM (IE 4.3.1)

As previously mentioned in 4.2.1, Granada is already developing smart services which are being autonomously developed by each Management Area of the Town-Hall. However, the Smart City concept is associated with a holistic or global vision of the city. In other words, it is not limited to a specific area but is present in all areas of the city and is reflected in its own management, unifying and coordinating urban areas and actors across the board. In this sense, Granada aims to develop a City Urban Platform which integrates the smart systems of the city in order to exploit the data received from each system by processing the collected info and using this valuable information to provide more efficient municipal services and achieving economies of scale.

The platform must be committed to transversality as a key element in the transformation of a city into a Smart City, and make available to its leaders a single and integrated view of all the information on the state of the management of urban services, providing the Granada's Town-Hall with greater control over processes and improved decision-making for its government.

The platform should also enable the transformation processes of services to be undertaken from a holistic point of view and the application of open data policies that favour the establishment of open and participatory innovation processes, as well as greater transparency in management.

The Smart City Integration Platform will be designed to obtain data from any smart system in the city, and be optimized to process them in order to generate useful business information for management, monitoring, governance and control.

On the other hand, to promote this holistic vision, committees will be created that will meet periodically and will be made up of at least one representative from each Management Area of the Town-Hall These committees will ensure that all areas are aware of the actions and projects carried out so that each area can benefit from the rest of the projects and avoid duplication, all working as a single team to develop a city at the service of its citizens.

This solution covers the O1 Strategic Objective and will be focused on:

- Optimisation of strategic decision making in the city through the joint analysis of the data obtained by each Smart service.

- Continuous improvement and real-time adaptation of the city's resources according to the needs of each moment.

- Enhanced coordination between the different areas of the Granada's Town-Hall.

4.3.2 Social acceptance considerations

In June 2022, at the request of the Council of the European Union, the EU's assembly of cities and regions has adopted an opinion [27] of the environmental imperatives and social acceptability of the ecological transition.

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To boost social acceptance, the Committee suggests several measures, including greater use of participatory governance – for example through participatory budgets and local dialogues – and financial support for permanent consultation mechanisms such as local climate summits. The Committee also proposes stepping up the activities of existing networks such as the **Ambassadors of the Covenant of Mayors** and of the **Climate Pact** and calls on the European Commission and Member States to finance public awareness campaigns to boost energy savings.

As well, a survey (Eurobarometer [28]) conducted by the EU commission in 2021 made clear that Europeans remain very concerned about climate change and support action across the EU to tackle it. The main findings were the following ones:

- European citizens now identify climate change as the single most serious problem facing the world.

- Over a quarter of Europeans (29%) chose either climate change (18%), deterioration of nature (7%) or health problems due to pollution (4%) as the single most serious problem we face.

- 93% of EU citizens see climate change as a serious problem and 78% see it as a very serious problem. 90% of respondents – and at least three quarters in each Member State – agree that greenhouse gas emissions should be reduced to a minimum while offsetting the remaining emissions, in order to make the EU economy climate-neutral by 2050.

- 87% think the EU should set ambitious targets to increase renewable energy and support energy efficiency.

- 87% of Europeans agree that tackling climate change should be a priority to improve public health.

- 92% of respondents think it is important their national government sets ambitious targets to increase the amount of renewable energy used and 87% believe governments should provide support for improving energy efficiency by 2030. At the same time, 75% think their national governments are not doing enough to tackle climate change.

- 81% believe that more public financial support should be given to the transition to clean energies, even if it means reducing subsidies to fossil fuels.

Nevertheless, it is not easy to reach citizenship, and often we find barriers that we didn't expect in the very first moment. There is a high resistance of citizenship to changes, and even if they usually argue about the public authorities not doing enough for the environment, is the society the first one that argues against some measures are placed in action. This is the experience that we have gained in Granada Ecosystem during POCITYF project and other results obtained at provincial level with ESMARTCITY, OPTITRANS, or GREENVOLVE projects. We have attended even the Spanish National Assembly for Clima [29], composed by 100 people of all social layers, with very impressive conclusions, but with lotsof contestation against those conclusions. The main conclusions have been the following ones:

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- When local politicians speak about participation at local level usually refer to publication in official bulletins (which a regular citizen usually doesn't check).

- There is yet low culture about participation in our public administrations, and few technicians really prepared.

- Citizenship really wants to be taken into account, but in Spain and in Andalusia there is a low culture of participation, and generally speaking they do not demand it in a proper way or do not dedicate time for it.

- In a regular basis at local level, citizens go to the administration only to ask for things for themselves, but do not want to take time to analyse the situation and participate in a responsible way. There is a clear inconsistency between the request for participation and the actual effort they devote to it.

- There is a need to promote RESPONSIBLE participatory schemes, in which citizenship is first informed about the general situation and then can suggest realistic solutions and do not feel unheard.

- There are lots of pilots about citizen participation at local level based in some meetings with few citizens and/or a group of stakeholders, which are better than nothing, but just give a partial view of the opinion of the general public. Social participation is carried out in many cases on an extremely low numerical base of citizens, being able to affirm that in many cases the "same and few" citizens are those who participate in multiple processes.

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There is a small volume of citizens with a lot of commitment who are the ones who usually participate.

- There are some really successful participatory schemes of Granada Townhall, in which neighborhood local associations gather the general opinion of their associates, and attend regular monthly meetings in which they meet townhall technicians and see all current issues to be considered.

- Nevertheless, even those nice participatory approaches do not reach the general public, and the introduction of participatory applications could be one possible solution to reach general public as its being done in some municipalities in the Province of Granada. Still, those schemes are not well advertised and under trial, and not much participation is achieved. We all need more best practices in order to promote these schemes among a wider public.

- Usually lots of current projects are achieved with raised funding from third parties as EU calls that include specific resources for the implementation of each project. But these funds do not include specific resources for citizen participation in the project. It seems that everything must be previously defined, and afterwards the funding calls don't let the administration change anything or do not allow specific resources for participation. This makes most of the projects very rigid and not flexible for participation.

- There is a lack of confidence from citizens towards public administrations, and as well in the contrary sense. This complicates a lot any participatory approach and how the public administration takes into account public opinion.

- Citizen participation is a MUST, having advantages both for the public administrations that know better the needs of the neighbors, and for the citizens that can participate to improve their local public services. Thus, participation have to be promoted and resources for it have to increase in every public administration.

4.4 Financial estimation and resources allocation of the Replication Plan

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

The Replication Plan is still in the first development stage at the date of publication of this document (August 2022) and the Municipality of Granada does not yet have any financial assessment or calculation of the economic sustainability of the project. In the next version of this document (September 2024) a financial evaluation of the solutions envisaged in this Replication Plan will be presented. However, due to the financial situation of the Municipality of Granada, it

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does not have own funds to carry out this type of project, and therefore, it is foreseen that these projects will be co-financed with European funds.

The basic regulation is contained in the Common Provisions Regulation (Regulation (EU) 2021/1060) and each Fund has a specific regulation. The ERDF, ESF+ and EMFAF should support the following five Policy Objectives:

- OP1. A more competitive and smarter Europe, promoting innovative and smart economic transformation and regional connectivity to information and communication technologies.

- OP 2. A greener, low-carbon Europe, transitioning towards a zero net carbon and resilient economy, promoting a clean and equitable energy transition, green and blue investment, circular economy, climate change mitigation and adaptation, risk prevention and management and sustainable urban mobility.

- OP 3. A more connected Europe, improving mobility.

- OP 4. A more social and inclusive Europe, through the implementation of the European Pillar of Social Rights.

- OP 5. A Europe closer to its citizens, by promoting the integrated and sustainable development of all types of territories and local initiatives.

For its part, the JTF will support the specific objective, based on the Paris Agreement, to enable regions and people to cope with the social, employment, economic and environmental impacts of the transition towards the Union's 2030 energy and climate targets and a climate-neutral Union economy by 2050.

The ERDF, ESF+ and JTF will contribute to strengthening the economic, social and territorial cohesion of the European Union by pursuing two objectives:

- Investment in growth and jobs, aimed at strengthening the labour market and regional economies through ERDF, ESF+ and JTF;

- European territorial cooperation, aimed at strengthening cross-border, transnational and interregional cooperation within the Union through ERDF (Interreg).

4.4.2 Exploitation of resources deriving from ongoing and already planned projects

Based on the aforementioned Strategic Plans, numerous Smart projects have been carried out in the city of Granada which will be used a base of the Innovative solutions that have been selected to be replicated. A description of the actions already carried out in the city linked with its associated innovative element can be found below in Table 28. Actions already carried out in the city and associated Innovative Elements:

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Action	Description	Innovative elements
Smart lighting	Regarding energy savings in public lighting, the Granada Town-Hall has made a significant investment to increase the efficiency of infrastructure and optimize energy consumption without loss of efficiency or visual comfort.	1.2.1 Smart Lamp post with EV charging and 5G functionalities
Efficient management of facilities	Mondragones Pavilion and Zaidín Civic Center, to optimize lighting and air conditioning systems through sensors that detect the presence of people and through the adaptation of the load curve to the demand curve.	1.1.10 Building Energy Management Systems
Project On/Off	In different public buildings, to remotely operate the switching on and off of buildings outside normal operating hours.	1.1.10 Building Energy Management Systems
PV rooftop	Installation of a 100kW PV rooftop system in the fire department building.	1.2.5 Community Solar Farm
Transparency Portal	Granada Town-Hall launched a Transparency Portal through its official website to ensure that everyone can have access to public information. This portal regularly publishes information on municipal public management, related to: the Granada's Town-Hall, the Albaicín Agency, the Municipal Tax Office, request information and statistics.	4.3.5 Citizen Information Platform
Municipal e-Government	The official website of Granada Town-Hall includes a platform which can be use as virtual office where citizens can perform and process actions, procedures and services that require authentication. In this way, it is intended to simplify and facilitate procedures, eliminate queues and travel, thus saving time and money.	4.1.1 Digital transformation in Social Innovation
Citizen's helpline (010)	This service was launched to provide personalized attention about the municipal services and to answer enquiries related to the Municipal Administration.	4.1.1 Digital transformation in Social Innovation

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Telematic management system for faults monitoring and control	Granada has a system for the telematic management of faults that establishes control criteria for public facilities and manages the repair of anomalies. By the use of 238 control centres installed throughout the city, remote control is established by means of a computer application that allows remote control, telemetry and functionality of the electrical mechanisms as well as a study of the electrical parameters of each installation.	2.1.6 City Energy Management System
Granada Human Smart City	The initiative aims to make the Albaicín neighbourhood universally accessible to all people regardless of their physical condition, age or place of origin, a dynamic platform will be implemented that integrates a 3D model of the neighbourhood with useful information for people over 65 years of age, disabled people and tourists.	4.1.3 Tourist app
Integrated Mobility Management Centre	This initiative consists of a powerful management centre that dumps the information it generates on a website, available in Spanish and English. The purpose of the project is to inform the user of all aspects related to mobility in the city.	4.3.1 City Urban Platform
Virtual Tourist Assistant.	It is a virtual tour guide that plans a complete visit to the city. Once the details of the trip have been entered, the assistant calculates your visit based on the variables entered.	4.1.3 Tourist apps
Turismo Ciudad de Granada	A website where all the tourist information of the city is collected which also promotes the cultural offerings and festivals that take place in Granada, provides information on tourist offices and offers the possibility of applying for the 'Granada Card Bono Turístico' (Granada Tourist Card). It also has a mobile app.	4.3.5 Citizen Information Platform
Digital platform of tourist and heritage information Albaicín	This computerized information system involves the installation of innovative information technology based on information processing and communication (ICT), to facilitate the management, in all its dimensions, of the cultural heritage of the Albaicín district.	4.3.5 Citizen Information Platform

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Casa de Zafra's Albaicín Interpretation Center and Casa de Zafra mobile application	It is conceived as an ambitious project to modernize the cultural offer of the Albaicín neighbourhood, incorporating the new Information and Communication Technologies (ICT) to the more classical interpretation of the historical heritage. This has made it possible to make available to the public, in an easy and accessible way, all the heritage content linked to the building itself, while maintaining respect for the original remains and without contaminating the architectural appreciation of the building.	4.1.1 Digital transformation in Social Innovation
App Running Granada.	This is a new initiative based on the launch of a free mobile application for citizens and tourists. The application presents a new way of getting to know the city, through jogging across its historical neighbourhoods or its natural resources.	4.1.3 Tourist apps

Table 28. Actions already carried out in the city and associated Innovative Elements

4.4.3 Holistic cross-ETT-sectional feasibility study

The ISs studied in the frame of POCITYF were discussed among the Granada ecosystem taking into account the existing outcomes from Political, Economic, Social, Technology, Environmental and Legal previous analysis and the feasibility studies already carried out for the development of the Granada's strategic plans. This information ensures a holistic replication-vision aligned with the Granada's Smart City Strategy. All these works are still in progress and comprises SWOT and PESTEL analysis for all relevant IEs which will be included in the next version of the RP.

4.5 Long-term planning towards a Smart City Vision 2050

The roadmap that this Replication Plan aims to implement in order to turn Granada into a Smart City and to achieve the final goal of reach climate neutrality by mid-century will have to be continuously updated with the new regulatory frameworks and the emergence of new technologies. In this evolution process, there are three cross-cutting sectors which will be critical in the achievement of the objectives [30]:

- Renewable energies and distributed energy generation

- Sustainable urban mobility

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- Sustainable buildings and districts

Because of their importance, these sectors have specific measures and objectives to be reach firstly in 2030, and others more ambitious for 2050. But, the transformation of the energy system and the economy towards a climate-neutrality by 2050 also implies a challenge for which it is essential to involve citizens in an engaged manner. The aim is to mobilise existing social resources so that the transition can optimise talent for innovation and the participation in decision-making as well as to find the necessary support to overcome the difficulties that will arise along this period and to foster the major changes in behaviour that are needed and to involve society as a whole in the new business opportunities.

RENAWABLE ENERGIES AND DISTRIBUTED GENERATION IN ELECTRICITY SECTOR

The reduction of GHG emissions and penetration of renewable energies in the electricity sector makes electrification one of the main vectors for the decarbonisation of the system as a whole, representing a major investment opportunity. This sector is expected to be the first to drastically reduce its GHG emissions.

The technological development of renewable energies has allowed that, in many cases, they are currently the most competitive alternative for generating electricity, enabling a reduction in electricity costs for consumers. As a result, the national INECP 2021-2030 plans to achieve a very significant reduction in emissions in the electricity sector and to reach 74% renewable electricity production by 2030.

In order to move towards climate neutrality in this sector from 2030, and to reach a level of 100% renewable energies by 2050, placing citizens at the centre of the electricity sector, the lines of work that will play the most relevant role are:

- The design and operation of distribution smart grids will have to face challenges such as distributed generation with higher levels of intermittency.

- Self-consumption, as well as local energy communities, will make it possible to promote the participation of citizens in projects and initiatives, through the figures of energy aggregators.

- Technologies for flexible and secure system operation should be introduced. These include: daily, weekly and seasonal storage, demand management, as well as smart grids that, through digitalization, allow for improved monitoring, control and automation systems.

The decarbonisation of the electricity sector helps to make further electrification of other energy demands (such as mobility, heating and cooling or industrial uses) a key factor for achieving climate neutrality. To the extent that they can be manageable, these demands are in turn an

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opportunity for the coupling of sectors and thus better operation of a renewable electricity system.

SUSTAINABLE URBAN MOBILITY

The transformation of transport and mobility represents a challenge, as its implications affect a large part of the population and businesses. On the other hand, the responsibility and participation of local authorities will be decisive, as mobility patterns in rural and urban environments in the coming years will depend to a large extent on their decisions.

The Figure 24 shows the evolution of this sector, as well as the main technological developments and tools, which will enable the emission reductions necessary to meet the commitments.

By 2030, as a result of measures foreseen in the INECP such as the shifting to sustainable mobility models and the increase in electrification, a 28% share of renewable energy in transport-mobility and a reduction in emissions of more than 30% in the same decade are expected to be achieved.

In order to move towards climate neutrality in this sector from 2030 onwards, and to reach a level of GHG emissions of only 2 MtCO2 in 2050, the lines of action that will play the most relevant impact are:

- Energy efficiency measures and changes in mobility patterns and needs. The modal shift from more polluting and energy-consuming individual transport towards collective, more energy-efficient individual transport, such as cycling or electric vehicles, and walking mobility will continue to be encouraged.

- Electrification will continue to be a key technology for light-duty vehicles.

- Renewable gases and the coupling of sectors can provide important benefits, such as renewable hydrogen, an important energy vector to contribute to decarbonisation.

- Digitalisation and innovation will enable better use of all energy resources.

- Urban planning should be integrated with the mobility sector.
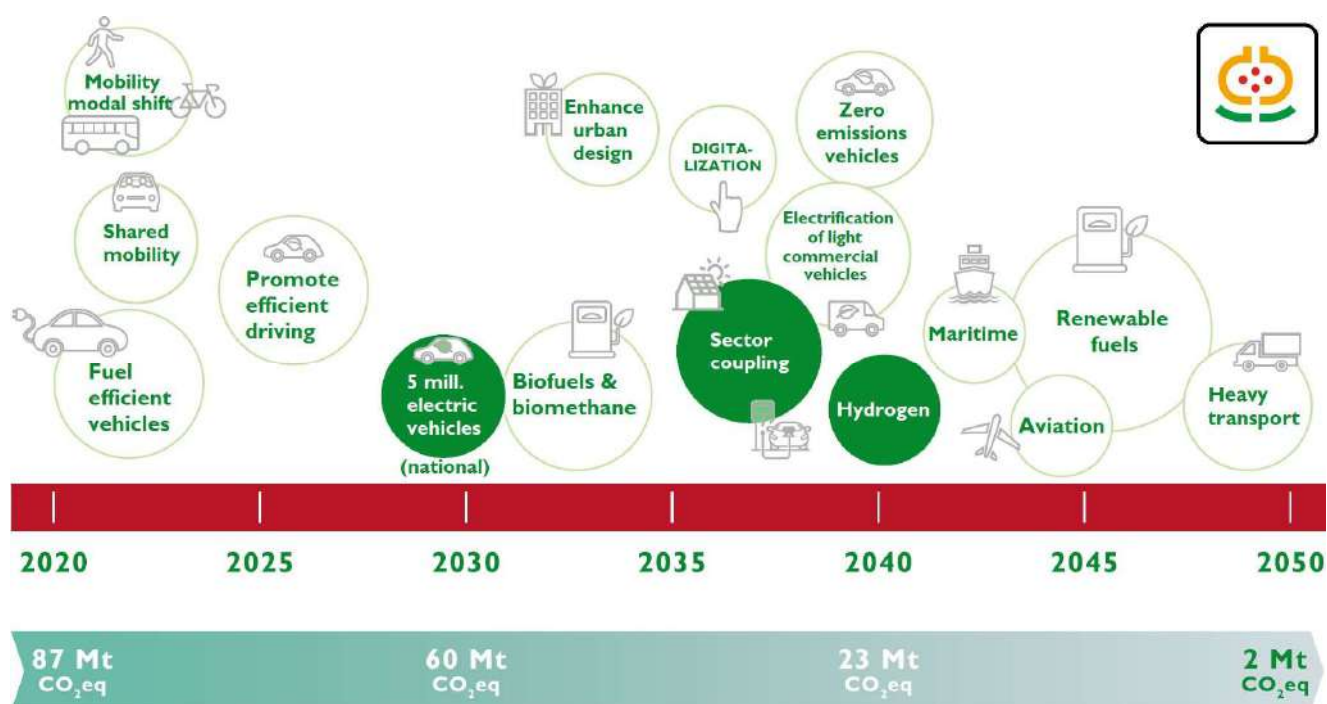
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Figure 24. Technologies used in the mobility sector and national emissions objectives

SUSTAINABLE BUILDINGS AND DISTRICTS

Final energy consumption in the building sector in Spain has a lower relative importance than in the EU average, mainly due to climatic differences, accounting for around 30%, while in the EU as a whole it represents 39%. Under the common denomination of buildings, two energy consumption sectors with different patterns and dynamics are included:

- Residential. This sector comprises mainly household consumption and accounts for about 18% of final energy.

- Services. Commerce, public administrations and, in general, the economic activities of the service sector, which account for 13% of final energy consumption.

Following the "energy efficiency first" principle, the European Commission proposes energy efficiency in buildings as the first package of measures to be undertaken. In accordance with this principle and in line with the proposals of the Long-term Strategy for Energy Rehabilitation in the Building Sector in Spain, in compliance with Directive 2010/31/EU, the logical order for actions in the decarbonisation of the sector will be:

- Reduction of demand through energy efficiency actions;

- Use of highly efficient systems;

- Supplying final energy through renewable energies, mainly produced on site.

The Figure 25 shows the evolution of this sector, as well as the main technological developments and tools that will enable the emission reductions needed to reach the objectives.
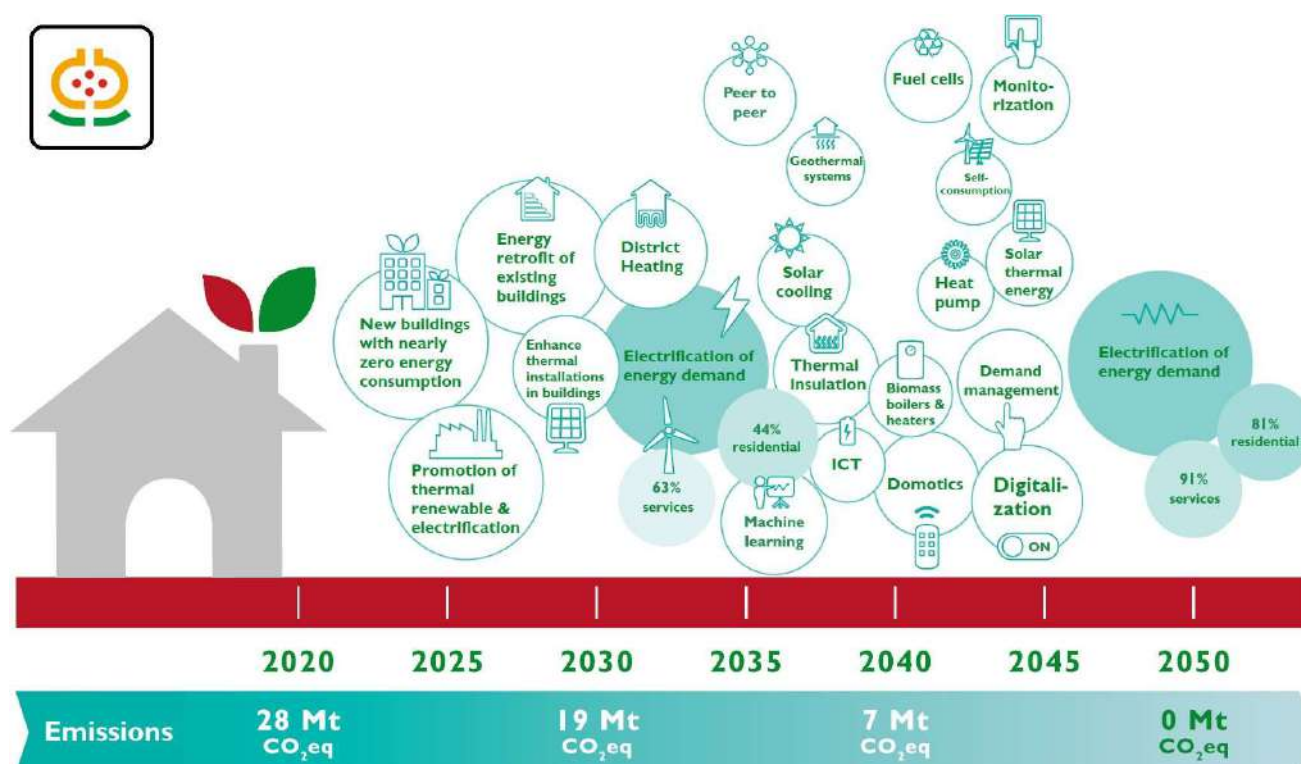

Figure 25. Technologies used in the building sector and national emissions objectives

By 2050, it is estimated that 80% of the building stock will be made up of buildings that have already been constructed, so it is necessary to prioritise actions on existing buildings. On the other hand, new buildings will have almost zero energy consumption in accordance with the regulations governing the building sector in Spain, as set out in Directive (EU) 2018/844 of the European Parliament and of the Council, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. The use of alternative materials and sustainable materials should also be promoted over other materials.

To promote energy retrofit actions in existing buildings, it is not enough to have an appropriate regulatory framework, and specific measures are needed. These measures should include appropriate financial incentives, support for stakeholders and mobilisation of investments. Given the long lifespan of buildings and the relatively low renovation rate compared to other sectors, it

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is necessary to align policies, investments and measures to be undertaken in the coming years so that they can be made compatible with a decarbonisation scenario by 2050.

As already mentioned, together with actions in energy efficiency and renewable energies, the electrification of demand is the main vector for decarbonisation in this sector. Since 81% of demand in the residential sector and 91% in the services sector will be electrified by 2050. Heating and cooling systems (hot water and air conditioning), which currently have a higher proportion of fossil fuels consumption, will be the main drivers. The energy consumption associated with these systems will be covered by a combination of electrification, demand reduction and thermal renewable.

In order to move towards climate neutrality in the building sector from 2030, and to reach zero GHG emissions by 2050, the selected ISs of POCITYF will have a key role. Furthermore, the main changes will be in the role that consumers will play in the sector through demand management and demand reduction.

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5 Conclusions

This document is the first edition of the Granada Replication Plan and City Vision for 2050 and had the aim to present the work performed by the Municipality of Granada in the frame of POCITYF project until September 2022. The final version of the Replication Plan will be delivered as an updated version of this document in September 2024.

As a first step in the preparation of the Replication Plan, the Granada Ecosystem partners have defined the city framework (Granada Smart City 2020 Strategic Plan) with relation to the smart city indicators, identified the city needs and key priority areas in relation to these indicators and in alignment with its Strategic Plans for sustainable urban development, energy and mobility, and defined the expectations from POCITYF solutions in addressing these needs.

The involvement of local stakeholders in the project was initiated since the first year of the project in the form of a project Work Group, with different online meetings due to COVID19 pandemic. The participation so far could be considered satisfying, but in order to increase acceptance, collect as many useful insights as possible and create a commonly accepted City Vision for 2050 it is very important to expand the group and activities to include and motivate also those who have not responded to our invitations so far. Our activities with the local Work Group will intensify and become more personal and direct as our Replication Plan takes shape in order to increase their interest but guarantee they won't disengage on the way. Users of the buildings will be actively involved in the planning process in the next phase. Citizen engagement activities will be continued with GRANADA MEJORA, GRANADA DECIDE applications and continuing neighbourhood management meetings in order to inform citizens, increase awareness and social acceptance, and start cultivating a co-designing culture.

The participation of local stakeholders and the information gathered from different municipal already approved strategies helped us understand the solutions better, even if the current financial situation of the townhall is not the best due to national restrictions and the debt of the townhall from previous years. With the help of the various replication tools offered by the consortium and the knowledge exchange with the LHCs, the Granada Ecosystem partners finalised the set of solutions to be replicated. This set of solutions might be updated as we proceed with the Replication Plan and as more knowledge becomes available from the LHCs.

Granada partners have completed the first stage in designing its Replication Plan, which included the collection of data from various sources to provide inputs for the buildings' analysis and the estimation of the energy needs of the case-study buildings. The buildings' analysis was done for the sustainable urban development strategy of the Town-Hall. The preliminary results verify the need for interventions to improve the energy efficiency of the buildings and the conditions for people working in them. In the next phase, the selected set of POCITYF solutions will be applied on these buildings' models to estimate the generated energy benefits after the interventions. During this process, solutions might need to be substituted by others in order to reach the desired energy results. At the same time, a whole-life economic analysis of the project and a sustainable

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business plan to support it will have to be performed and presented in the next version of this document in September 2024.

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