IRIS

Integrated and Replicable Solutions for Co-Creation in Sustainable Cities

Project Acronym:	IRIS
Project Full Name:	Integrated and Replicable Solutions for Co-Creation in Sustainable Cities
Grant Agreement:	No 774199
Project Duration:	5 years+0.5 (starting 1 October 2017)

Deliverable 8. 9

Santa Cruz de Tenerife Southwestern implementation guideline

Work Package:	WP8: Replication by Lighthouse regions, Follower cities, European market uptake
Task:	T8.5 Santa Cruz de Tenerife Follower City replication activities
Lead Beneficiary:	SCT
Due Date:	30 September 2022 (M60)
Submission Date:	31 March 2023 (M66)
Deliverable Status:	Final
Deliverable Style:	R
Dissemination Level:	PU
File Name:	D8.9 Santa Cruz de Tenerife Southwestern Europe implementation guideline

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 774199

Authors

Surname	First Name	Beneficiary
Broock Hijar	Diego	Cluster Construcción Sostenible
Arbelo Hernández	Aglaé	Santa Cruz de Tenerife municipality

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

Reviewers

Surname	First Name	Beneficiary
Knuts	Mauritz	Vaasa
Lymperopoulus	Kostas	Alexandropoulis
Winters	Milo	Utrecht Sustainability Institute
Peekel	Arno	Utrecht Sustainability Institute

Version History

Version	Date	Modifications made by
0.1	25/09/2022	Diego Broock Hijar
0.2	14/10/2022	Diego Broock Hijar
0.3	29/11/2022	Diego Broock Hijar
0.4	12/01/2023	Diego Broock Hijar
0.5	31/01/2023	Diego Broock Hijar
1.0	31/01/2023	Final version to be released to the EC

Disclaimer

Preface

Santa Cruz de Tenerife is a medium-sized city located in the Canary Islands. Its strategic location creates very favorable conditions as well as some challenges for sustainable development. Anaga's Biosphere Reserve is the sustainability flagship of the municipality, on the hand its role as capital of the Canary Islands region creates pressures to its resources and natural based balances which are being currently tackled.

The municipality is fully committed to carbon footprint reduction as shown in the current city's SECAP of the Covenant of Mayors. This commitment goes further towards other realms of sustainability as becoming greener, more accessible and more mobility efficient.

Evolving a city towards sustainability also requires the transformation of the mindset of the citizens, local leaders, public workers and the local economic ecosystem. This is normally an organic process which requires time, energy, resources and leadership. However, becoming part of IRIS project has boosted up this process thanks to the inspiration granted by Utrecht, Gothenburg and Nice, the technical support and the adoption of the smart city approach by the city.

During the five and half years that IRIS have being part of this municipality, a new mindset for the city development have been set into motion. Its impacts radiate already towards several areas such as renewable energies, building retrofitting, urban mobility, city innovation platform and its internal organization. Some areas progress faster than others but all are growing and providing better opportunities to the city and its citizenship... the near future seems brighter.

Within this document you will find Santa Cruz de Tenerife IRIS smart city roadmap. I hope you find our journey useful and inspirational. Just remember our motto "adaptation to local conditions and realities are crucial for success".

José Manuel Bermúdez Esparza

Mayor of Santa Cruz de Tenerife

Executive Summary

The aim of this deliverable is to present an update of the smart city initiatives deployed by the municipality of SCT as well as to tell the story of its journey along the IRIS project execution. In order to help, motivate and inspire, SCT shares in this document its learnings and findings as well as its roadmap to become smarter and more sustainable along the IRIS framework.

The present document firstly explains the main smart city initiatives of SCT based on the learnings from the LHC in IRIS context. What is more important, SCT shares the intangibles of the process of developing its own Smart City plan. Eventually with this document SCT pretends to provide more light to other alike cities in their process of developing their own path to smart and sustainable city development.

This deliverable is more focused to cities with similarities to SCT; such as similar city size, same region, or common environmental conditions, close cultural identity or with similar challenges.

This document is mainly addressed to other cities' representative as well as public workers. Those who really want to go forward for creating an innovative change in their city. However, it is more suitable for cities in the Macaronesia region since we share many challenges and environmental conditions.

This deliverable comprehends, in a brief way, most of the knowledge and experiences gathered during SCT IRIS experience; therefore is expected to contribute in a positive way regarding dissemination of the IRIS fellow city mature results, since it represents an advanced summary of the Replication Plan of Santa Cruz de Tenerife.

This document has been mainly nourished by Deliverables 8.1, 8.3 and 8.8. Nonetheless these mentioned deliverables have been supported by the deliverables generated by LHC belonging to WPs 5, 6 & 7 respectively. Furthermore, Deliverable 8.5 has been of help in developing this deliverable.

Table of Contents

List of Figures

List of Abbreviations and Acronyms

Abbreviation	Definition
CIP	City Innovation Platform
EDUSI	Integrated Sustainable Urban Development Strategy
ESS	Energy Storage Solutions
EU	European Union
EV	Electrical vehicles
FC	Fellow city (follower city)
GA	Grant Agreement
ICT	Information and Communication Technologies
LEMS	Local Energy Management System
LHC	Lighthouse cities
MaaS	Mobility as a Service
MPV	Mobility Personal Vehicles
MRR	Recovery, Resilience and Transformation Plan
NZCB	Near Zero Carbon Buildings
PIREP	Program for the impulse of public buildings retrofitting
PV	Photovoltaic
RES	Renewable Energy System
RP	Replication Plan
SCT	Santa Cruz de Tenerife
SECAP	Sustainable Energy Climate Action Plan
SUMP	Sustainable Urban Mobility Plan
V2G	Vehicle to grid
WP	Work Package

1. Introduction

The main goal of this deliverable is to introduce the fellow city of Santa Cruz de Tenerife's journey along the learning process of becoming a smart city during IRIS project. This learning progression comprises study time dedicated to the LHC integrated solutions, the knowledge transference based on the demonstration projects and the intangible know-how acquired during the project. It is also shared how and why the city has chosen its replication actions. In addition to this, it highlights the importance of the stakeholders' participation, the citizens' engagement, as well as the role of the human team leading SCT IRIS RP. The utter purpose is to give a guideline base on SCT experience to cities with interest in developing their smart city concept in the Macaronesia region.

1.1. Structure of the deliverable

The deliverable 8.9 is structured into three sections. The first section describes smart cities on a general level; what is the concept of smart cities and what smart city solutions typically exist. After this smart city solutions which are typically specific for the cities located in the Macaronesia region are presented. Finally, a list describing the smart city solutions implemented in the LH cities of the IRIS project is examined. The second section, or the main section of the deliverable, presents the smart city journey of the Fellow City (FC) Santa Cruz de Tenerife, describing the background and reasons Santa Cruz de Tenerife decided to start its demanding smart city journey. The faced challenges, what replication projects the city has initiated, and finally summarizing the lessons the city has learned during the IRIS project. The final third section presents guidelines for the cities in the Macaronesia region, based on the knowledge gained and lessons learnt in Santa Cruz de Tenerife during the project.

This deliverable is part of the documentation of the replication actions carried out in the FC Santa Cruz de Tenerife and should also serve as a guide for other cities in the Macaronesia region who want to work with becoming a smart city. The FC Santa Cruz de Tenerife has presented a replication plan based on the demonstrations in the LH cities of the IRIS project in the earlier deliverable named D 8.8 Santa Cruz de Tenerife replication plan. Both deliverables are connected to the replication actions of the IRIS project and are part of the work package named WP8: Replication by Lighthouse regions, Follower cities,European market uptake.

D8.4 Vaasa replication plan, and D8.5 Vaasa North Eastern Europe implementation guideline.

D8.6 Alexandroupolis replication plan, and D8.7 Alexandroupolis South-eastern Europe implementation guideline.

D8.10 Focsani replication plan, and D8.11 Focsani South-Central Europe implementation guideline.

2. Smart Cities and the IRIS project

IRIS smart city project, launched in 2017 and funded by Horizon 2020 (EC) framed in the Smart Cities and Communities' call. It was a five year project (2017-2022) with a six months extension due to Covid-19. IRIS Lighthouse cities are Gothenburg (Sweden), Nice Cote d'Azur (France), and Utrecht (The Netherlands).

These cities acted as living labs for demonstration, integration and implementation of innovative energy efficient areas, flexible smart energy solutions and applications, incrementing the utilization of Renewable Energy Systems (RES) and Energy Storage Systems (ESS), e.g. battery-energy storage solutions with first and 2nd life batteries, heat energy-storages, and EVs' energy storage capacity via Vehicle to Grid (V2G) and photovoltaic (PV) integrated systems.

Additionally, the LH cities strive for intelligent use of state-of-the-art ICT solutions, sustainable mobility schemes and services, and interactive citizen engagement. The paramount goal is to improve urban life, and to ensure sustainable, secure and affordable energy for living and mobility for all citizens and businesses. To achieve this, a coalition of universities, research organization innovation agencies, local authorities and private expertise joined forces in collaboration. To enforce this, the LH cities cooperate actively with the follower cities: Alexandroupolis (Greece), Focsani (Romania), Santa Cruz de Tenerife (Spain) and Vaasa (Finland).

2.1. Introduction to smart cities

Nowadays, large cities concentrate more than half of the world's population. In 2040, it will be around the 70 %. Urbanization has straight impacts on global warming via CO_2 emissions, pollution levels, besides of on the energy value chain. Additionally, urbanization bears direct impacts on urban infrastructure requirements, land use, residential and transport requirements, and sustainability on all its levels: environmental, economic, social, and cultural.

The accelerated urbanization and growing environmental awareness have risen concerns and demands to develop cities to become "smarter", with the ability to be constantly evolving. There is a grave need for ambitious sustainability strategies and projects, which can aid cities intelligently and comprehensively in this task. By promoting innovative, efficient, far-reaching and replicable solutions, from the fields of smart energy production and consumption, traffic and mobility, information communication technology, and citizen engagement, the objectives of the strategies can be achieved.

Smart city development promotes innovative energy solutions, smart grid and RES development, and strives to advance sustainable transport modes, thus affecting on economic and social levels, and enhancing quality of life. A smart city utilizes ICT to reach more efficient and intelligent standards in achieving carbon neutrality. It preserves natural resources and reduces land use by mature and jointly executed coordination and planning of infrastructure and transport design. A smart city strives for implementation of green and innovative technical solutions, leading to savings in costs and energy, and promoting better service delivery.

The smart city advancement should have a holistic approach on sustainability. Measures to reduce a city's impact on the environment and to expedite the integration of intelligent and efficient use of technologies

with the urban infrastructure outright form the backbone of environmental sustainability. Economic sustainability signifies attempts to develop a city's economic potential, new financial and business models and innovations, and advance more efficient and annexed service and infrastructural solutions. A smart city's attractiveness for people, businesses, and capital improves the overall employment, business, and service possibilities, when social and cultural sustainability levels are functioning properly. Thus, cost reductions, higher stability and security, and enhancement of quality of life can be achieved.

In order to plan, capitalize, and implement the best operating smart city solutions, new methods, technologies, and innovations are required. These include efficient and affordable energy production based on RES, and promoting sustainable mobility solutions, smart charging and innovative energy storage schemes, and advanced ICT and digital solutions. Additionally, key stakeholder engagement is relevant, including political leaders, government and city officials, organizations, service operators and solution providers, investors and consumers. Indeed, local level citizen engagement has a paramount rolein any smart city development strategy. By these means, the continuance of the smart city development can be secured, including the optimal end-result of citizen-awareness and an attractive city environment.

2.1.1. Smart city concept-SCT

The smart city concept in Santa Cruz de Tenerife city is founded on the learnings gathered along IRIS project accordingly with the city needs. These needs were identified by a participatory process with citizenship, local companies and municipal public employees.

Addressing city problems and embracing city opportunities via trustful and economically feasible solutions have been the general smart city philosophy to select smart solutions in SCT city. A further step in this regard is that all smart city investments must present an acceptable payback period or provide an undoubtedly public service when its benefits are immeasurable.

In order to outline the adequate launching framework of the projects, it is important to count on local stakeholders. They can shed light on smart cities' SCT initiatives for a better understanding of its technical feasibility as well as to gather their view and experience. This process supports the decision making process and will help during implementation.

SCT has put the focus on mobility solutions. Since this is the most urgent and highlighted issue in the city, this area has a prominent weight in SCT Replication Plan and it has been backed up with more human resources and investments. Complementarily, RES are a must to be expanded across the city in order to take advantage of the local conditions. These two mentioned pillars are essential but other working lines are in progress such as flexible grids and the city platform. Citizen's engagement is the most challenging defy but crucial for success. Since CIP is a sensitive as well as strategic for the municipality, during the IRIS project SCT has studied all technological implications and taken the lessons from LHC in order to deploy it with enough time.

2.1.2. Smart city solutions

Smart Grid and Energy Solutions

The new approach to energy management in the cities requires a different design and capacities of the electric network and power system. Grids need to become smarter, in other words, reliable, resilient,

flexible, secure, controllable and customer friendly. Power systems are not designed to meet smart city requirements; such as a balanced electricity supply, increasing integration of RES, electricity storage or the growing EV demand.

However the change is already happening within the current centralized energy production stations and the old electric grids, both facing an atomized and increasing RES implementation, which creates peak curves.

Regarding energy management in smart cities and it is necessary to develop smart grids; retrofitting the existing turning them into flexible, optimal and bidirectional grids. Smart power plants must work coordinately and locally managed, having full integration of distributed energy generation with RES alongside large-scale centralized power plants. In this view, electricity storage systems need to be implemented for the safety of the grid. Furthermore, mobility can play an important role in this peak shaving curve as well as dimensioning energy production requirements.

With RES customers are becoming their own manager of the energy, turning into prosumers. When this is widespread a more competitive economy will arise in the cities, with less environmental impacts and larger safety.

Smart Mobility Solutions

Some of the biggest transport related challenges in today's growing cities are congestion, pollution, accidents, noise and scarceness of public space. Enhancing the development of diverse transport systems and technology requires deployment of Mobility as a Service concept (MaaS), urban mobility governance, and real-time data collection and management. Thus, better traffic and infrastructural planning and management can be achieved. Additionally, there are matters of social nature to be considered, such as better ability to improve traffic safety, enhance environmental performance and attractiveness, and advance information management and decision-making. Ultimately, the goal is more sustainable and well-functioning urban surroundings, with the ability to provide a better quality of life to the citizens through efficient, secure and sustainable mobility, energy technology and ICT solutions.

Electric vehicles can reduce carbon emissions however changes in car ownership in favor of car sharing or carpooling are necessary for making cities more human friendly. This ownership transition combined with better public transport services and better bike or mobility personal vehicles (MPV) infrastructures will result in more sustainable mobility.

Using advanced technologies to integrate EV, RES and energy storage system are key for integrative solutions in mobility. However, Mobility as a Service (Maas) is a strategical concept for sustainability in mobility. MaaS uses data management, ICT and real-time information access to provide cost-effective mobility solutions.

2.2. Macaronesia region smart city solutions

The Macaronesia region also has similarities with other European regions since all need to tackle global warming challenges, such as the following:

- Integrated RES
- Building energy efficiency solutions
- Smart grid innovation
- Mobility Solutions

- Citizen's engagement process

However, there are specific smart city solutions which are more needed and specifically useful for this Atlantic region.

- Bioclimatic solutions in city planning and building
- Water management
- Circular economy and waste management

2.3. The IRIS smart city solutions

The IRIS project consists of five Transitions Tracks, which all include various integrated smart city solutions (IS). Once a Lighthouse city has successfully demonstrated an activity of an innovative smart city solution in their environment, a follower city is able to create a replication plan for the chosen integrated solutions, and determine their schedule, resources, partners, which are the requirements for successful implementation. Not all the solutions demonstrated by the LH cities are required or even can be replicated by a follower city. Each participating city, a follower and a Lighthouse, has its own baseline, needs, framework and goals when starting the IRIS Smart City endeavour, determining which integrated solutions form its replication plan.

The five IRIS project's transition tracks and the included integrated solutions are:

2.3.1. Transition Track 1 Smart Renewables and Closed-loop Energy Positive Districts.

- IS 1.1 Positive Energy Buildings
- IS 1.2 NZCB Social Housing
- IS-1.3 Symbiotic waste heat networks

2.3.2. Transition Track 2 Smart Energy Management and Storage for Grid Flexibility

- IS 2.1 Flexible electricity grid networks
- IS-2.2 Smart multi-sourced low temperature heat networks with innovative storage solutions
- IS 2.3 Utilizing 2nd life batteries for smart large-scale storage schemes

2.3.3. Transition Track 3. Smart e-Mobility Sector:

- IS 3.1 Smart solar V2G EVs charging
- IS 3.2 Innovative mobility services for the citizens

2.3.4. Transition Track 4 City Innovation Platform (CIP)

- IS-4.1 Services for urban monitoring
- IS-4.2 Services for city management and planning
- IS-4.3 Services for mobility
- IS-4.4 Services for grid flexibility

2.3.5. Transition Track 5 Citizen Engagement & Co-creation:

- IS-5.1 Co-creating the energy transition in your everyday environment
- IS-5.2 Participating city modelling
- IS-5.3 Living labs
- IS-5.4 Apps and interfaces for energy efficient behavior

3. Smart City Journey of Fellow City Santa Cruz de Tenerife

The smart city journey of SCT is a process of change. To become “smart”, the city needs to solve its problems and take advantage of its opportunities by using affordable resources and making people more satisfied with its city. To achieve this goal, the city must change its key urban-metabolic processes; such as mobility, energy production, energy transportation, information and data management, and citizens´ engagement

SCT’s replication plan tries to respond to city needs and opportunities with smart city adapted solutions supported by IRIS Lighthouse Cities’ experiences and support. The smart city concept of SCT pursues to improve the citizens quality of life prioritizing actions accordingly with the importance of the problems to be tackled, considering the economic feasibility of the measures as well as its replicability across the rest of the city. Smart City Solutions have not been concentrated in a specific area of the city in order to implement the different types of solutions where it will be of more benefit, either due its best yield or better representability.

3.1. The reasons FC SCT started to work with smart city solutions

SCT started to work with smart city solutions to tackle city problems with a more innovative approach, since traditional solutions did not offer the desired results. There was a new window of opportunity to make use of.

In this regard, SCT understood smart city solutions represented a way to increase public efficiency. A smart solution for SCT should reduce the time gap between need diagnosis and its final resolution. Furthermore, it should use balanced human and budgetary resources accordingly with the final benefits.

Inspiration was also a motivation to start with smart city solutions in SCT, since this type of solution increases the necessary creativity to face problems under a different light.

3.2. Needs, challenges and prioritizations of FC SCT

The evolution of a XX century city towards a XXI century city requires a huge change of the urban metabolism; energy, water, food, waste and mobility are the most significant. In addition, it also entails a cultural change in the organizations besides incorporating the IC technologies.

Considering IRIS framework, the participatory process has pointed out the principal needs of the city, accented the challenges to be undertaken and helped to define the prioritization in the replication plan to be executed.

Regarding the needs, in accordance with the Sustainable Mobility Plan [1], mobility issues (traffic jams and pollution) are the largest concern for citizens, local companies, and public employees. Hence, this realm has taken larger attention as well as budget designation in the RP.

Accordingly with the Covenant of Mayors, the increasing social awareness regarding Climate Change and the even more increasing energy price, the carbon dioxide reduction combined with a more self-sufficient energy capacity is the second priority in the city.

Furthermore, the technological advancement in city monitoring and control is a remarkable challenge mainly highlighted by the municipality since it represents a huge opportunity to improve the efficiency of the local administration.

3.3. Replication projects in FC SCT according to transition tracks

The city of Santa Cruz de Tenerife used the IRIS project as an opportunity to learn from European leading cities. However, local features made clear from the very beginning that some integrated solutions were not meant for the city, nonetheless since IRIS integrated solutions were quite wide, there was very suitable integrated solutions for the city among all transitional tracks. Along the IRIS project journey SCT has incorporated more initiatives and discarded another due to the rise of new opportunities or because project execution limitations came across.

IRIS lighthouse cities develop their own smart city solutions structured in 5 transitional tracks. In order to develop its own replication plan, SCT, and the other fellow cities, analyses which of these demonstrating solutions suits to its needs. On these foundations, SCT sets the route map for its implementation. Some solutions are set into motion from the very beginning due its simplicity, other need more study and will be implemented after the end of the project as planned in the GA.

The current status of SCT IRIS Replication Plan is described in the next sections.

3.3.1. Transition Track 1- Renewables and energy positive districts

Regarding TT1#, tackling a whole SCT district is a too large mission, therefore SCT approach was to work in two demonstrative specific cases; public schools and social housing retrofitting. These two combined experiences are expected to show the way to attain positive districts in near future.

- IS 1.1 IS-1.1: Positive Energy Buildings

This Integrated Solution presents three levels of work in SCT. PV Schools, Other public buildings and public buildings retrofitting.

PV Schools project consists in the transformation of all public schools in the municipality (34) into virtual near zero carbon buildings by installing photovoltaic technology for self-consumption. The role of this educative building is strategic.

The design of these installations was made to find the optimum between the curves of PV production and energy consumption of each school case. This has allowed us to attain the most reasonable economic investment since it permits to obtain the quickest payback with the possible maximum energy production accordingly. The total investment is 679.937,62 € to implement 371,62 kW of PV capacity. Furthermore,it has already been granted 309.995 € of public funds (MRR, Renewable Energies). It must be operative before May 2024.

Figure 1. Location of the primary schools in the city of SCT

It will generate a direct 54% CO2 reduction, and 35% CO2 compensation thanks to the not employed energy surplus. It has been granted a Next Gen funding of 56,8% of the total, with an expected 3,6 years payback.

The 54% and 35% leave only 11% of energy consumed based on fossil fuels, this is expected to be reduce by implementing the economic savings in complementary energy saving measures.

The demonstrative capacity of the project is quite large since its direct impact in families and the rest of educational community.

The municipality currently has 103,5 kW functioning in 9 public buildings. Nowadays, the municipality has already hired the PV execution projects of 12 other public buildings with a total capacity of 209,53 kW. The execution of these projects is planned to be based on own municipal funds during 2023.

In brief, before mid-2024 the municipality will pass from 103.5 kW to 684,65 kW PV capacity in public buildings. Nonetheless, the implementation of the SECAP [2] will increase this value in the coming months and years. All public buildings are planned to count on PV installation to cover (on average) more than 65% of their energy consumption.

Other public building retrofitting involves 3 strategic buildings in SCT. The main goal is to reduce energy consumption by isolating the thermal enclosure, increasing efficiency of the active equipment (Climate, lifter, etc.) and PV production. Green roofs have been proposed for thermal and ecological benefit. Batteries will be installed to make these buildings more resilient. With special attention to the Police Station, where this feature is even more necessary. All buildings will obtain an A-Energy Label and will be near zero carbon, in some cases the energy balance will be positive considering the PV production and energy consumption of the buildings.

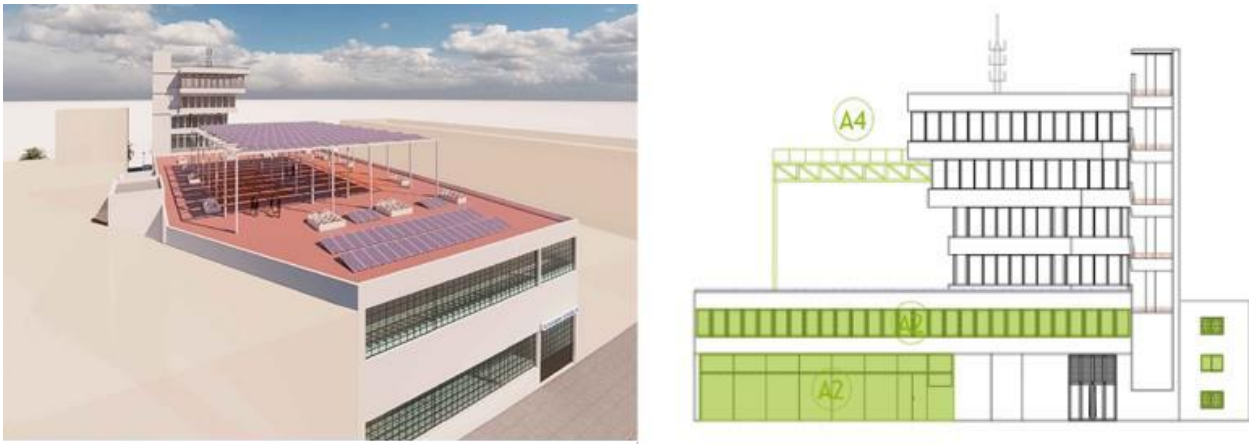

Figure 2. Central Police Station. Heritage protection.

These three projects have been turned into four funding proposal in the PIREP retrofitting program (from Recovery, Resilience and Transformation Plan (MMR) funding program) in the national level, aspiring to obtain an 85% of public co-funding on the following budgets. See figures 2 to 4.

- Central Police Station: 1.162.639,17 €
- Fiestas: 602.478,55 €
- General Antequera: 564.263,85 €

Figure 3. General Antequera retrofitting design (left) and Retrofitting of Casa del Carnaval (right)

Regarding private investments, and accordingly with the Technical report [3], one the most relevant local stakeholder is the Water Company, EMMASA. This organization accordingly with the mandate of the municipality have invested in seven photovoltaic installations associated to water infrastructures,

with a total of 434 kW peak and estimated energy production of 788.114,55 kWh/year with an approximately investment of 495.000 euros

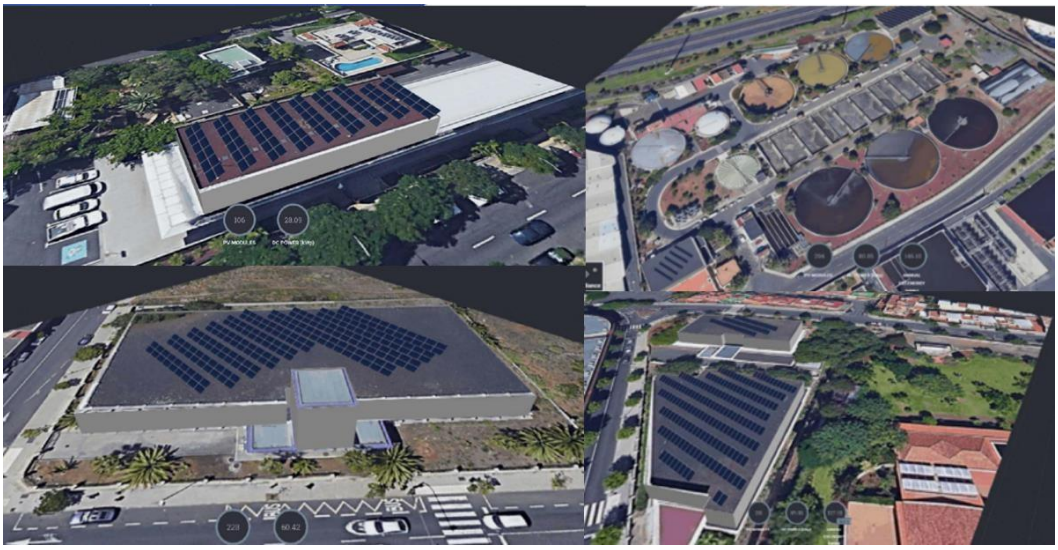

Figure 4. PV Examples of EMMASA PV installations

Furthermore, it is planned to carry out two more installations related to water infrastructures with 140 kWp in total, with a total budget of 149.585 €.

- IS 1.2 NZCB Social Housing

NZCB Social Housing project is focused on retrofitting two buildings (57 & 21 dwellings) in two separated neighborhoods, Barrios de La Alegría and San Andrés, expected to happen in 2024. These works will be accomplished by combining bioclimatic criteria with renewable energies and monitoring of the building performance. Considering the mild weather conditions in the Canary Islands region, the result of the retrofitting will help to understand the benefit of the bioclimatic solutions mixed with RES in order to obtain near zero carbon buildings.

These edifications are twenty year old and represents good examples of the most common building in the region built at the beginning of the century. Therefore, the success of this project will likely help other owners to consider emulating it. Furthermore, other municipalities and the regional government might contemplate to replicate it in other social housing retrofitting.

The public funding received from the national program (EDUSI) with 400.000 € for both buildings, for a total budget of 500.000 €.

Figure 5. Two social housing buildings. San Andrés (left) & Barrio de La Alegría (right)

3.3.2. Transition Track 2 - Flexible energy management and storage

- IS-2.1: Flexible electricity grid networks.

Smart Gerencia-Tome Cano project is a development of an intelligent and flexible electricity grid. In the same square there are four medium-large buildings with different roles and features (health centre, fire station, school and administrative building). The use of its roofs for PV production (155 kW) will not be enough separately for every building, however the electrical interconnection of these building will help to share energy and balance the energy needs among them. In case of more energy demand, small wind power (10 kW) is under study. The expected energy self-supply of these high energy consuming buildings will be about 40%.

In addition, a further step will be the integration of existing and new coming EV charging stations (14 units). In order to make the energy balance work a Local Energy Management System (LEMS) will be developed *ad hoc*.

The coordination among public administrations to turn these four buildings into more resilient, economical and sustainable infrastructures is a real challenge which has to be overcome in order to take advantage of the mentioned benefits.

These public buildings receive every year a great number of citizens, hence the demonstration impact will be large in scale as well as in the importance of getting on board three different public administrations. The satisfactory implementation of the project could result in its replication in many other similar cases across the city and in the region.

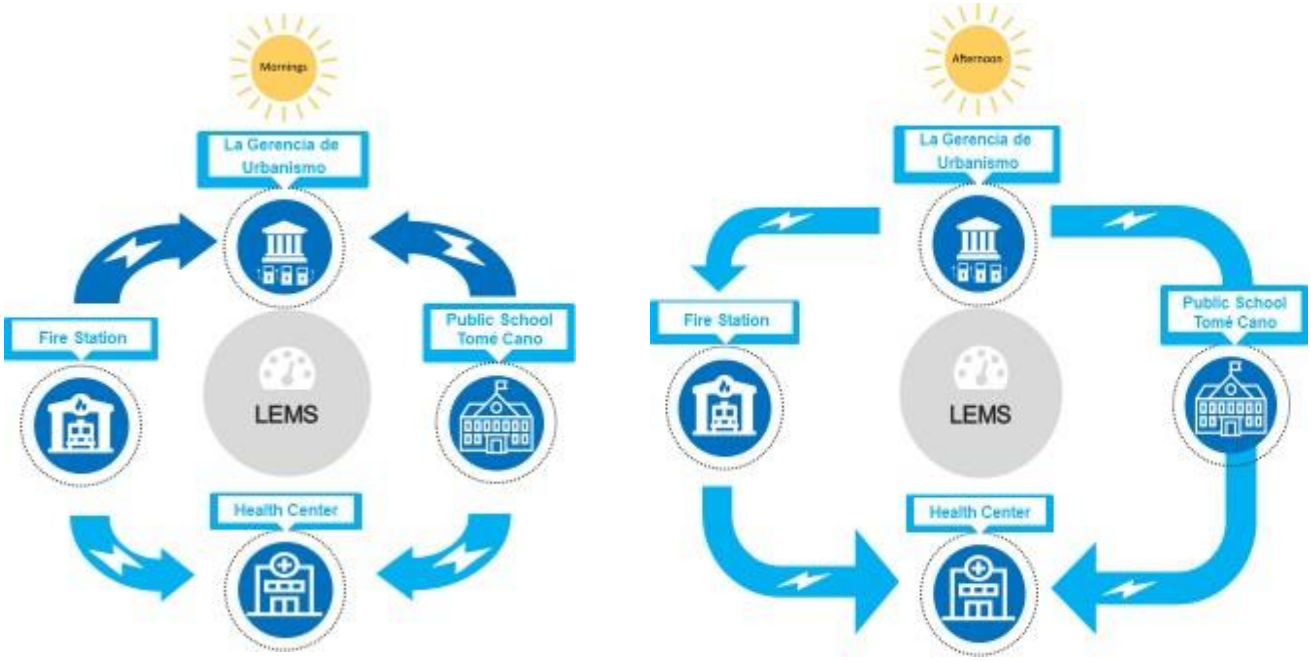

Figure 6. Smart Gerencia Energy flow. Left: 7:00- 15:00 h. and right: 15:00h onwards

The foreseen budget of this integrated solutions is 321.239,25 €. There is an MRR funding call, currently open, and the municipality is working on the proposal with the goal of obtaining a 60% of co-funding.

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

In order to improve the energy resilience, increase the economic savings and reduce the hazardous wastes; the Smart Energy Storage project will re-use the worn out e-buses batteries from local bus company (TITSA) to support the smart grid “La Gerencia-Tomé Cano”.

The fleet bus electrification is an on-going process which, in medium term, will generate hazardous wastes which could be avoided by the battery reuse as back up for RES in public buildings helping on its self-supply. Experiences have shown that extra safety measures are needed when setting them in the buildings. This could turn into an economically unaffordable measure, however, it utilization in open spaces nearby the buildings is a feasibly tested solution.

This measure will help to increase the energy self-sufficiency (10%) in the Smart Grid “La Gerencia-Tomé Cano”.

This project has an estimated budget of 20.000 €.

3.3.3. Transition Track 3- Smart e-mobility sector.

- IS-3.1: Smart Solar V2G EVs charging: Sustainable Street, RES-EV charging points in public buildings & E-Buses.

With the purpose of reducing pollution in the city as well as to reduce the global CO_2 emissions, electrification with RES support of public and private fleet is a strategic need for the city. In this regard, three main projects are in different levels of execution.

In accordance with the Technical Execution Project [4], the Sustainable Street is a public EV-charging infrastructure, place by the South-East entrance of the city, with PV (302 kW) and wind power (18 kW) support with a total estimated energy production of 0.489 MWh/year, and 379,6 Tm of CO_2 reduction. This project will have a direct impact on citizenship since it will promote EV usage by providing parking priority and charging service. The existing 79 official cars are going to be renewed in the new leasing

Figure 7. Location of Parque Marítimo dissuasive parking

contract with electric vehicles. In order to charge them, in first stage it will be installed 27 EV charging points (7 fast and 20 slow charging) with a total capacity of 0.462 MW in 12 public dependencies. In a second phase, 14 EV charging stations will be installed in public parking spaces across the city with a total capacity of 0.286 MW. These will be added to the 21 charging stations working today. Furthermore, in a third stage, 40 more charging stations will be installed in several public parking spaces. These charging points will be associated with the public lighting, hence, they will be operative only during daylight.

This solution has a 1.596.807,16 € budget with an 80% co-funding from EDUSI national funding program.

Regarding the bus fleet, there are two hybrid buses operating in the municipality and there is a pantograph already supporting them. There will be operating two more hybrid buses during 2023. These four hybrid buses will cost 1.930.000 € and have been granted with an 80% co-funding EDUSI funds. However, in order to electrify the public transport fleet, SCT is acquiring its first 11 100% e-buses for five bus urban lines, to serve 835.834 passenger per year. It will prevent the emission of 949 Tm of CO_2, 47.54 kg CH_4 and 12 Tm of N_2O in the city center. These 11 e-buses will cost 5.500.000 € and have already been granted a 40% MMR mobility funding, accordingly with the techno-economical document for grant request. SCT. ZBE I. [5]

Figure 8. Test electrical bus

Furthermore, SCT in collaboration with the bus company (TITSA) will invest in an additional 630 kVA transformer station to cope with this and the coming e-bus investments. This project costs 774.000,00 € and it has received a 90% co-funding by MRR mobility funds. Furthermore, TITSA will deploy a 0.44 MW PV installation in the central station of SCT with an investment of 457.025,31 € and 10% public grant already approved (MMR PV funds) accordingly with technical execution project of photovoltaic installation in Intercambiador [6].

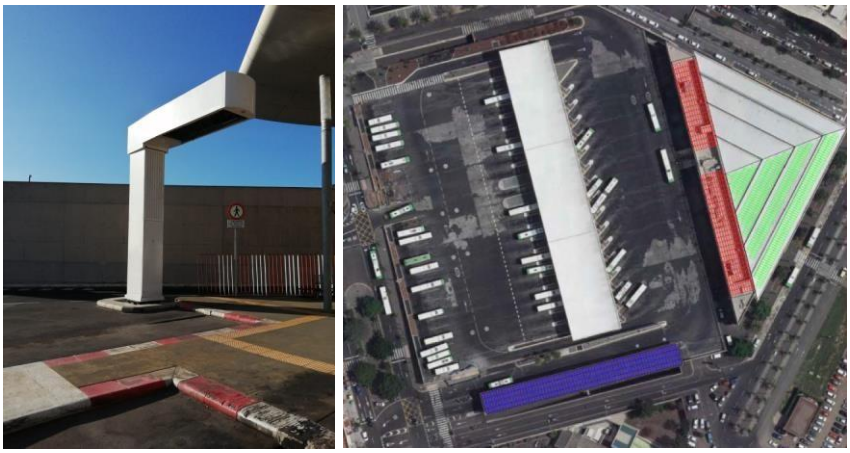

Figure 9. First Pantograph in TITSA Central Bus Station & PV planned System in TITSA Central Bus Station.

- IS-3.2: Innovative Mobility Services for the Citizens. Personal Mobility Strategy.

The Personal Mobility Strategy pursues to make the city more habitable for people by creating better conditions. To make this happen SCT is launching a Low Emissions' Zone in the city center, investing in dissuasive parking, favoring safe paths for children to go to school, and developing the cycling network in the city center with safe bike parking. Furthermore, in order to interconnect the five districts of the municipality a segregated cycling network is planned.

The Low Emissions' Zone will be operative before end of 2023, it will cover 796.622 square meters in the city center, where residential buildings, administrative nodes and commercial areas are presented. It will be comprised by 39 control access with cameras and automatized access system. It will affect to 8% of the population (16.604 inhabitants) but its impact will be larger considering the attraction capacity of the area (29.800 vehicles per day today and reach progressively 17.900 vehicles per day in 2030).

The first phase of the LEZ in the city will cost 1.420.000 €, and it has been already granted with 90% of the budget by MRR mobility funding. In accordance with the Techno-economical document for grant request. SCT, ZBE II [7]; a second phase (digital automation of the control system) has been defined and proposed for a new round of MRR mobility funding.

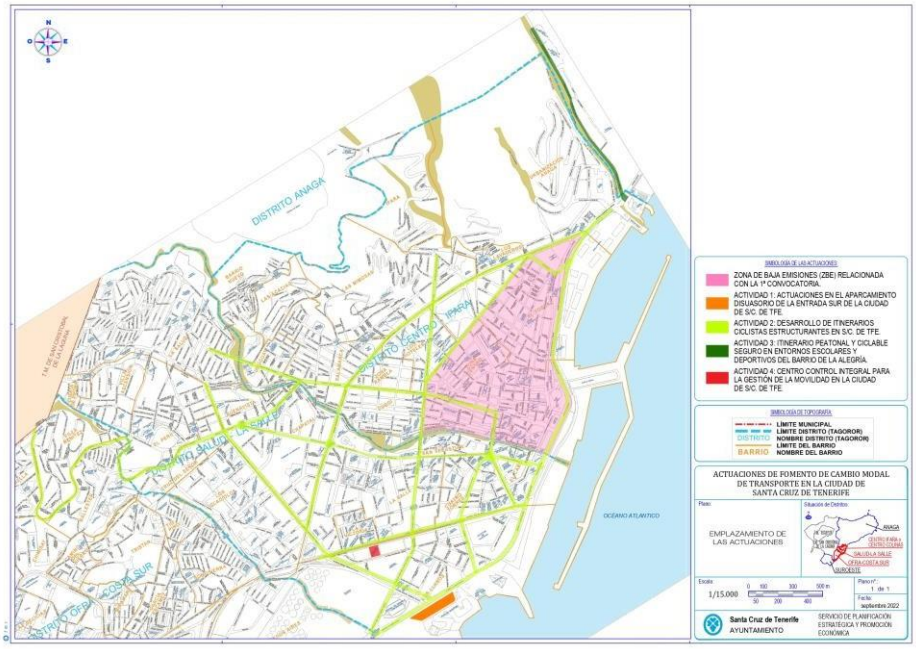

Figure 10. Low Emissions' Zone (in rose)

The dissuasive parking looks for reducing cars penetration in the city center by letting an accessible and easy to use parking space in the entrance of the city. In combination with the parking spots there will be an e-bus service as well as cycling lanes to the city center.

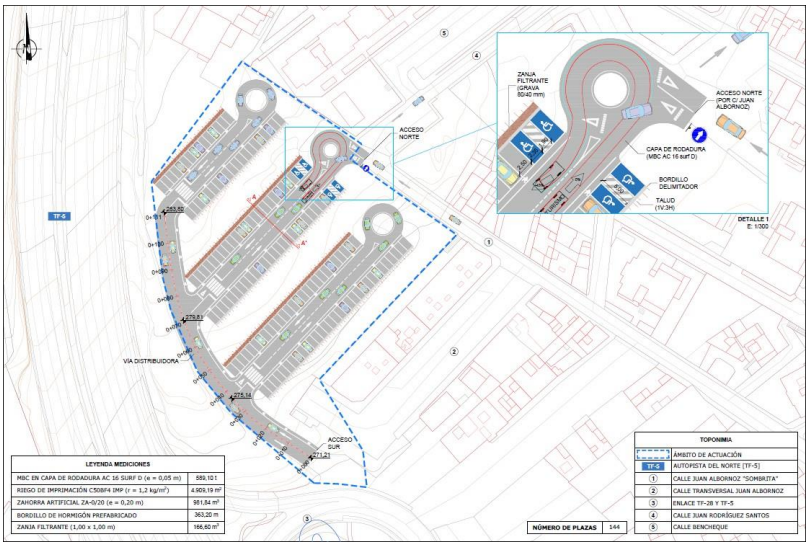

Figure 11. Dissuasive parking, Juan Albornoz

The dissuasive parking, Juan Albornoz, accordingly with Technical execution project of Albornoz parking [8], has an initial budget of 210.000 € and counts with a 50% co-funding granted by MOVES 2 funding programs. The other two alternative parking zones under study. Initial rough budget estimation indicates a total budget of 500.000 €.

Figure 12. Study locations for two more dissuasive parking

Schools paths project chases to create safe and sustainable net of paths for students to go to their schools either on foot or by bike. It is planned to be developed initially on five public primary schools. There will be a preferential walking and biking paths of getting around used by families. There will be a specific signage either for students or for vehicles, and an app will be available, as well, with detailed information about the schools paths in the municipality. Traffic restriction will be implemented on potentially dangerous spots, as well as protection fences or bike lanes whenever possible and recommended. The funding scheme of this project is the following; 565.000 € budget with a 50% co-funding already allocated by MOVES 2 program in accordance with the Techno-economical document for grant request. MOVES II [9].

The cycling network, accordingly with the Feasibility shared roads study [10], is the first real action to introduce cycling in SCT. Considering the proximity to this network, this measure will affect 33.000 inhabitants. Furthermore, it will help in the transition of the modal split towards less pollutant modes. It will interconnect the dissuasive parking and the central bus station with the main administrative, commercial and touristic attractor's nodes. Due to urban limitations it will be comprised by segregated bike lanes as well as shared roads with bike preference. Furthermore, 250 bike parking places will be

installed in the central station as well as across the network, close to the nodes with a least 25 charging e-bike stations. The funding scheme of this project is the following: 1.720.000 € budget with a 90% co-funding already allocated by MRR mobility program. This network will also overlay with the Low emissions' zone.

Figure 13. Proposed shared-road strategy for city centre

Regarding cycling connectivity, there is another level of work to be developed. It will be the cycling corridors among the five city districts. These corridors are planned to be segregated from the roads in order to enhance security due to the speed limit of the potential roads to be used and the level of occupancy. The preliminary phase oversees 13 different feasible segments to interconnect the districts with the city centre and most of the districts among them. The first estimation indicates a rough budget of 3.450.000 €. The feasibility technical study is currently under development. MMR funds will be pursued once the study is finished.

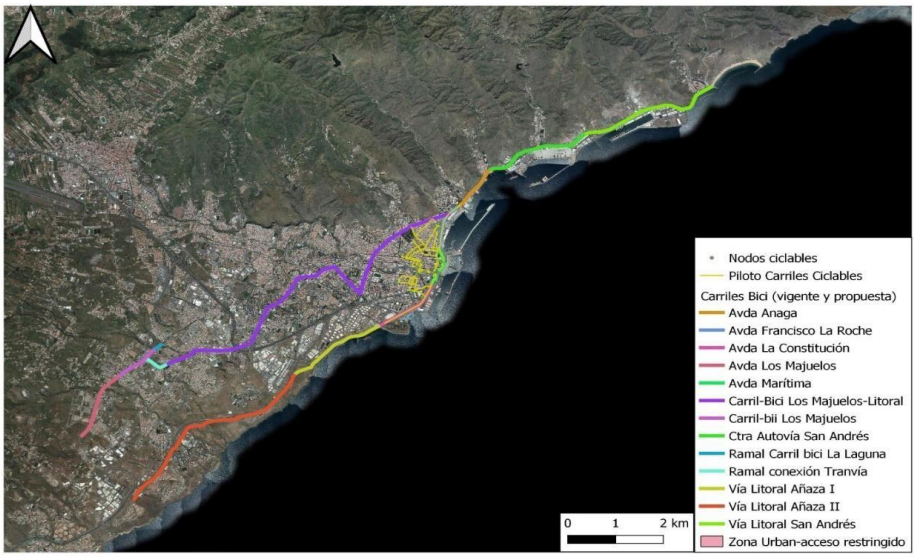

Figure 14. Preliminary scheme of cycling corridors

In addition to this, there are several actions to improve the pedestrianization of the urban space.

- The La Rosa street pedestrianization initiative. Budget: 3.500.000 €. MRR granted with 49% co-financing allocated.

Figure 15. Section of the La Rosa street project

- The Imeldo Serís street pedestrianization initiative. Budget: 2.191.082 €. MRR granted with 90% co-financing allocated. This project is already finished.

Figure 16. Imeldo Serís detail

- The Mercado de África (local market) surroundings. Budget: 759.000 €. Proposal applied for MRR funding with 90% co-financing. [11]

Figure 17. Pedestrianizatoion zone

3.3.4. Transition Track 4 - Digital transformation and services

SCT is planning to enlarge the capacities of the City Innovation Platform which is expected to gather all technological applications in the city. Currently the first approach to a CIP for the municipality is based on a licensed solution named MISTRAL totally focused on mobility.

Presently, SCT uses MISTRAL on the following systems:

- Traffic Control. Real time monitoring of traffic entities (areas, subareas, crossing, sensing, state of the traffic...)
- Indicators management. Total traffic mobility, average traffic speed, traffic congestion index, pollution index, traffic lights/other equipment availability levels.
- Incidents Automatic Detection System. A semiautomatic registration system to monitor all mobility incidents.
- Strategic and predictive Management module. Smart and automatic system to analyze and provide quick answers to complex situations.

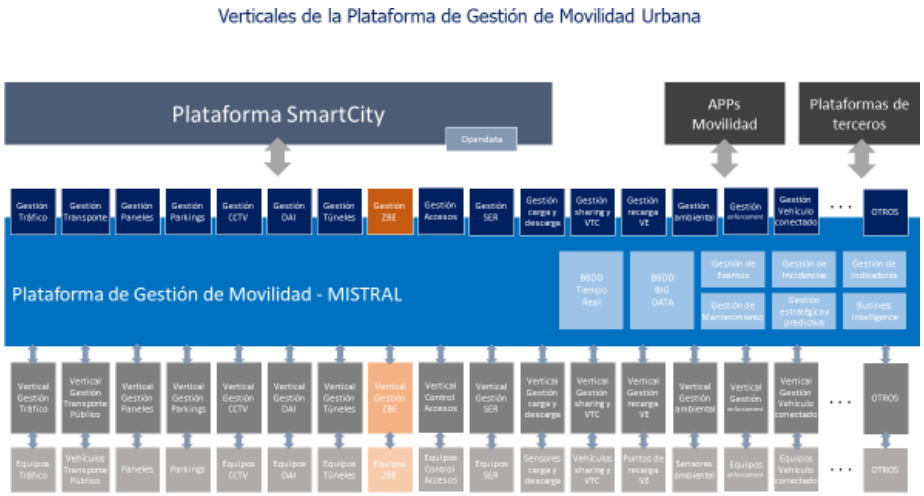

Figure 18. Architecture of MISTRAL

The vocation of this platform is to gather all vertical systems, equipment, sensors and information of the city providing a holistic management. In particular, it will let to integrate Low Emissions' Zone, EV Charging Control System, environmental urban monitoring, camera control, taxis, regulated parking. Its main features are the following:

- Gathering and monitoring as a whole in a single interface all selected information.
- Analyze and interrelate information accordingly with defined criteria
- Show information graphically in a scorecard to facilitate decision making.
- Provide open data to let other actors to use it.

This platform is open source system, using normalized protocols and standard information exchange methods (API rest, NGSI v2, etc.) This allows integration of any equipment or control system with connectivity.

Next it is shown the three main actions to be developed and integrated in the SCT CIP.

The budget for this project is 1.751.000 €. It counts with no other public funding to the present moment.

- IS-4.1: Services for Urban Monitoring

The Urban Monitoring project will measure city pollution, linked to traffic, by using 6 environmental sensing stations (with double sensors capacity) to assess the following parameters; CO_2, CO, NOx/NO.

Real time data will be displayed across the city as well as via a specific APP. This data also will help to decide and inform about traffic restrictions accordingly with air quality indicators.

Figure 19. Selected locations for environmental sensor

This IS has a budget of 1.346.923,50 €. It counts with EDUSI national fund grant with 80% co-financing.

- IS-4.2 Services for City Management

SCT ambition is to integrate buildings, infrastructures and urban planning data to create the City Innovation Model (CIM) of the city. In order to achieve it, a pilot initiative will be developed to gain experience and help to expand it across the city in near future. In this first step, a model will be implemented at the square level where "La Gerencia-Tomé Cano" IS-2.1 project will be executed. By doing it this way, synergies are expected to happen by taking advantage of the various RES, EV-charging, 2nd life batteries, variety of public buildings, etc.

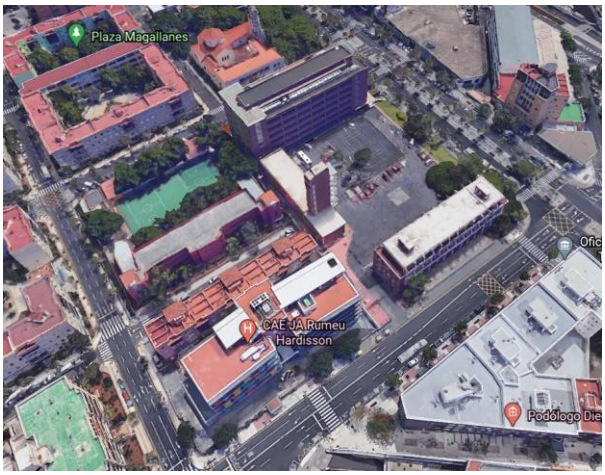

Figure 20. Selected block for CIM pilot. Tomé Cano

.

This IS has a budget of 160.000 €. It counts with no other public funding to the present moment.

- IS-4.3: Smart EV Charging Control System

Despite the relatively large EV charging stations system deployed across the city, SCT pursues to enlarge it but also to improve its service by implementing an informative APP to let users know what charging points are available, what is the level of the charge, as well as other management information (maintenance needs, planning use according with RES, etc.).

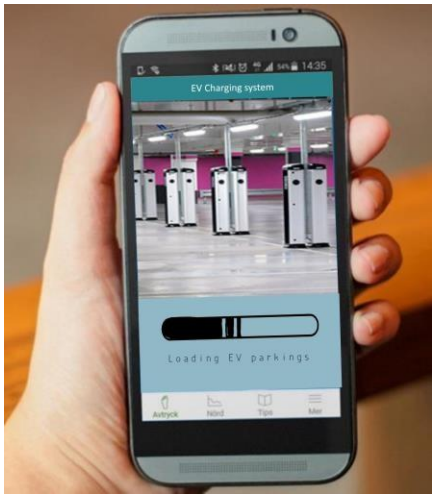

Figure 21. E-parking APP representation

This IS has a budget of 100.000 €. It counts with no other public funding to the present moment.

3.3.5. Transition Track 5. Citizen's engagement

- IS-5.1: Changing everyday energy use. Public awareness campaign Energy – School; Youth & Family.

The main goal of this replication action is to increase the sustainable energy awareness of the educative community at different levels. Primary education students are the main targeted public. But also, teachers and school directors will gain from this initiative. Furthermore, families too will eventually be affected by this awareness campaign to help this community to change everyday energy usage.

The first step of this project is already launched with the Climate Change Card's game. See Deliverable 8.8 for an explanation of the game. The second will be its promotion among the 35 primary public schools. And the third level will be the integration in the educative curricula of the RES implemented in schools.

This IS has a budget of 32.000 €. It counts with no other public funding to the present moment and basic methodology [12].

Figure 22. Climate Routes Card Game. Validation Workshop

- IS-5.3: Living labs. VR BIM.

The Gerencia-Tomé Cano project consists in a set of actions such as RES, EV charging, Building Energy Management System and digital twins (CIM). In this regard, Virtual Reality will be an easy way of improve building management for property owners. Furthermore the AR/VR BIM visualization tool to be developed in 2025 will put the information at the fingertips of the building users in a simple and easily understood interface.

This IS has a budget of 12.000 €. It counts with no other public funding to the present moment.

3.4. Lessons learned for Macaronesia region

In first place, there are several lessons which could be a general learning for any medium size city in Europe.

- First Murphy's Law; "everything takes longer time than planned".
- Replication should be understood as learning from other and adapting solutions to your own circumstances and context.
- Transforming the innovation culture of the city requires political leadership and motivation of the human team inside the organization.
- Improving internal collaboration channels to mitigate silo's effect.
- Changes in project's team create turbulences, but new professionals bring other new assets which are of benefit.
- In order to increase success in several levels, communication actions must be integrated in all working levels as soon as the project starts and needs to accompany the process.
- Make use of synergies within the municipality organization regarding the SECAP's execution.
- Mapping local stakeholders and making them interact to enrich local diagnosis and obtain common ground to work together strategically.
- Well driven participatory process could overcome initial expectations and enhance motivation of the public employees and politicians.
- Collaborative projects are essential to boost change process or speed up innovation.
- Use collaborative data reservoir (e.g. EMDESK)
- Make best use of the Marketplace capacities (other smart cities solutions).
- Technological distrust could delay *sine die* project advancements. Learning from other cities experiences can unleash doubts and evaporate distrust with the right communication actions.
- Financing capacity is a barrier but it could be overcome having the right motivation and capacities favored with the good context.
- Language constraints in the teams could lead to a minor communication capacity among project partners.
- Mapping and applying for National and EU funding requires more human resources and/or alliances with local stakeholders.
- Analyze local data availability (open data, GIS sourced data...) to integrate with a larger CIP.
- Accordingly with every specific integrated solution to be deployed, there is a need for specific scientific and technical know-how as well as socio economical savoir-faire. Knowledge is gained via several ways. Support and mentoring from LHC is a practical one. In spite of it, there is still need for finding local stakeholders to collaborate with.
- Citizen's engagement requires a good previous planning and specific team to deploy it.
- Assigning a multidisciplinary team specifically for the project success increases the opportunities to reach the pursued goals.

Furthermore, SCT experience with IRIS project can also be of benefit for similar cities at the regional level or at other levels with common characteristics. In particular, the focused zone for this is the Islands from Macaronesia region; Canaries, Azores, Madeira, Islas Salvajes and Cape Verde. These archipelagos have very close climate conditions and similar economic constrains (distance to mainland) which will make it easier to share and apply SCT IRIS experience.

- Building retrofitting is a long term worth it investment. However, using bioclimatic criteria from the beginning can save money. Cost-benefit studies show that in colder cities, energy used is much larger than in Macaronesia. Hence active equipment (conditioning system) requires much longer amortizing time.
- Regarding renewable energies, Macaronesia Region presents very large natural resources, which are very profitable technologies for sustainability and to attain energy sufficiency.
- Mobility challenges finds sooner space limitations due to islandic conditions.
- Central and Northern European countries are not normally used to water scarce, therefore water is not an issue to confront nowadays. However, Macaronesia Region as well as Mediterranean arc countries need to develop smart cities solutions on water management.
- Adopting a CIP in a medium size city is a complex task, hence this is a process which requires time and knowledge gathering.

4. Guidelines for smart city concept implementation for Macaronesia region

For implementation of a smart city concept, Santa Cruz de Tenerife city proposes this brief guideline, in particular for the Macaronesia region.

1. Develop a deep understanding of the city challenges and struggles by combining citizen engagement, local ecosystem and public employees. Invite politicians to participate too.
2. Prioritize the objectives accordingly with the previous exercise and counting with the same stakeholders. Limit the number of objectives accordingly to its importance. Let's focus on them.
3. Align the smart city goals with the general municipal development strategy.
4. Find other initiatives in the municipality which might have some relation with Smart City goals. Create synergies with them.
5. Compile all available and related data or info to create a baseline of the city.
6. Accordingly with the observed needs, expand data acquisition to create an appropriate data city baseline for the defined city goals.
7. Benchmark and learn from other cities at all scales and network with them.
8. Investigate smart city solutions that could be suitable for your city. Take advantage of the Smart City Marketplace website.
9. Map relevant stakeholders and contact them.
10. Map funding programs on national and European Union level.
11. Create a smart city team with an *ad hoc* leadership and counting with public employees ranging in all related departments. Breaking silos is essential.
12. Communication inside the organization as well as with citizenship and local ecosystem is indispensable. Define a communication program from the very beginning.

Specific considerations for the Macaronesia region:

- Ultra-peripheral islandic regions gather several limitations (distance to mainland, fragmentation and reduced surface among others).
- Similar tempered climate with great potential for renewable energies.
- Innovation investment ratio is much lower than European average.
- Capacity to become a living lab for smart cities due to its controlled conditions.
- Scattered population makes it is a challenge to provide services in particular solving mobility issues.
- Attaining a certain level of self-supply on energy, water and food are crucial for becoming real smart cities.
- There is potential to create an innovative ecosystem taking advantage of the special tax regimen.

5. Conclusions

Despite the municipality is at the first stages of the RP implementation, the global experience of the municipality during this implementation of the replication plan is in general very positive. However is crucial to consider several aspects to prevent frustration and lack of success during implementation.

In this regard, developing a smart city strategy in a medium size city is a complex process, which requires political commitment, a good team of public workers, but also motivated, as well as a collaborative local ecosystem. Moreover, it is essential to count on a sound and clear replication plan with objectives aligned with the city goals. In SCT case the existence of several key actors helped to turn traditional inertia into a swift of the municipal direction towards alignment of the replication plan with the municipal policy.

Secondly, even counting on board the first items previously mentioned, this is not a guarantee of success; hence, having the support of other cities is an asset which not all cities can take for granted. Nonetheless, there are European networks such as Smart City Marketplace which can be of much help as well as it was the IRIS partnership.

Thirdly, citizens' engagement is crucial to enrich the process and obtaining the right feedback to align the smart city process with society. The sooner is started this process the better for a deeper and more consolidated success.

However, this is only part of the elements to be considered. The proper organization of the municipality in terms of structure and internal communication flows are two elements which have evolved in SCT case, which helped to integrate a better innovation culture as well as a more efficient administration.

SCT experience is a humble but consistent experience in smart city development, which could be of motivation and to some extent of help mainly to cities in the Macaronesia region.

5.1. Recommendations

The recommendation SCT can share is that in order to accomplish a robust smart city plan this process needs to be led by the highest level of the municipality and needs to be accompanied by the commitment of the rest of municipal team. Furthermore, participatory process and communication actions must start from the very beginning.

6. References

[1] Sustainable Mobility Plan. SCT. 2022[2] SCT SECAP. SCT. 2022.

[3] Technical report of photovoltaic installations in water infrastructures. EMMASA. 2022.

[4] Technical execution project of La Calle Sostenible. SCT. 2018.

[5] Techno-economical document for grant request. SCT. ZBE I. 2022.

[6] Technical execution project of photovoltaic installation in Intercambiador. TITSA. 2022.

[7] Techno-economical document for grant request. SCT.ZBE II. 2022.

[8] Technical execution project of Albornnoz parking. SCT. 2021.

[9] Techno-economical document for grant request. MOVES II. SCT. 2020.

[10] Feasibility study for Shared roads for cycling and MPV. SCT.2021.

[11] Techno-economical document for grant request for Mercado de África. SCT. 2022.

[12] Educative workshop methodology. Daan Daniels. 2021.