Project no. 691735
REPLICATE PROJECT
Renaissance of Places with Innovative Citizenship And Technology

This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

REPLICATE PROJECT

REnaissance of PLaces with Innovative Citizenship And Technology

Project no. 691735

H2020-SCC-2015 Smart Cities and Communities

Innovation Action (IA)

D7.5 Report on management models v2

Submission date: 17/04/2019

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Index of contents

This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

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1. EXECUTIVE SUMMARY

The aim of Replicate lighthouses' pilot actions is to find innovative technologies and approaches to be extended and exported in other smart cities, starting with the followers and observers involved in the project.

In the first three years of the project the measures included in the pilots' comprehensive sets have passed from the idea to reality, some of them going through adaptations due to the evolving framework and unexpected obstacles but collecting the first results and useful feedbacks.

The most interesting managing solutions are illustrated in this deliverable by the responsible partners together with the lighthouses to provide other cities and professionals with hints and ideas for the propagation of the results.

The actions selected have been:

- ✓ Smart buildings:
  - Biomass district heating
  - Retrofitting
  - Retrofitting & district heating with solar thermal seasonal storage
  - Smart homes
- ✓ Smart public lighting:
  - Smart lighting service
  - Innovative eco-lighting
- ✓ Smart mobility:
  - e-taxi fleet and fast recharging infrastructure
  - Smart Mobility Service e-bus "WeGo"
  - E-bikes
- ✓ ICT:
  - Smart mobility platform
  - Big data for mobility services
  - High speed mobile network based on post WIMAX technology
  - IoT
  - Smart City Control Room
  - Open data
- ✓ Participation:
  - Citizen participation platform
  - The Bristol approach to citizens' sensing
  - The energy gaming App

The analysis is supported by a study on the technical solutions in use developed in D7.3.

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2. REPLICATE

The main objective of REPLICATE project is the development and validation in three lighthouse cities (**San Sebastián** – Spain, **Florence** – Italy and **Bristol** – UK) of a comprehensive and sustainable City Business Model to enhance the transition process to a smart city in the areas of the energy efficiency, sustainable mobility and ICT/Infrastructure. This will accelerate the deployment of innovative technologies, organizational and economic solutions to significantly increase resource and energy efficiency improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas.

REPLICATE project aims to increase the quality of life for citizens across Europe by demonstrating the impact of innovative technologies used to co-create smart city services with citizens and prove the optimal process for replicating successes within cities and across cities.

The Business Models that are being tested through large scale demonstrators at the three cities are approached with an integrated planning through a co-productive vision, involving citizens and cities' stakeholders, providing integrated viable solutions to existing challenges in urban areas and to procure sustainable services. Sustainability of the solutions is fostered in three areas: economic and environmental and finally, fostering transparency in the public management.

In addition, the Model features the replicability of the solutions and their scale up in the entire city and in follower cities, particularly in three follower cities (**Essen** – Germany, **Lausanne** – Switzerland and **Nilüfer**–Turkey) that are involved in the project and therefore, have access to know-how and results achieved on the project so they can apply the developed model. At the moment, there are 2 observer cities, Guanzhou (China) and Bogota (Colombia).

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3. INTRODUCTION

3.1 WP7 "cross cutting activities": aims and links

Work package 7 of Replicate project summarises the experience of the pilot actions providing materials for the following WPs (task 7.1 and 7.2) and extending the pilots with a concrete replication plan at city or metropolitan level (task 4): following the STEEP project experience, the three cities are working together, after the common planning phase and the recent test realisation phase in the field, to deliver a scalability analysis of the interventions (task 7.3) based on the concrete realisation results.

After the work done in the field (Lighthouses Pilot districts WP3,4,5), very valuable lessons in understanding the obstacles/results of the integrated measures set have been acquired: the three pilot actions have been analysed in detail and each city has also started thinking about the opportunities and barriers in replicating and scaling up this approach to the city level, but also in the other two cities contexts in order to have a wider landscape of the test phase.

The results from the technical comparison (D7.2 and 7.3 "Report on technical solutions") matched to the different management models and the business plans (D7.4 and 7.5 "Report on management models") will offer the cities all the tools to develop reliable replication plans (D7.6 "Lighthouse cities replication plans").

The consortium has three assumptions:

- A district could be considered as a small city area where urban issues can be represented.
- The pilot in the districts will help to understand the complex system related to implementation of the integrated Smart City Plans.
- It is necessary to collate the knowledge of all stakeholders involved in the three pilots, to validate the relevance of the initiatives selected.

With these three assumptions, the objectives related to the cross-cutting WP are:

- Detect the optimal conditions for the replication of the solutions tested in the Smart districts in connection with industrial/SME partners
- Define the scalability potentials and the possible roadmaps for the extension of the pilot at city/metropolitan level
- Use stakeholders' knowledge for understanding, defining and validating interventions in the urban system.

The activity will take advantage of the work being done to develop the actual Smart City Plans for the three cities (STEEP project). Thus, the resultant methodology will have a solid guarantee, due to the fact that the three city replication Plans will have been developed and properly validated following the plans' directives and the same construction process.

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3.2 Relation to Other Project Documents

Above the obvious close interaction with the three pilots (WP3,4,5), whose results and schedules it depends on, WP7 is strongly linked also to the other transversal workpackages regarding ICT platform and monitoring (WP6, 10) and it presents important synergies with the replication potential analysis at market sectorial level or in other follower cities (WP2, 8, 9).

In particular the following activities regarding learning from pilots (WP2 and 8), networking, replicability and exploitation potential are interested in data harvesting from pilots which is the main goal of this document.

3.3 Reference documents

This deliverable has interacted with the following project documents:

Ref.	Title	Description
REPLICATE Grant Agreement signed 240713.pdf	Grant Agreement	Grant Agreement no. 691735
DoA REPLICATE (691735)	REPLICATE Annex1-DoA to the GA	Description of the Action
REPLICATE Consortium agreement	Consortium Agreement	REPLICATE project - Consortium Agreement
REPLICATE WP1 project management	D1.7 Data Management Plan	REPLICATE - data management plan
REPLICATE WP2	D 2.2 Business Models of the Lighthouse cities	First description of the BMs adopted
REPLICATE WP3 San Sebastian Pilot	D3.3 District Heating	Report on DH implementation in SS
	D3.8 Smart mobility platform	Report on smart mobility platform deployment
	D3.9 electromobility monitoring	Report on electromobility
	D3.10 High speed network based on post WIMAX technology	Description of the high-speed network implemented
	D3.11 Smart Lighting	Report on smart lighting measure
REPLICATE WP4 Florence Pilot	D4.1, D4.3 Periodic Reporting on the state of the implementations in Florence.	Florence Energy Pilot -Report on the state of the project
	D4.2, D4.4 Pilot action measures advancement sheets	Monitoring report of the pilot at the 18th and 30th month

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REPLICATE WP5 Bristol Pilot	D5.3 ENERGY DEMAND PLATFORM DEPLOYED TO MONITOR ENERGY GENERATION AND DEMAND	Report on EDMS action
	D5.4 Twelve E-bikes Deployed in a Corporate Scheme	Report on e-bikes deployment
	D5.5 Expansion of a Car Club in the Area with Electric Vehicles	Report on car club action
	D5.7. Transport Infrastructure Adaptation Including EV Charge Point Installation	Report on transport infrastructure adaptation
REPLICATE WP6 ICT Platform	D6.4 Integrated architecture and services catalogue	Description of the 3 pilots ICT platform and services
REPLICATE WP7 Cross cutting activities	D7.1 Peer review methodology	City Data Canvas and first data
	D7.2 Report on technical solutions v1	Pilot actions technical solutions analysis
	D7.4 Report on management models v1	Pilot actions management models analysis
REPLICATE WP9	D9.1 Baseline definition and integration and results analysis from WPs 3,4,5,8	Baseline for the 3 pilots
	D9.2 Methodology review and methodological framework definition	Business models analysis methodology
	D9.3 Sectorial Business analysis / Exploitation potential in the field of energy, ICT, sustainable mobility and other remaining sectors included in REPLICATE	Sectorial Business analysis / Exploitation potential
REPLICATE WP10 Monitoring	D10.1 Report on indicators for monitoring at project level	Set of indicators to assess each Replicate project intervention
	D10.2 Report on indicators for monitoring at city level	Set of indicators to assess the impact of interventions at the city level
	D10.3 Baseline analysis of city level indicators for follower cities and benchmarking with lighthouses	Evaluating the baseline analysis of city level indicators for follower cities and benchmarking with lighthouses.

In the event of discrepancy between documents, WP7 Materials are overruled by the contract with the EU (Grant Agreement) including its Annexes and amendments, which takes precedence over all other documents.

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3.4 Abbreviations list

ADS	San Sebastian municipality (Ayuntamiento Donostia San Sebastian)
BCC	Bristol City Council
CA	Consortium Agreement
GA	Grant Agreement
DoA	Annex I-Description of the Action
DH	District Heating
EC	European Commission
EDMS	Energy Demand Management System
EPC	Energy Performance Contract
ESCo	Energy Service Company
EV (BEV)	(Battery) Electric vehicle
RES	Renewable Energy Sources
SCCR	Smart City Control Room
TES	Thermal Energy Storage
VCE	Value Creation Ecosystem (WP9)
WP	Work Package

4. DELIVERABLE DESCRIPTION

Starting from the peer review methodology, described in D7.1, this deliverable will exploit the info collected to exchange feedbacks among lighthouses (breaking silos) and to carry out further analysis by experienced partners to describe in detail, validate or adapt the models tested in the pilot district for the scale up and replication phase.

The description of the framework together with the measurement of city performance is one of the critical ways in which we can assess the complexity of urban change, and judge which approaches are successful or not; the first annex will report the changes that have been occurred in the 3 cities' context since the proposal phase to assess their influence on the implementations and to evaluate the adaptations adopted by the lighthouses.

In a fast-evolving economy is necessary to keep on learning about city strengths and weaknesses to be more and more flexible and to adapt the planned measures in order to optimize the results and the impacts for citizens.

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For this analysis at the third year of the implementation, the three cities have been asked to select the most interesting measures whose business models play a central role in their smart district concept.

The actions selected are described under the present document which covers:

- **Section 5**: description of the current framework (detailed in annex 1)
- **Section 6**: the methodology adopted (reported in annex 2)
- **Section 7-15**: analysis of the pilot measures and first scale up analysis

In sections 7-15 after the detailed analysis of the implementation and the lessons learnt in the field, for each action included in the deliverable further evaluations have been carried out: the SWOT matrix has been used to support strategy making together with the Unique Selling Proposition, providing the basis for the replication plans development.

A first attempt for the extension of the actions after the pilot test has been developed together with the lighthouses and the involved partners through the definition of a possible management model described through the management model scheme based on ESADE's VCE.

In **annex 1** the national and local framework have been detailed to understand and compare the boundary conditions of the three different pilot.

Annex 2 provides a description of the methodology adopted and the links with the other workpackages, while **annex 3** is a detailed list of the partners involved in the different actions mentioned in the report.

5. THE FAST EVOLVING FRAMEWORK

Lighthouse cities, as every smart city, are based on a very dynamic environment following closely societal and technological evolution and at the same time they are located in multilevel national systems with own policies and strong influences in some sectors. It has been three years since the development of the project idea or even more since the definition of the actions with the participatory processes and in the lighthouse cities the framework has slightly changed influencing the actual implementation. The analysis of the changes from the national to the local level has become important to understand the adaptations and the optimal conditions for the replication/scalability of the measures.

In annex 1 a short update from the three cities to contextualize the actions, considering the three main sectors involved: buildings, mobility and ICT.

To better compare the intervention and understand the cross-fertilisation chances of the different measures implemented in the three lighthouses, a short overview on energy prices is also reported in annex 1 with a focus on the three participating nations.

The status of the ESCo market in the three nations of the lighthouses has been summarised in a supporting table to enable comparisons and assessment of potentials for the replication phase.

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6. The methodology adopted

To validate the relevance of the initiatives selected, the actions have been shared and the discussion open to any interested partner with the aim of cross fertilizing the scale up and replication plans to be developed in the next years. A follow-up activity is already in place with followers within the city-to-city learning program coordinated by Oxford University.

The information exchange is based on the previous Project outputs described in annex 2: the *City Model Canvas* provided by ESADE in WP2 (D2.2), the related *City Data Canvas* developed in WP7 (D7.1).

The analysis of each action starts from the data collected in the City Data Canvas, developing the points closely related to the management model and replicability. The contents analysed are:

- General description (what)
- Value proposition (core value – why)
- Players (stakeholders and users – who)
- Market analysis (framework)
- Impacts & Business model scheme (how)

To complete the analysis and wrap up the lessons learnt, for each action a *SWOT & USP (Unique Selling Proposition)* analysis have been included

For the management model schemes, the theoretical framework is based on the *Value Creation Ecosystem* concept developed by ESADE developed under WP9 of Replicate project; all the implementations included in the present analysis have been modelled together with partners and lighthouses to illustrate the complex eco-system of the actual implementations.

Afterwards, a first attempt of scale-up at municipal level or possible replication involving other municipalities has been designed with the three cities: these further schemes have been drafted to support the next phase consisting in the scale up plans development for the lighthouses as well as the replication plans for followers (WP8) or any interested city.

It is a first attempt that will be further refined and optimized in the up-coming months with lighthouses in cooperation with local stakeholders and through the experience exchange among cities and Advisory Boards.

The viability and the performance of the interventions are the objective of the REPLICATE business models monitoring system (refer to Deliverable 10.7): a first analysis is reported in D7.3 Report on Technical solutions v2.

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7. Buildings

7.1 Solution 1: District heating exploiting local biomass

The District Heating (DH) project provides a system for distributing heat, powered by biomass, for Domestic Hot Water and heating generated in a centralized location through a system of insulated pipes for the new residential area Txomin Enea (160.000 m²) in Donostia – San Sebastian. The framework for this project spans the development of the DH building, installation, setup, operation and maintenance. It should guarantee continuity and quality of the thermal energy supply to meet the heating and DHW demand of 1,458 homes, including the connection of 156 retrofitted houses. For this purpose, the installations are composed of two biomass boilers (1400 kW) and two gas boilers (2300 kW).

DH is the largest woodchip/biomass-fired power plant in the Basque Country. When the neighbourhood is fully occupied, the plant's total energy efficiency will be above a record breaking 90% in combined hot water and heat mode. For decentralised boiler systems, efficiency is usually around 55%. The project will deliver better results in terms of performance, energy efficiency, and greenhouse gas emissions than a decentralised boiler system.

Furthermore, an operation platform has been developed to control the demand side through ICT, allowing residents to monitor their consumption.

Value proposition

Fomento de San Sebastián started heading up the DH development project for Txomin neighbourhood in the year 2010, a highly innovative project for the city and region, and the first publicly owned DH system in the Basque Country.

The project brings benefits of different kinds:

- environmental benefits, for the use of renewable energy (biomass) and the reduction of CO_2 emissions. Moreover, the centralized system has more efficiency than decentralised boilers, which means a reduction in energy consumption.
- economic benefits thanks to a lower spending on preventive maintenance (carried out by specialist staff), a lower spending on primary energy procurement (used to generate thermal energy) and fewer incidents and therefore lower spending on corrective maintenance.

Beside this, users benefit from various advantages:

- 15% savings on the price of the thermal energy consumed
- Non-individual maintenance actions for each building
- Greater guarantee and quality of service, and its availability
- Reduction of investment required in each building.
- No need for each dwelling to have its own central heating system and gas mains connection
- No need to invest in the building's gas network
- Better use of floor space in each building.

This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

Players

Key partnership:

Fomento San Sebastian (project coordinator) and San Sebastian City Council (project partner)

UTE Txomin Enea (third part), Smartos (third party), UTE Txomin Berria (third party), Commtech.

Beneficiaries:

Owners, tenants and citizens of the district

Supporting Stakeholders:

Property owners Associations, technical experts, citizens, real estate developers

Market analysis: enablers and obstacles

Legal framework:

Below is a list of the main regulations that apply to the District Heating project.

- UNE-EN ISO 17225:2014 Solid Biofuels - Fuel specifications and classes.
- Royal Decree 1042/2017, of 22 December, regarding the limitation of emissions of certain pollutants from medium combustion facilities, updating appendix IV of Act 34/2007, of 15 November, regarding air quality and protection of the atmosphere. The purpose of this Royal Decree is to incorporate into Spanish law EU Directive 2015/2193 of the European Parliament and the Council of Europe, of 25 November 2015, on the limitation of emissions of certain pollutants into the air from medium combustion facilities.
- The Regulation for Thermal Installations in Buildings (RITE) sets out the conditions required for the installations designed to meet the demand for thermal comfort and hygiene through heating, air-conditioning and hot water installations, to achieve a rational use of energy.
- The Technical Building Code, current regulation in the period of definition and development of the DH project, approved by Royal Decree 314/2006, of 17 March. The Technical Building Code (TBC is the regulatory framework that establishes the requirements that must be met by buildings in relation to the basic safety and habitability requirements established in Act 38/1999 of 5 November, regarding Building Regulations (LOE). The basic quality requirements with which buildings must comply relate to matters of safety and habitability. The TBC also addresses accessibility as a result of Act 51/2003 of 2 December, regarding equal opportunities, non-discrimination and universal accessibility for persons with disabilities, LIONDAU.
- The Energy Performance of Buildings Directive 2010/31/EU adopted by the European Parliament and the Council on 19 May 2010
- Additional Building Regulations specific to San Sebastian City Council

Incentives:

The economic and management of the District Heating model consist on a public-private collaboration with the aim to generate a management system that allows aligning public and private

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sector objectives, while guaranteeing public policies, energy prices stability and maintenance for final users.

The service is owned by Fomento de San Sebastián, S.A., in other words, the City Council itself will be involved in day-to-day management through a strict monitoring of service quality and the requirements set out for the operator in the tender competition process.

It has been decided that any energy not consumed should be charged in a differentiated way, at a price that only covers the cost of the primary energy required to produce it. This means that Fomento de San Sebastián, in its business plan, assumes this cost, and it is not reflected in the fixed price defined for users, protecting people and families who require more energy consumption (older people or large families).

Human factor (success factors, opposed sentiments, …):

The project development took a long time due to changes in regulation framework, which erased the incentive schemes, and that obliged to design a new project model.

Moreover, the lack of previous projects, as references for citizens, caused an initial uncertainty among final users.

Competitors:

The main competitors are other companies who offer connection to DH.

Main impacts of the measure:

Expected Impact	Contribution
Energy (and emission) savings	Thanks to the DH project for Txomin-Enea, CO_2 emissions will be reduced by 80% compared to individual heating and hot water systems. The project will drive emissions down from 2,900 t of CO_2 emitted per year with conventional heating, to just 450, which within a period of 20 years would lead to a reduction of almost 50,000 t.
Monetary savings	Users can benefit from 10-15% savings on the price of the thermal energy; non-individual maintenance actions for each building; reduction of investment required in each building.
Social inclusion	The whole area of Txomin-Enea (around 1.500 dwellings) will be connected to the DH enhancing the well-being and the social inclusion of the citizens
Increased awareness	Tenants will have the possibility to monitor their energy consumption through an online platform that will also offer information and advices.

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Exemplary case study	The DH project is highly innovative for the city and region, as it is the first publicly owned DH system in the Basque Country. The action could represent a best practice to be replicated in San Sebastian for other users.

Management model:

Economic costs and revenues:

The complete system has been implemented and funded in 3 blocks: the thermal energy production plant itself, the heat network of the primary circuit and the hydraulic installations in buildings.

- The distribution of the investment in the thermal energy production system and its building has been as follows: 50% has been contributed by the Council itself, just over a million euros from the temporary union of businesses made up of Ferrovial Servicios S.A. and Tecnocontrol Servicios S.A., - UTE Txomin Enea - and the rest by the European Union as part of the Replicate project. The total investment of this part is 3,3MM€.
- The primary heat network has been funded within San Sebastian City Council's own urban planning project. This investment has been around 0,5MM€
- The buildings' hydraulic installations are the responsibility of the building developers (with a lower cost per household than they would have had with a traditional system). This part has no yet been quantified because it is part of the investment of each building connected to the DH network.

Maintenance costs will be low and the revenues will consist in the energy bills of the tenants who will benefit from a 10-15% of reduction on the yearly energy expenditure.

Management model scheme in use:

The management model adopted is a public-private collaboration in which Fomento de San Sebastián is the owner and proprietor of the service provided by the District Heating system, and the contracted company is renting the installations from Fomento and maintaining the service.

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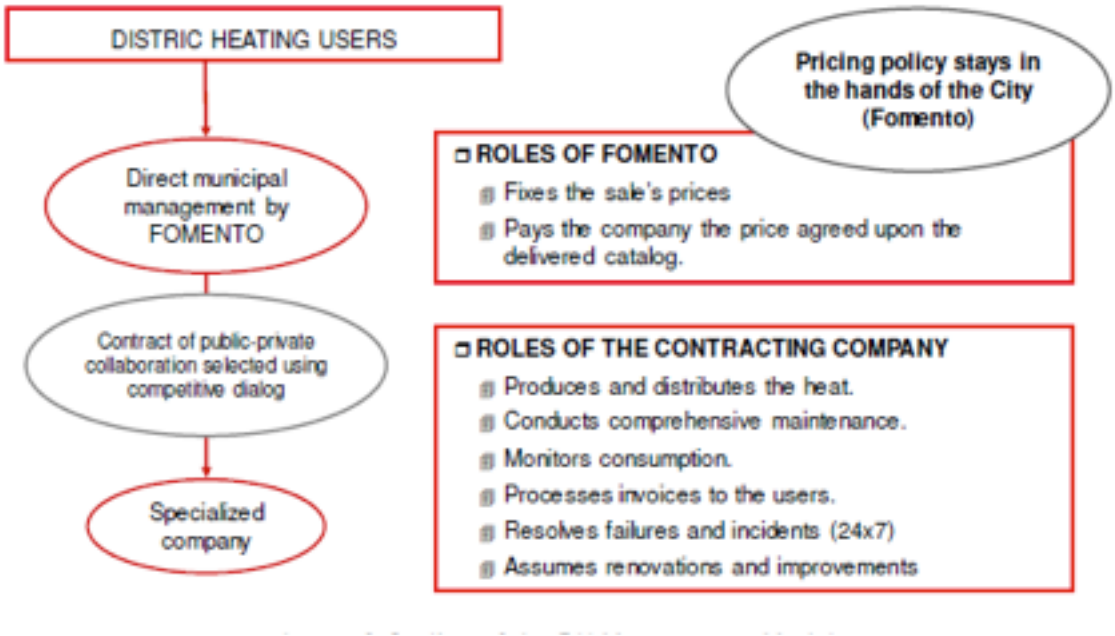

Figure 7.1 – Outline of the DH management model

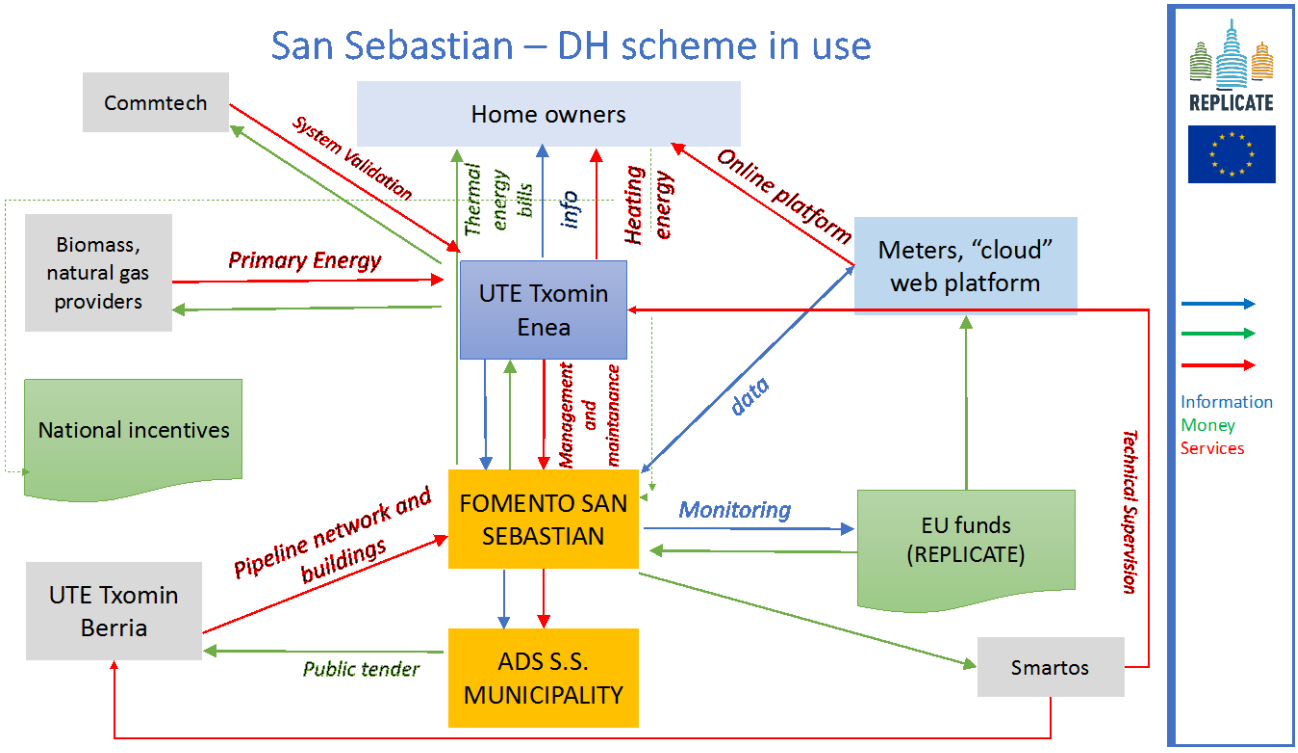

Figure 7.2 – DH management model in use in San Sebastian pilot

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7.2 Solution 2: Buildings retrofitting

The retrofitting intervention of 156 dwellings and 34 commercial premises (distributed along 10 doorways) is being done in San Sebastian totalling 18.365 m² and their connection to the District Heating deployed. The retrofitting scope includes façades, windows, roofs and the connection to the district heating.

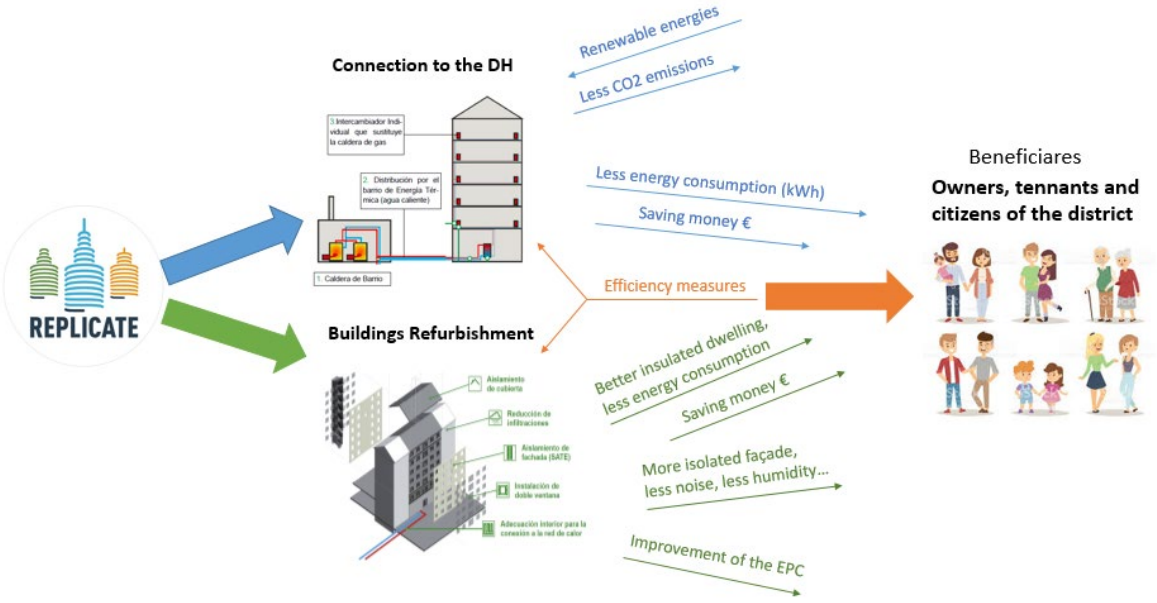

Figure 7.3 – the retrofitting action in San Sebastian

The façades of 156 homes (7% of the neighbourhood) are proposed to be isolated using the SATE system. Isolation with SATE system which consists of Isolxtrem Poliestirex layers.

The windows are replaced by more insulated windows, with breakage of the thermic bridge and low emissivity glass with argon gas. The roofs insulation consists on the installation of rigid plates of extruded 80 mm tongue and groove polystyrene anchored to undercover. In order to insulate the floor of the first floor of the dwellings, a rigid extruded polystyrene board 80 mm thick, anchored to the roofs of the ground floor has been analysed to guarantee the adequate insulation.

The individual boiler system will be removed because of the connection to the District Heating.

For the commercial premises similar retrofitting solutions have been considered regarding the façade insulation and window replacement.

Value proposition

Retrofitting of the 156 existing dwellings in the District to achieve energy savings and integrate them in the area increasing the value of the homes. The energy reduction potential expected is very high: the 48% of savings due to efficiency measures and 86% of energy production with renewable energy sources. The savings are expected to be 2800MWh/year and 785,8 CO_2/year.

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The project will contribute to make the neighbourhood more habitable for its neighbours. The rehabilitated buildings will be more comfortable, and the energy bill will be reduced.

The dwellings will be warmer in winter and cooler in summer, dampness will be avoided due to condensation and non-desired air infiltration. In addition, the acoustic insulation will be improved. The isolation and thermal comfort will be comparable with newly built dwellings.

The neighbourhood will be more attractive for the opening of new businesses in the area and will increase the equity value of renovated homes.

Players

Key partnership:

Fomento San Sebastian (project coordinator), San Sebastian City Council (project partner), Giroa-Veolia (project partner).

Beneficiaries:

Owners, tenants and citizens of the district

Supporting Stakeholders:

Giroa-Veolia hold a tender to have one or more architectural studies that have been responsible for the preparation, processing of documents and authorizations needed, as well as the direction and execution of retrofitting works in Txomin Enea district.

Market analysis: enablers and obstacles

Legal framework:

Regulations for Thermal Installations RD 1027/2007 (RITE). The RITE establishes that the conditions that the facilities must meet are the demand for thermal comfort and hygiene through the installations of heating, air conditioning and sanitary hot water, to achieve a rational use of energy.

Technical Building Code RD314/2006 CTE, is the regulatory framework by which the basic quality requirements that buildings must comply, including their facilities, are met to meet the basic requirements of safety and habitability. The basic requirements must be fulfilled, as it is established by regulations, in the design, construction, maintenance, conservation and use of buildings and their facilities, as well as in the interventions in existing buildings.

Given the nature of the rehabilitation that will be carried out with this project, it will not only comply with the Basic Document DB-HE "Energy Saving" of the CTE that was updated by Order FOM / 1635/2013, but also improvements will be made to it.

The current state regulations through its law 8/2013, urban rehabilitation, regeneration and renewal, establishes that any building with residential use that will receive public subsidies for the implementation of rehabilitation must have the Technical Inspection of the Building.

In addition, Decree 241/2012, which regulates the technical inspection of the building (TIB) of the Basque Country, establishes that all residential buildings that are older than 50 years must have this

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document. The TIB will be included among the documents before executing the retrofitting works established by this project. This TIB includes:

- To assess the maintenance of the building in order to verify the possible flaws of the building, its causes and the recommended measures to do in order to assure stability, safety, structural sealing and strengthening of the building.
- To assess the accessibility to the building according to the current regulation.
- To do the Energy Performance Certificates (EPC) of the building.

The buildings that are part of the Replicate Project were built between 1967 and 1980.

Incentives:

Initially different incentives were studied but given the particular conditions to request the grants from the different institutions and thanks to the support of the Basque Government with an inclusion of grants for the neighbourhood of Txomin Enea, it was decided to manage with the latter to offer a very advantageous aid for the neighbours.

The total aid is 1,335,897€ from the European Union and 2,000,000€ from the Basque Government.

Thanks to these grants, 100% of the connection to the DH network will be subsidized and 85% will be subsidized for the new envelope, as long as it is a SATE system. If is the owners and tenants decide to add different improvements from the SATE in the envelope, for example ventilated façade, its cost will be in charge of those owners and tenants.

Human factor (success factors, opposed sentiments, …):

They key success factors have been detected in:

- To convince the neighbours of the benefits of the retrofitting and the District Heating.
- Management of all the drawbacks related to works of these dimensions.
- 3/5 of the neighbours of each doorway (10 doorways) have to agree in order to connect the building to the District Heating and do the retrofitting of the dwellings.

The main obstacle consists in the high investment that should be done, with a long payback time.

Competitors:

There are different competitors who offer the refurbishment works or the connexion to the District Heating, however there are no companies that offer both of them. For example, for the buildings refurbishment there are different local companies like Kursaal or Teusa.

For the connexion to the District Heating, there are international companies like Ferrovial and Cofely. These companies participated in the tender of the District Heating.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
GHG reduction & energy savings	The savings are expected to be about 2.800 MWh/year (48% savings) and 785,8 t CO_2/year (86% emission savings).
Increased comfort	Isolation offers better results than stated by the current legal framework.

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Social benefits	Retrofitted houses will be integrated in the new urban area.

Management model:

Economic costs and revenues:

Giroa-Veolia invested around 2 million euros (excl.VAT) in the envelope retrofitting and more than 900.000€ (excl.VAT) in the District Heating connection, which sums near 3 million euros (excl.VAT) of investment. The operating costs amount about 85.000 €, including the energy supply (biomass origin), the equipment maintenance and other indirect costs included in the retrofitting works. Giroa-Veolia, acting as an ESCO, will guarantee energy savings and the provision of a better comfort and benefits at a lower cost through this installation.

Management model scheme in use:

In this case the beneficiaries, citizens, obtain a saving on their energy bills due to the retrofitting service provided by the Project partner Giroa/Veolia who is supported by designers for energy efficiency measures and construction companies. The municipality of San Sebastian and Fomento are playing the facilitators role, leading the transition to the Smart city and engaging citizens.

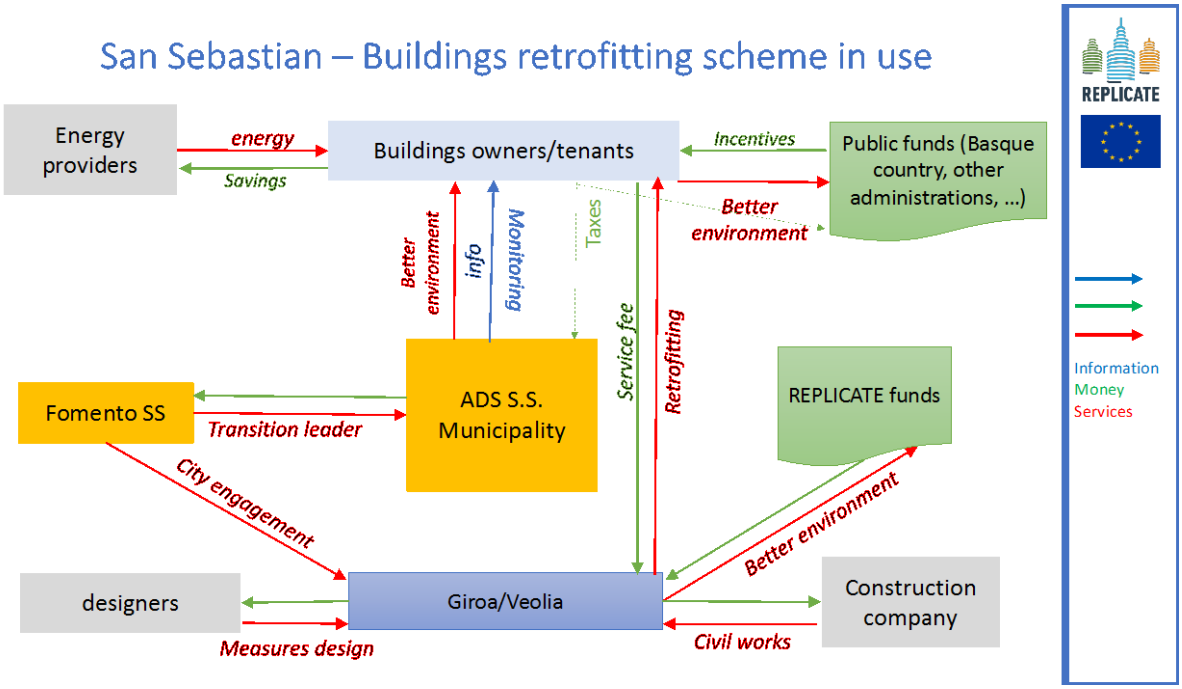

Figure 7.4 – the model in use for buildings retrofitting in San Sebastian (based on D9.3-Esade)

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7.3 Solution 3: Retrofitting & district heating with solar thermal seasonal storage

The intervention consists in the retrofitting of two residential social housing buildings in Florence and the creation of a dedicated District Heating network exploiting solar heating through a seasonal thermal storage. The total surface selected is about 20.000 m^2 with an actual consumption of about 3 GWht and 500 MWhe. The building blocks structure is made of reinforced concrete and bricks.

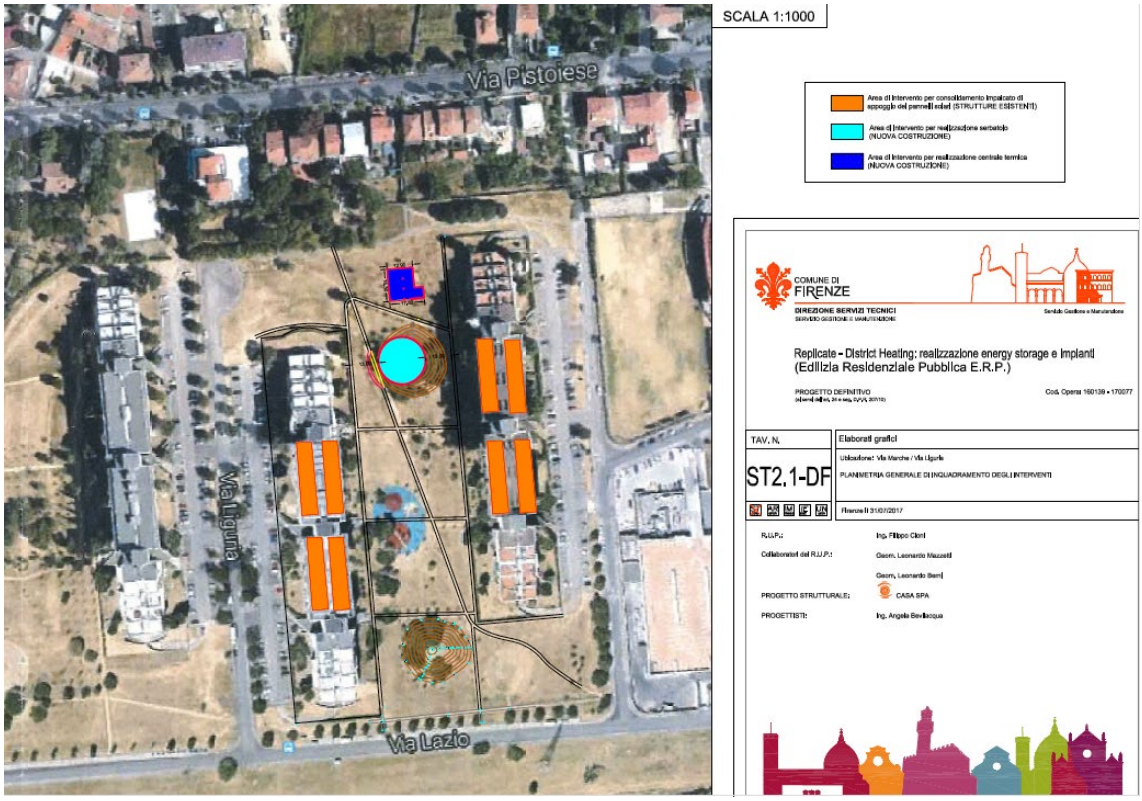

Figure 7.5 - Piagge, storage, solar plant and technical room location

The buildings are being insulated and the tenants are asked to adopt measures (exploiting national financial subsidies) and change their habits to decrease sensibly the energy demand (with smart info and apps). The DH network will reach the flats where the individual old boilers will be replaced with small heat exchangers without disruption for the tenants who will benefit from the change in terms of maintenance and energy costs.

The challenge consists in increasing the efficiency of residential buildings realizing such an innovative plant in a difficult urban environment (regulatory constrictions in such an urban area as Florence, low income users, single boilers replacement…) to demonstrate its replicability in more favourable boundary conditions.

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Value proposition

The energy demand required in residential sector, both electric and thermal, represents an important part of the consumption of primary resources (according to the latest evaluation of the municipality of Florence, over 53% of primary energy is used in buildings and 25-30% in the residential sector). Solar energy is certainly the most available and distributed renewable source in the context of urban areas but while photovoltaic technology is now sufficiently mature and already sufficiently applied widely, solar thermal technologies could be more and more exploited thanks to new panels developments but also to new configurations and solutions foreseeing the integration with storage systems.

Thermal energy storage (TES) is a technology that stocks thermal energy by heating (or cooling) a storage medium so that the stored energy can be used at a later time for heating applications and power generation. TES systems are used particularly in buildings and industrial processes. In these applications, approximately half of the energy consumed is in the form of thermal energy, the demand for which may vary during any given day and from one day to next.

Therefore, TES systems can help balance energy demand and supply on a daily, weekly and even seasonal basis. They can also reduce peak demand, energy consumption, CO_2 emissions and costs, while increasing overall efficiency of energy systems. Furthermore, the conversion and storage of variable renewable energy in the form of thermal energy can also help increase the share of renewables in the energy mix.

The implementation in Florence will represent a best practice for this technology in case of existing buildings blocks in city centres (first example in Italy).

Energy consumptions will be monitored in order to improve the system management and the users' awareness: a smart info system and a gaming APP will be made available to the tenants to monitor electricity and heating demand. All these actions are implemented on social housing to fight climate change together with energy poverty.

Players

Key partnership

The municipality of Florence is the owner of the two buildings.

Casa spa, the social housing company of Florence and its neighbour municipalities, is the building manager and also an ESCo.; they have been in charge of the storage design.

The university of Florence supported the design phase of the plants (dynamic energy simulation) and the connection with the Smart City Control Room.

SPES Consulting made a technical supervision of the action in close contact with the other measures insisting in the area.

Beneficiaries:

The tenants will benefit from the action receiving a free refurbishment and direct savings on the energy bills (around 10%).

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The municipality will benefit from the emission reduction and the best practice example.

Supporting Stakeholders:

Tenants' associations, designers' associations, buildings owners' and managers' associations

Market analysis: enablers and obstacles

legal framework:

In case of new buildings there are national regulations for mandatory central heating systems and percentages of RES. This implementation could represent a solution also for new buildings (maybe with existing refurbished blocks connected to the same DH).

At municipal level the structural plan "zero volumes" enhances the sustainable refurbishment of existing buildings. Moreover, the Sustainable Energy Action Plan adopted by the municipality in 2011 and the Smart City Plan active since 2015, foresee ambitious targets for the RES use and the energy saving in the residential sector.

There are also some regulations that have affected the implementation of the action: the changes occurred in the public tendering rules (the new national rules on public tendering DL 50 published on the 18/04/2016 modified with DL 244 30/12/2016, DL56 19/04/2017, Legge 205 27/12/2017) and the landscape boundaries added to the excavated soil and aquifer layers regulations of the pilot site caused a delay in the works and a significant growth in the investment needed by the municipality.

Incentives:

National incentives, the "Conto Termico (CT) 2.0", are available for buildings insulation, solar thermal plants, heat pumps and regulation&control systems. The incentives are paid at the end of the works and are subject to compliance with minimum performance requirements higher than the ones required in normal practice.

Human factor

People prefer autonomous heating systems because they can control the comfort and the costs as well. The benefits of the system must be well explained and communicated (costs savings, RES exploitation, no maintenance duties…): the presence of the municipality as facilitator made people more confident in the action.

The costs are still very high even counting on the subsidies which are paid only at the end of the realisation (more chances for the ESCOs). There are limits for historical buildings with insulation technologies. The main success factors consist in small savings (-5/-10%) on the actual energy costs, less responsibilities (no more private boilers) for tenants and RES implementation with consequent GHG reduction. On the other hand, the complexity of the implementation and the absence of national examples are big obstacles for promoters and designers (need of capacity building); moreover the costs are still very high even counting on the subsidies which are paid only at the end of the realisation (more chances for the ESCOs). The storage size and not optimal shape could be a limit due of space problems, related to flooding risk (the area has flooding risk because of the river Arno and therefore no significant additional volume has to be occupied by new

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constructions), to the presence of aquifer (the level of floating ground water is at circa 10m under ground level) and increase of the costs also related to the newly published regulation about excavated soils; in addition the inadequate supporting roof structures of existing buildings need additional controls and reinforcing elements to carry the extra-loads due to solar panels.

Competitors

The main competitors are the single boilers and the autonomous heating systems.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Energy (and emission) savings	After retrofitting, it is expected to achieve a reduction of the thermal demand of the buildings by a 35% through the improvement in the thermal properties of the envelope (insulation, elimination of thermal bridges, windows) along with optimized control strategies that will be implemented together with the renovated heating distribution system. The benefits are multiplied by the DH measure: thanks to the solar production, the primary energy demand from fossil fuels will decrease of (by) the 50%.
Money savings / Energy poverty	The main success factors consist in small savings (-5/-10%) on the actual energy costs, less responsibilities (no more private boilers) and increased awareness for tenants
Social inclusion	The building blocks and the whole area will be refurbished enhancing the well-being and the social inclusion of the citizens
Increased awareness	Tenants will benefit from an information campaign about the RES&RUE implementation, a Smart device (Smart Info) to control their electricity consumption and a gaming APP about energy
Exemplary case study	The resulting system will be a unique implementation at national level with high performances in terms of energy and emission savings in an urban context; These pilot actions could represent a best practice to be replicated by ESCOs at metropolitan level and in the whole nation

Management model:

Economic costs and revenues:

The total cost of the action will be reasonably between 4 ,5 and 5 million Euro while the amount made available by the municipality because of the tendering regulations is of 6,5 million Euro.

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About 2 million are co-financed by Replicate (special unit costs, personnel and third-party Casa Spa) while the national incentives will provide a financial support of 10-20%.

Maintenance costs will be low and the revenues will consist in the energy bills of the tenants who will benefit from a 5-10% of reduction on the yearly energy expenditure (consumption + boilers maintenance).

The preliminary cost benefits analysis shows a simple payback of about 14 years.

For the replicability, the general boundary conditions could be optimized (centralized heating systems, aboveground storage, higher baseline consumptions, VAT recovery...) with a payback of 8-9 years.

Management model scheme in use:

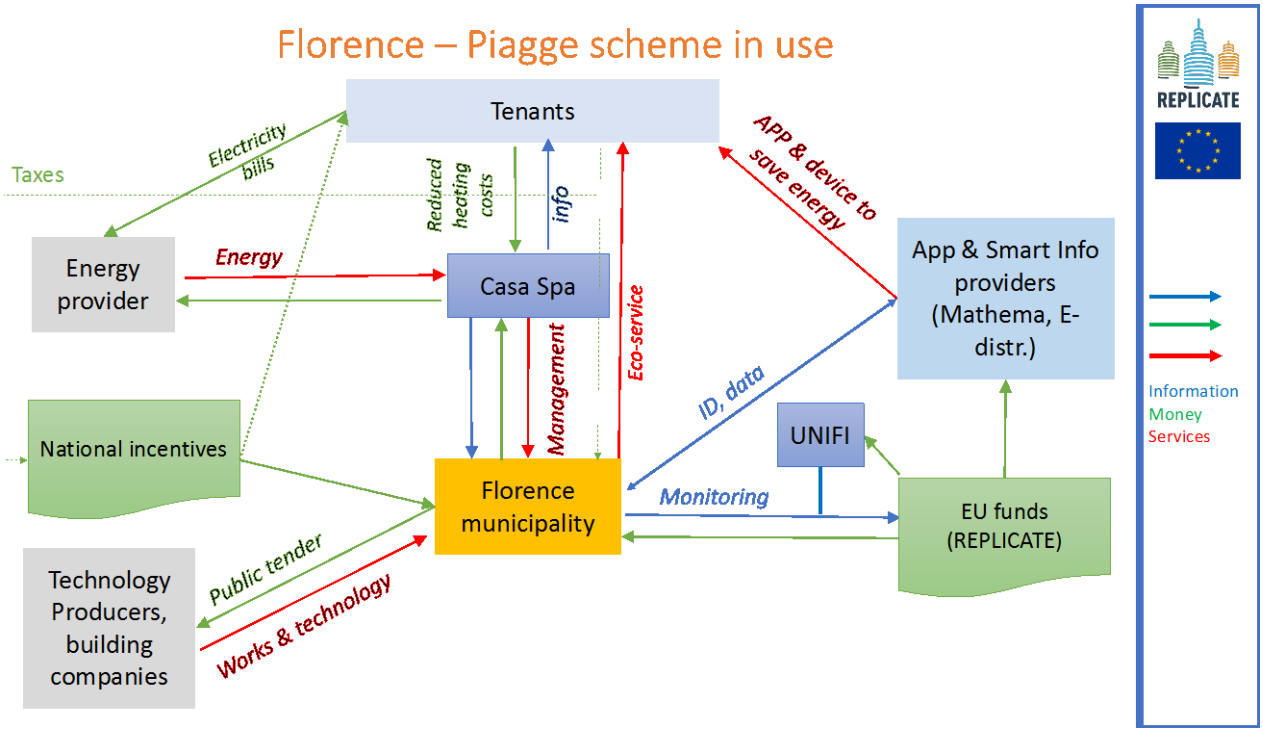

Figure 7.6 – the model in use for the housing retrofitting & DH in Florence (based on D9.3 Esade)

In the management scheme in use the municipality is supported by its in-house company acting as building manager and by the University of Florence for the system control and performance monitoring

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7.4 Solution 4: Smart Homes & EDMS

In Bristol 152 homes have been installed with smart 'wet' appliances to test demand side response via an Energy Demand Management System (EDMS). The overall purpose is to level out aggregated individual energy usage to avoid energy spikes on the local and national grid.

The installation included remotely controllable consumer devices, e.g. smart dishwashers, smart washing machines and smart dryers that would connect to an EDMS. A home hub, smart plugs and meter readers provide data monitoring and consumer interfaces. Householders will be able to control their devices remotely to override the automated delay at peak energy times, via an app on their smart phone or tablet.

The foreseen role of the Energy Demand Management System is to act as the community hub for managing supply and demand of energy. Energy in this context is not restricted to electricity but can include the gas, heating and cooling domains as well. The motivation for unifying the monitoring and control of these domains in a single system is that these sectors are becoming more interdependent. In the case of smart homes however, we are only currently monitoring electricity but are due to add a small amount of gas meters to broaden the learning aligning to the retrofit measures being installed. This will allow us to better understand a smart, retrofitted home.

The general functionality of the EDMS is monitoring and controlling energy consumption and production. As a monitoring system, the EDMS accesses data from a wide range of sources from generation, transport and consumption of energy, being able to flexibly create views of the data and making predictions and recommendations based on the observations. As a control system, the EDMS hosts energy management control algorithms to influence supply and demand patterns in order to satisfy one or multiple technical or economic objectives. This includes two aspects of relieving transport and distribution networks. Holistically, this will maximise local usage of locally produced energy, maximising monetary benefits, and/or minimising the environmental footprint.

Value proposition

Tackling fuel poverty and local energy consumption of available 'renewable' production. Enabling use of smart and controllable appliances when energy prices are lower and delaying use at peak times.

Players

Key partnership:

PUBLIC: Bristol City Council City Innovation, Bristol City Council Energy Service, KWMC, UWE, UoB, (Bristol Energy Network – Charity), (Sofa Project – Charity)

PROJECT PARTNERS: BIO, Zeetta, NEC

PRIVATE: Narec, Samsung, Loxone, North East Electrical, 0800 repair

Beneficiaries:

Connected home trial participants

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Supporting Stakeholders:

Community Groups

Market analysis: enablers and obstacles

Legal framework:

Two main kind of contracts have been defined:

- Contracts for delivery partners to install and maintenance/service
- Contract between BCC and homeowner to take part in trial but no obligation afterwards. Homeowner free to keep appliance.

Terms and Conditions of working with each contract have been analysed in dept as compliance with GDPR.

Incentives:

No incentives are provided as yet, however at the end of the process households will be able to keep the devices.

Demand Side Response (DSR) in the UK is currently limited to commercial premises primarily. There is no live marketplace for the residential demand response of energy. However, in the future, with the UK's plan for a decentralised energy system, there will be an increasing role for residential level DSR as part of a smart grid.

In the near future, this could be agreed with delivery partners or with support from the DNO/National Grid to help shift peak energy demand.

Human factor (success factors, opposed sentiments, …):

The rising costs of energy and the possibility of different tariffs could support the need of smart appliances in the near future as the availability of affordable smart appliances on the market

The main obstacles are to tackle digital inclusion, the fear of technology and data protection issues.

People needed to be supported in understanding the value of smart homes to obtain a durable behaviour change: community groups, champions and the support of KWMC are key in the solution for rolling out the initiative within the community.

Participant data contributions required may be a barrier to participation going forward i.e. impacting on meaningful monitoring and evaluation.

Another problem from the smart home installations were people moving to a new house or damaging equipment during the monitoring period. From the provision side, the functionality and reliability of apps were important aspects to optimise in order to ensure people remained engaged. This could then have knock on impacts for the future of DSR if disengaged.

Competitors:

Smart White Goods manufacturers – as the market develops.

Domestic electricity storage might negate part of the need for smart appliances – if batteries were distributed on mass in the future then there would be less of a need for timing energy use.

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Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Energy (and emission) savings	Saving energy and CO_2: 10tonnes with conversion of KWh 9kg washing machine 220 cycles per year B rated 360KW per year v 200KW for an A+++ = 127kg v 70 kg CO_2 x 175 appliances Drier B rated 616KW = 217kg CO_2 v A+++ 194KW = 68kg CO_2 http://www.carbon-calculator.org.uk/
Monetary savings / Energy poverty	Saving cost to householders' bills: up to £150 savings per year estimated per appliance
Social inclusion	reducing fuel poverty increasing digital inclusion
Increased awareness	Upskilling community champions in energy efficiency Capacity building within community groups – community events
Exemplary case study	EcoHome (show home) renovation for future demonstration of smart and efficient homes & technologies

Management model:

Economic costs and revenues:

The cost of the smart appliances varies but it can be evaluated about 20% more than a common device of the same class.

Savings have been estimated up to £150 per appliance.

The ICT platform and the EDMS have been financed by Replicate.

Management model scheme in use:

Households were recruited with the support of a Community Engagement Group led by Bristol Energy Network and supported by Knowle West Media Centre. The aim of this group was to recruit and support households to participate from a wide demographic to reflect the project area. There was a particular focus on involving groups who might not traditionally engage with technology projects of these types. An Asset Based Community Development approach has been taken utilising the 'Bristol Approach'.

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Criteria for involvement were set to ensure equality in the offer to the community. For example, only older 'A' rating or below machines would be replaced with A+++ machines due to the environmental impact of replacing new machines. Households were asked to sign terms and conditions and were supported during the installations on how to operate the equipment.

Installation: BCC worked with a number of suppliers to provide specialist equipment. Loxone supplied the smart home hub and smart plugs. The pilot opted for smart appliances provided by Samsung as these had high environmental credentials as well as having advanced smart functionality. A Raspberry Pi was supplied by Narec to provide a secure data connection to the Bristol Is Open data store. Installations were managed by Narec Distributed Energy and involved older inefficient machines being donated to The Sofa Project, a local social enterprise, for either recycling or reuse amongst lower income households.

Data flow: Energy data in the households was captured via two primary devices. Firstly a whole home meter reader attached to home electricity meters. Secondly a smart plug behind the appliances to record the usage of the device themselves. This data is both stored locally on the Loxone home hub whilst being transferred to Bristol Is Open via the VPN created with the Raspberry Pi. Once with BIO, this is then supplied to UWE for evaluation purposes.

A flagging system is in place to monitor the status of the VPN connection to households that contains an alert system should any errors be detected. Equally a flagging system to detect anomalies in data quality is being developed with UWE to ensure quality of data during the monitoring period.

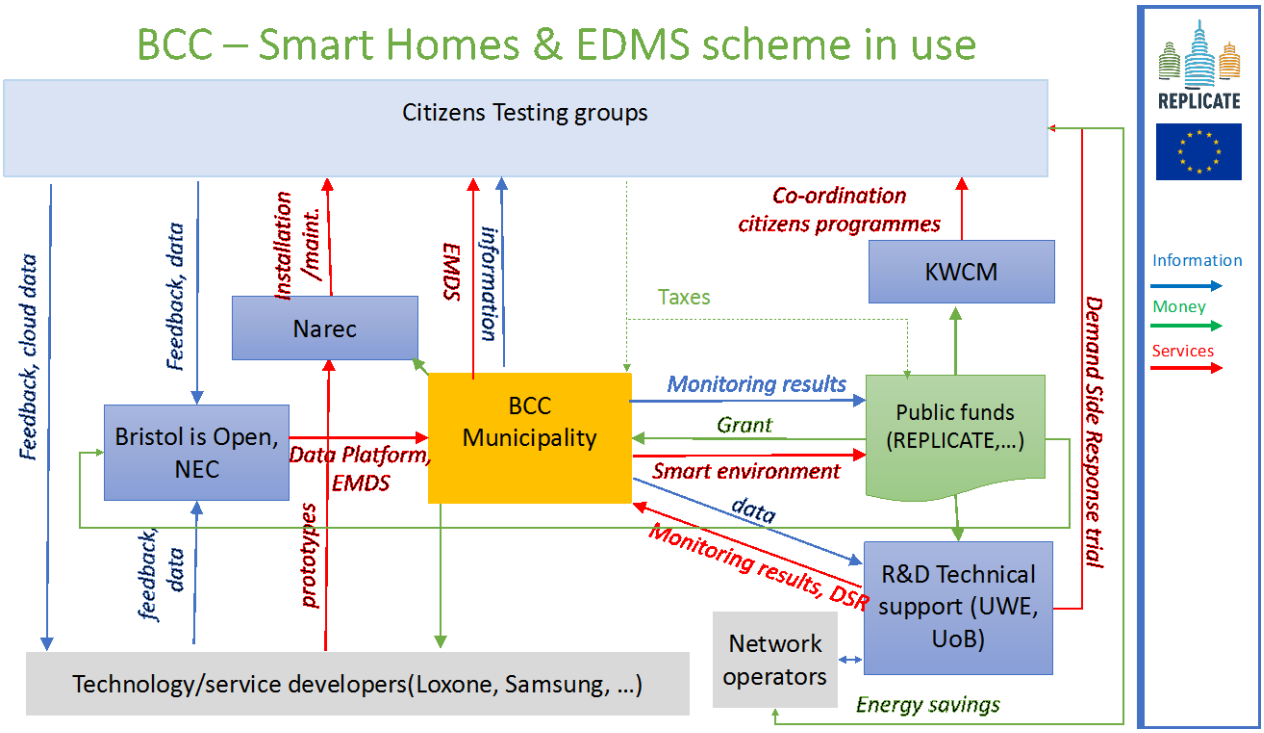

Figure 7.7 – Current EDMS deployment in Bristol

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7.5 FIRST REPLICATION ANALYSIS

The SWOT & Unique Selling Propositions analysis:

Solution 1: District Heating exploiting local biomass	
USP: A district heating network biomass-fuelled for more efficiency, less CO2 emissions, lower maintenance costs and savings for the final users.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• A Central Plant is more efficient than several smaller plants, with the corresponding reduction of energy consumption and costs savings for tenants. • Local supporting planning framework • No extra costs for faults or equipment replacements • 24 hours service, individual use of energy and bill according to consumption • Improvement of the energy rating of housing • Usage of local biomass	• Selection of the most advocated district area • Long process to define a feasible business model
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• Business model implemented (public private partnership) • Presence of ancillary actions (On-line Service Platform)	• Variable demand • Necessary investments • ensuring compliance with a sustainable business plan

Solution 2: Retrofitting	
USP: Retrofitting of dwellings to be integrated in a new district, favouring energy savings to the tenants and, together with the District Heating, it is increasing the overall value of the houses.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Noise suppression	• Low-medium profile inhabitants

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• Energy and money savings • No additional expenses or charges	• Low-medium economic profile • Retrofitting subcontracted • No control from the DH
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• Accessibility • Revaluation of the dwellings • Smart city district integration	• Previous problems in the neighbourhood • Dwellings already retrofitted

Solution 3: retrofitting and micro DH with seasonal solar thermal storage	
USP: *"Fai la casa giusta" ("do the right house").* Residential sector needs a substantial energy refurbishment even in historical cities: performant plants like small district heating systems exploiting available RES can be combined with shell refurbishments to reach ambitious climate targets and to improve the comfort and the buildings value.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Big buildings/ social housing • Local supporting planning framework	Some aspects to be improved: • Selection of the most advocated buildings (shape, location without restrictions, centralized heating, low temperature distribution systems,…) • Cooling inclusion or electricity production to cover cooling needs
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• National incentives • ESCo market • Private tendering procedure (faster and cheaper) • Evolving solar technology • Presence of ancillary actions (smart info & energy APP)	• Mid-long term contracts to cover the investment costs • Reliable baseline to design the size of the plants properly

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Solution 4: Smart homes & EMDS	
USP: *Intelligent use of appliances could save energy, CO2 and money and make the network more and more smart*	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Municipal ICT platform • Partners now how (NEC, UWE, UoB…) • KWCM support with citizens group recruitment	Some aspects to be improved: • APPs reliability • Devices user friendliness • EDMS logistics/integration • Open API developments
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• Rising costs of energy / different hourly tariffs • Lower costs of smart appliances in the future • Possible support by network managers and DSO • Energy poverty / digital inclusion targets • Energy companies offering new service tariffs • Smart appliance standards	• Data management and privacy issues • Public distrust of data • Further equalities divide • Smart services only available to digitally included

The possible schemes for replication:

In Replicate model, the municipality of San Sebastian and Fomento are playing the facilitators role, leading the transition to the Smart city and engaging citizens.

In terms of scalability of the biomass district heating (solution 1), the new construction of neighbourhoods such as the pilot in San Sebastian is not usual, however there is an urbanisation plan for two areas of the city with good characteristics for a scale up, while replicating in existing districts seems more complicated.

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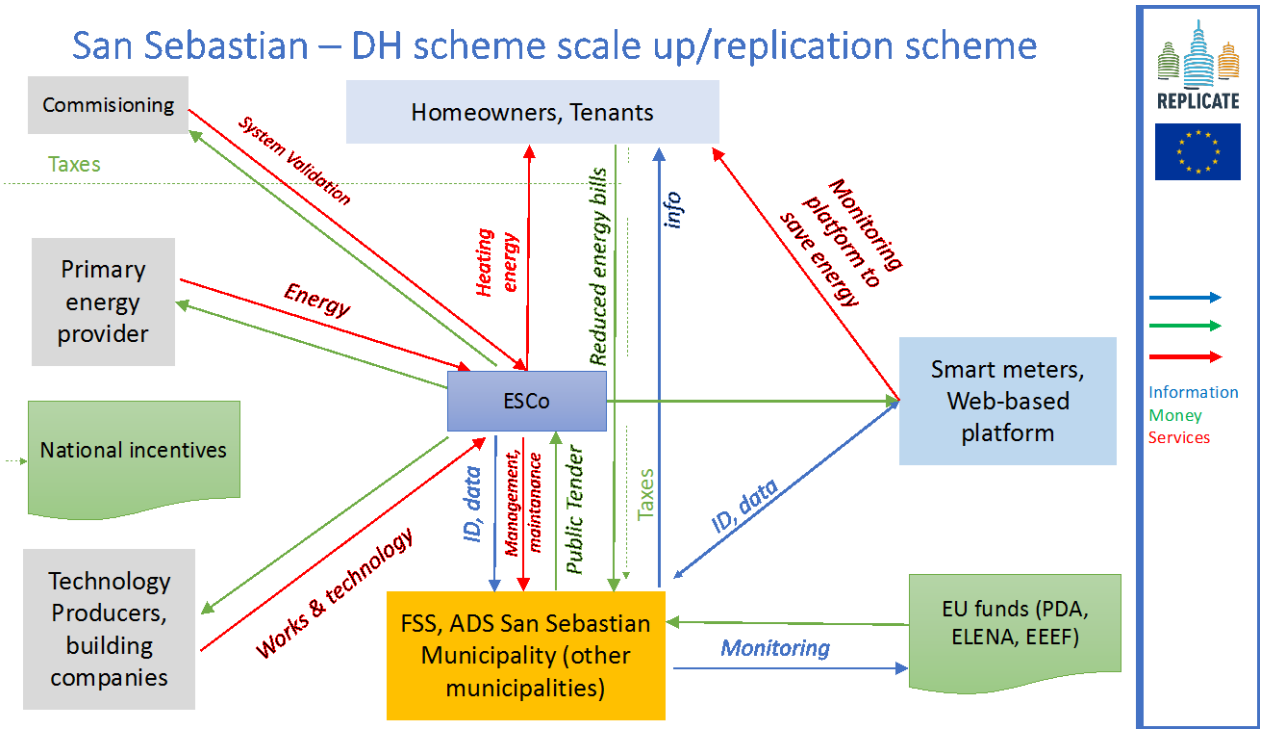

Figure 7.8 – the possible future model for RES DH in San Sebastian

In case of the retrofitting (solution 2) in the replication phase the facilitator role is no more necessary, but it represents a guarantee for citizens and could eventually support with information while the process is leaded by the Energy Service Companies.

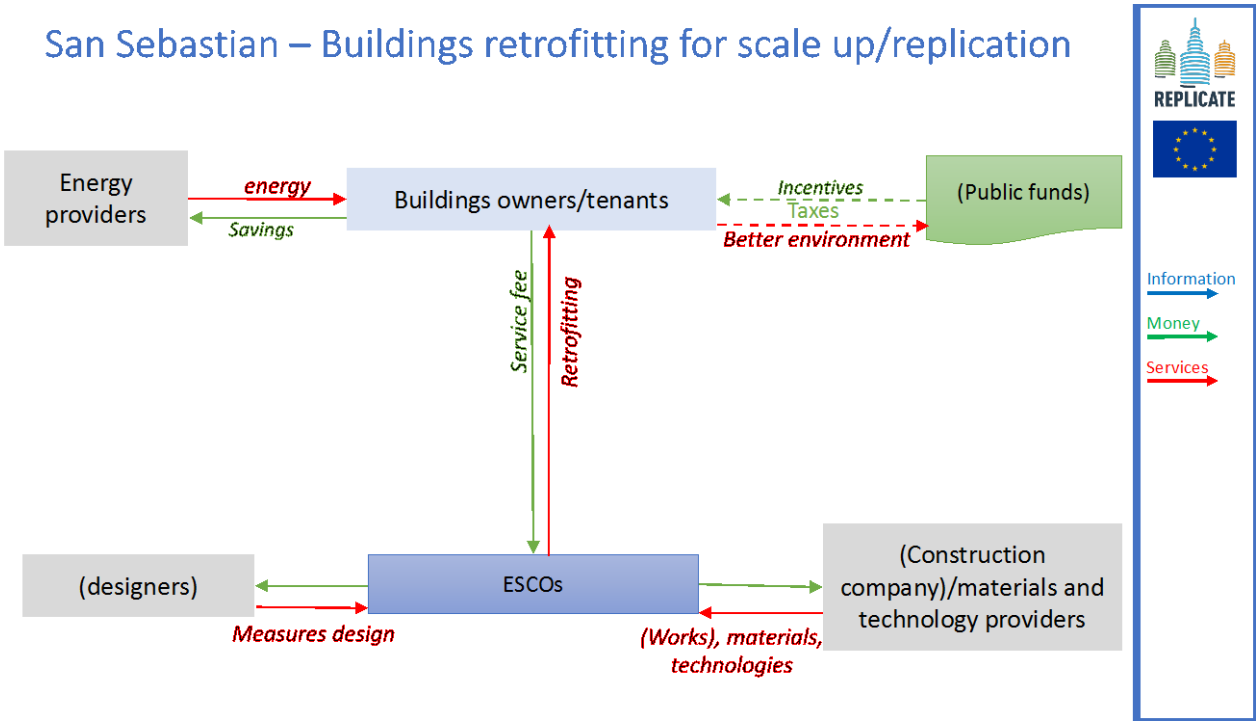

Figure 7.9 – the possible future model for buildings retrofitting in San Sebastian

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For solution 3 also, there could be a possible scale up in different conditions thanks to the ESCOs involvement and the requirements of the "zero volumes" plan; the three pilot phases (retrofitting, DH&regulation, RES&storage) could even be implemented separately adapting the intervention to buildings conditions & features. The facilitator role could be still necessary if the full intervention takes place in existing buildings at least supporting the communication campaign.

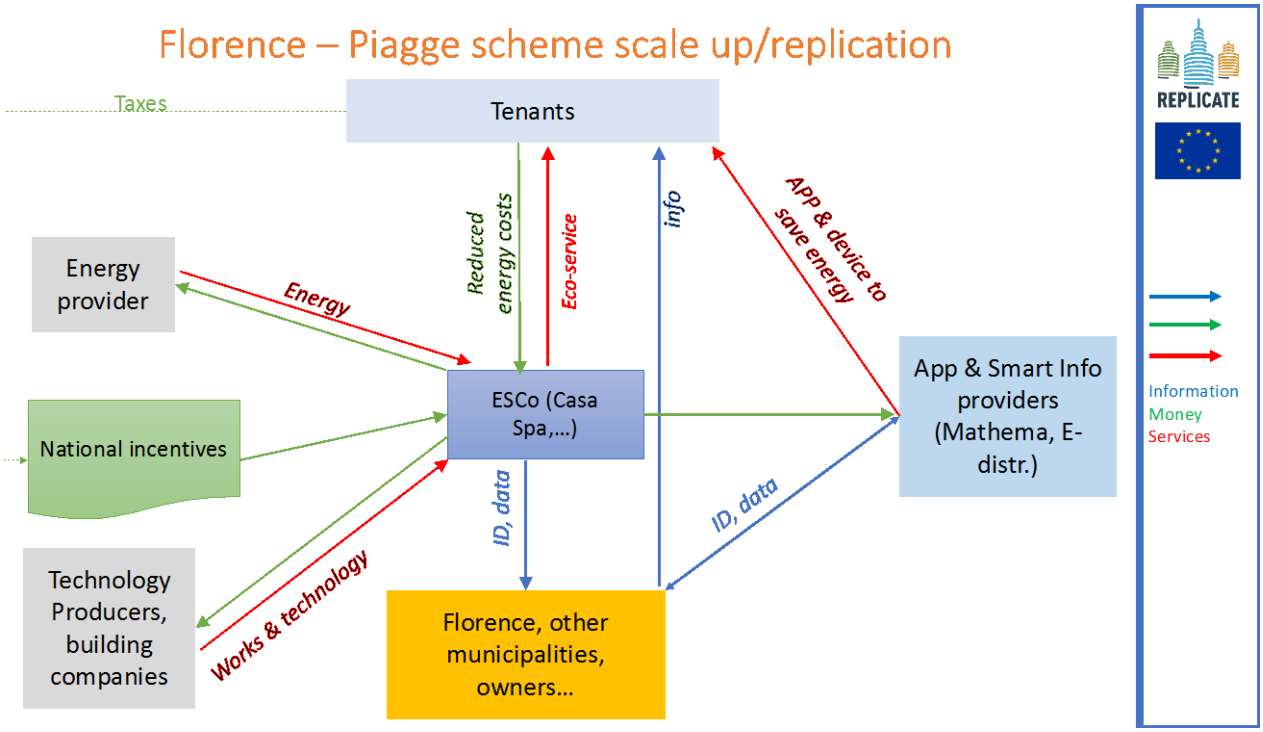

Figure 7.10 – the possible future model for buildings retrofitting and small RES DH in Florence

In case of solution 4 – Smart Homes, the driver for replication should be the market development for smart appliances as energy demand will affect the grid. The knowledge gathered by project partners during the smart homes process and the DSR trial will be used to sell services to final users and market stakeholder. Additionally, the learnings from the REPLICATE project are being used in a concept and design project for developing customer energy propositions with a local energy provider where this is being explored further. The Bristol Energy Smart System Transformation (BESST) project is funded by the UK's Industrial Strategy Challenge Fund.
The municipality will remain in charge of the platform with partners supporting the market uptake with information campaigns and monitoring the results in terms of policy targets (energy poverty, digital inclusion; energy and emission savings).

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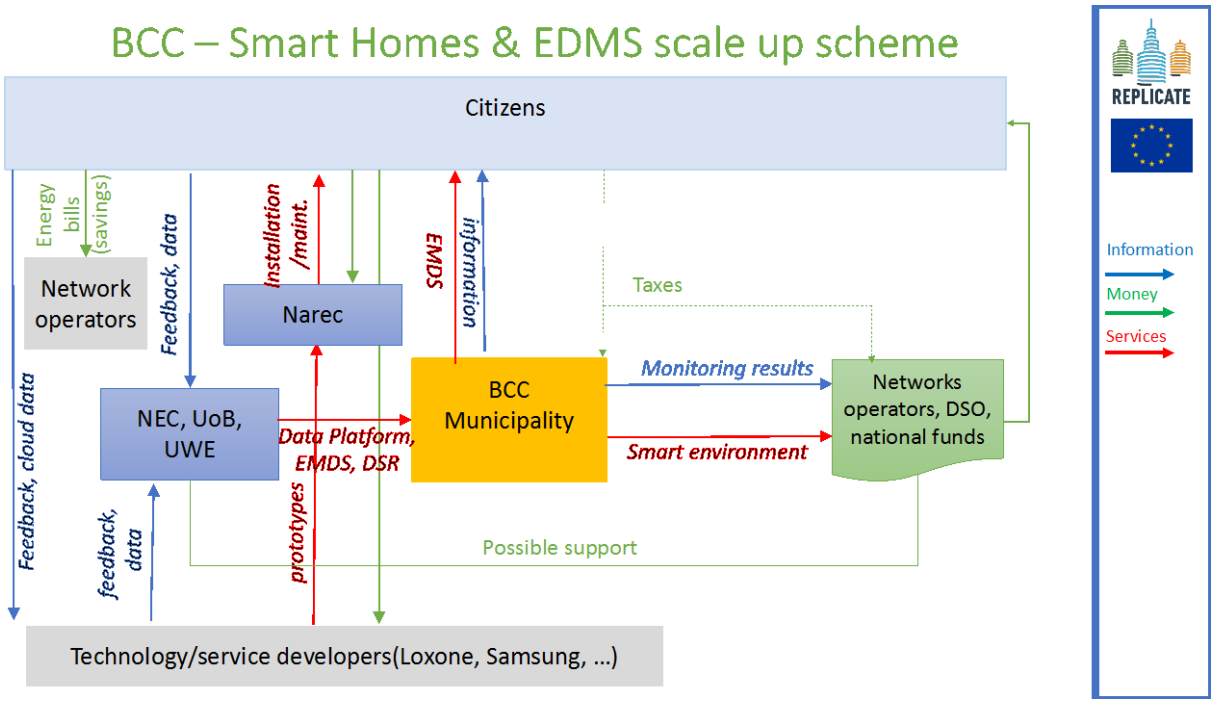

Figure 7.11 – the possible future model for smart homes & EDMS in Bristol

8. Smart Public lighting

8.1 Solution 1: Smart public lighting

The implementation and deployment of an innovative lighting system in San Sebastián based on the development of detection technologies that enable low cost motion detection of people and/or vehicles, intelligence systems, communication between luminaries and remote management software and remote management of the facility.

Replacement of 90 vapour-sodium luminaries with new LED technology implemented. (60% of the existing lighting spots in the area).

In addition: 19 detection devices, 2 audio packs, each of six units, 2 video transmitting devices, 1 vehicle counter, 2 energy meter devices, 2 rain sensors and one vehicle counter will be implemented.

Value proposition

Implementation of an intelligent lighting system to achieve energy consumption savings.

The issues to target are:

- Implementation of LED technology light sources.

- Implementation of a remote / Management Control system, able to work under sensor devices and under calendar basis, point to point.

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- Implementation of light, rain and presence detection devices in order to incorporate their signals to the control system.

- Implementation of several IP services, Vehicle counting, Sonorization, video detections and image transmission devices.

- Incorporation of the lighting system data into the Smart City Platform of the project.

With all these actions, 70% energy consumption savings can be achieved, as confirmed by the first monitoring data, and in addition an implementation of new technological services that should help the management of the energy consumption are intended to be achieved as well as the introduction of new services for the citizens using the district.

Players

Key partnership:

Fomento San Sebastian (project coordinator), San Sebastian City Council (project partner, Leycolan (Project partner).

Beneficiaries:

San Sebastian City Council, citizens (near 4.500 workers of the industrial area plus visitors).

Supporting Stakeholders:

Private sector companies, that can benefit from additional services that can be deployed, like information from the vehicle counting devices, information and evacuation notices through loud speakers, street lighting maintenance company that can reduce maintenance costs and increase the quantity and quality of information.

Market analysis: enablers and obstacles

Legal framework:

The regulation to comply with is related to the Spanish Law for the Street light Regulation RD 1890/2008, including technical instructions (ITC-EA-01 Y ITC-EA-02). Additionally, for all the IP services and remote control the regulations to comply with are the Regulations related to the Electrical power Grid regulations in Medium and Low Voltage: RD 842/2002 and its ITC-BT-09.

Incentives:

None

Human factor (success factors, opposed sentiments, …)

Lights and light control system are 100% replicable, together with the detection systems. It can be stated that due to the actual results that are being obtained, - total online control of the installation and energy consumption savings, plus the relatively easy installation procedures, a total replicable project is foreseen in other areas of the city and/or in other cities.

Obstacles: Difficulties in the evaluation of cost savings of the IP service implementation and live conditions improvement generated.

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Competitors:

The remote control and specifically the long-range detection systems deployed are totally outstanding from what is existing in the market; therefore, to bring a more advanced technology to the street light management. The system is built under Open Source programming and is easily integrated in other upper or bigger platforms, while the remote control online to every single point is also an important differential characteristic of the system. Therefore, the competitors in the market reaching this level of technology are few.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Environmental impact optimized	The reductions have been estimated on the basis of the actual achieved savings: Energy Savings: over 0,23 MWh electricity within the project duration CO_2 reduction: minimum of 80 tonnes within the project duration.
Economical savings for the municipality	About 6.000 € per year savings on energy are expected. These estimations are based on the previous invoices and a comparison to actual metering and actual invoices. Other indirect savings are expected generated by the additional services. Maintenance savings will be approximately at least 40% of annual maintenance costs or 1.700€/year.
Social benefits	Generation of new jobs during the implementation period

Management model schemes in use:

Economic costs and revenues:

The direct material costs and subcontracting activities for installation amount is about 100.000€.

Annual Savings: energy + maintenance savings are about 7.500€ as average in the run of 5 years.

Revenues: in addition to the annual savings that will be generated for the owner of the public lighting system, due to the project showcase new business could be generated in the coming years using the reference of REPLICATE. The estimated increase in revenues (Sales/Turnover) for the company could be at least the following: 2018 – 75.000€, 2019 –250.000€, 2020 – 400.000€

Management model:

Hereafter is reported the scheme in use in San Sebastian for the public lighting action: the flows analysed consider money transfers, services provision and information/data exchange.

The owner of the public lighting network, the municipality, will benefit from savings on its energy bills and from a renewed lighting system equipped with innovative services.

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Leycolan is testing the business model managing the Smart lighting system with Replicate Project enhancing the introduction of innovative services.

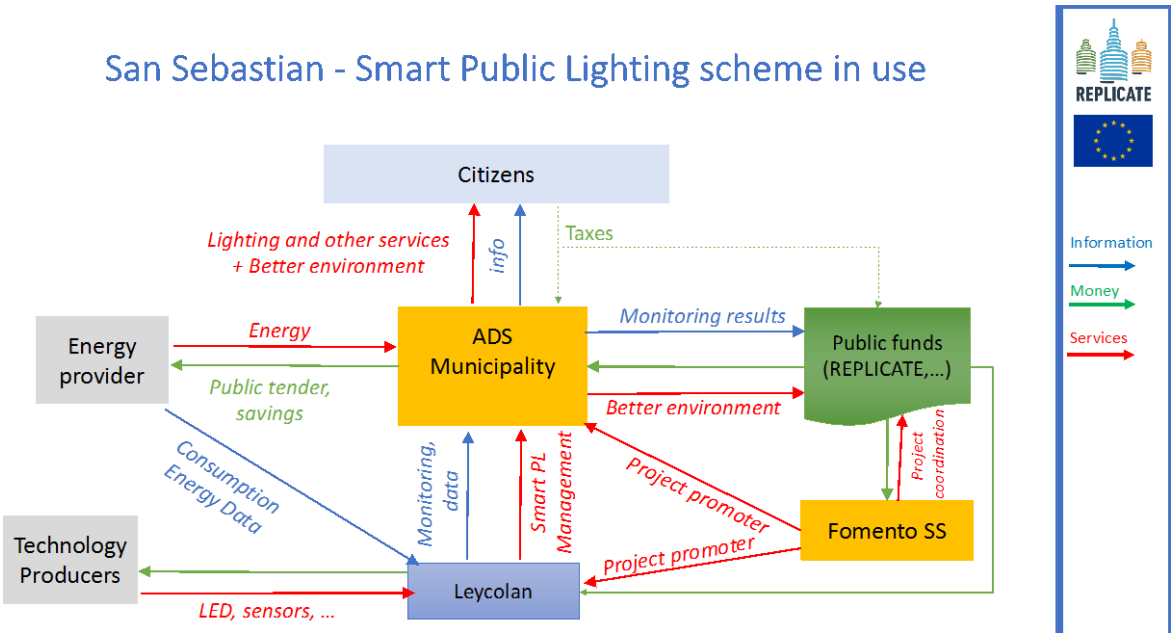

Figure 8.1 – the model in use for smart public lighting in San Sebastian (based on D9.3-Esade)

8.2 Solution 2: eco-lighting and smart services

In Florence there are 40.500 lampposts and 3.500 traffic lights; in the district there are about 7.500 lampposts which are not networked or efficient. Only in the Cascine park during last three years a pilot action has been implemented to test an adaptive light system in a special environment as an urban park. The municipality is implementing a tailored refurbishment plan of the public lighting infrastructure in the district trying to match for each area the best lighting conditions and the needed additional services (video surveillance, traffic control, WiFi, weather pluvial or wind sensors....).

A new lamppost design is under analysis which could be able to host additional services, save energy and stand in harmony with the particular urban landscape.

Value proposition

The public lighting service has to become more efficient to reach the savings targets set in the SEAP (2020) and in the Smart City Plan (2030-2050). The design must be compliant with the special boundary conditions of an UNESCO historical city and it is planned to validate and deploy the project in several phases according to the different needs. Above the energy efficiency issue, the infrastructure, which is one of the most capillary in a city, can be optimised carrying other services on board (video surveillance, environmental sensors, WiFi, IoT capillary network, traffic sensors/cameras, data collection,...) to minimize the impact, and to reach a wider coverage with a low cost implementation.

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Players

Key partnership:

Municipality of Florence, SILFI, UNIFI, Thales

Beneficiaries:

Citizens, data users

Supporting Stakeholders:

Mobility sector stakeholders, cultural heritage sovrintendence authority, fiber networks providers

Market analysis: enablers and obstacles

Legal framework:

The municipality of Florence in its sustainable Planning tools (SEAP, Smart city Plan, …) has set efficiency targets for the public lighting service: -15% at 2020 (SEAP) and -40% at 2030 (SCP).

For the purpose of the definition of the measures on public lighting systems, the action must be related also to what is specified in the Municipal Public Lighting Plan adopted (DG 00517/2009), which shows the lighting classification of the place. This efficiency plan meets the regional and ministerial legislative framework.

Incentives:

There are several energy savings programs at national level: the energy efficiency titles ("white certificates") are the main supporting measure in case of public lighting measures.

For metropolitan areas, other financing programs are in place for infrastructures and suburbs (PON Metro, "bandi periferie", ...)

Human factor (success factors, opposed sentiments, …)

The interventions reducing lighting power have to be shared and agreed with local stakeholders and authorities regrading cultural heritage, monuments and landscape. The additional services need is a driver for the infrastructure optimisation while the investment costs are the main obstacles (supported by the energy savings but only in case of old lighting systems).

Competitors

ESCO market related to LED implementation

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
The action will reduce the energy consumption of the public lighting network (and the GHG emissions)	Actual consumption in the district about 4,5 GWh/y, foreseen consumption 2,6 GWh/y (savings > 40%) i.e. 650 CO_2t/y

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Increased safeness in the district	A huge amount of data could be made available to the municipal control room to increase and manage the safety and vigilance of the area
Optimized impact of the services infrastructures	The impact of other infrastructures (WiFi network, video surveillance, traffic & access control, ...) minimized while their coverage will be widened
Capacity building and jobs	SILFI, the third-party municipal company acting as an ESCO, will increase its skills and market chances

Management model schemes in use

Economic costs and revenues:

Installation costs: 380,00€/lamppost for a total investment of about 1,5 million euros of public investment including design. The lifetime is 20 years for the infrastructure, 10 years LED lights and different values for the other components belonging to the additional services.

Costs savings: 394.200€/y

Management model:

The owner of the public lighting network, the municipality, will benefit from reduced energy consumption and related cost savings and from a renewed lighting system equipped with innovative services. Silfi is the operational responsible in the implementation phase and the manager of the system afterwards. Materials have been subcontracted to specific providers.

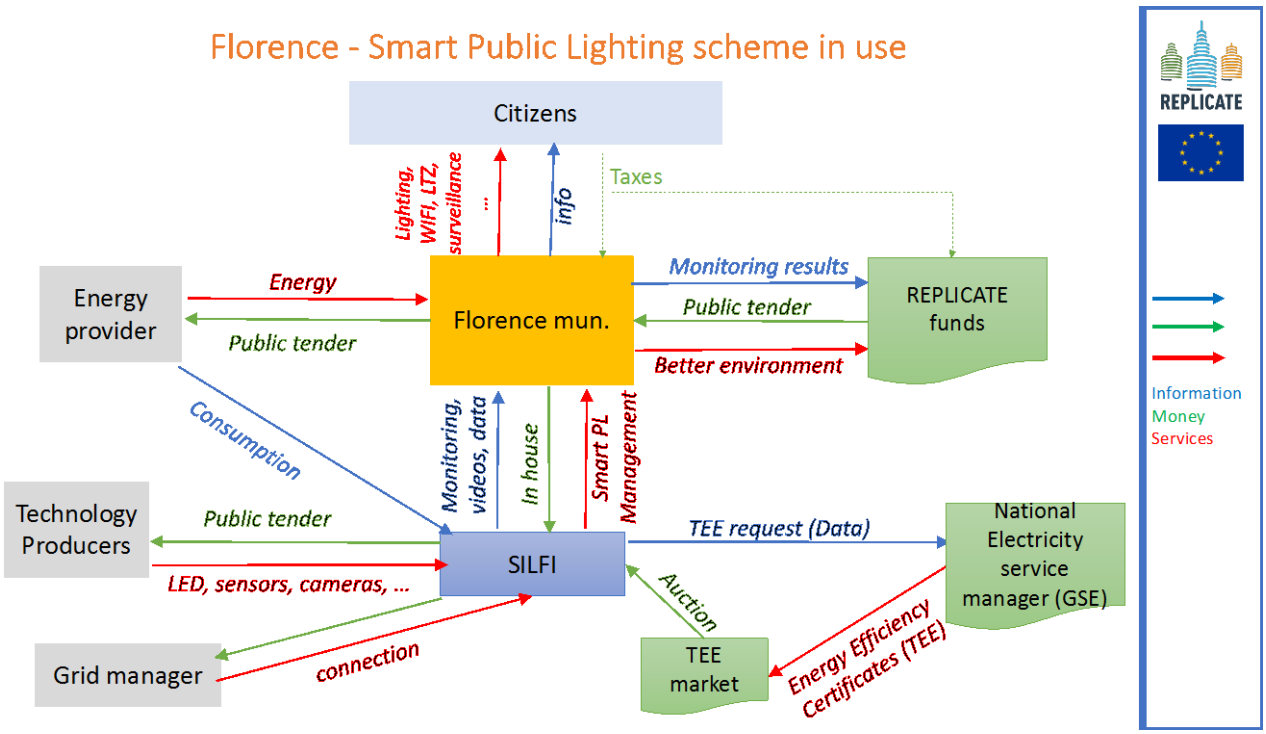

Figure 8.2 – model in use for smart public lighting in Florence (based on D9.3)

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8.3 First scale up SWOT & USP analysis

The SWOT analysis:

Solution 1: Smart public lighting	
USP: LED technology lights implementation and additional services deployment that allow energy and monetary savings thanks to the change of the luminaries and to the regulation system to adapt the light to the presence.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Deep knowledge on street light remote-control system. • Flexible system from Software base and from device integration side. • Open source system able to integrate in all other systems.	Some aspects to be improved: • Need to gain experience on the IP services integration • Improve security devices for not disrupting power supply.
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• Possibility to adapt the light and energy consumption to the real needs. • Capability to integrate other IP services with reduced or no communication costs. • Total control on every point of street lights (point to point).	• Appearance of new and more competitive technology. • Solar electricity use for lampposts.

Solution 2: eco-lighting and smart services	
USP: Public lighting is the backbone of the city and can easily support other services reducing land use and costs.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Energy savings • Knowledge and skills in Silfi (design of the intervention, tendering procedure	Some aspects to be improved: • Aspect/look of the components • Management models of the additional services (maintenance, responsibility...)

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with high performances innovations and certifications, operation) • high replicability potential in the metropolitan area	
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• Supporting schemes at national level (white certificates) • Need of additional services/infrastructures for data Fiber network/WiFi system to be extended soon	• Systems regulations and standards (video surveillance, light, environmental and air quality sensors, …) • Landscape restrictions • Cultural heritage area limits

The possible scheme for replication:

In general, considering the transition to LED technology, the energy savings are able to support the management service extension to additional areas. On the other hand, other funding sources should be also investigated for the different additional services (surveillance, environmental data, WiFi,…): subsidies could be made available at national/regional level for the implementation of those services which in the case could exploit the public lighting infrastructure allowing also an improvement of the lighting efficiency.

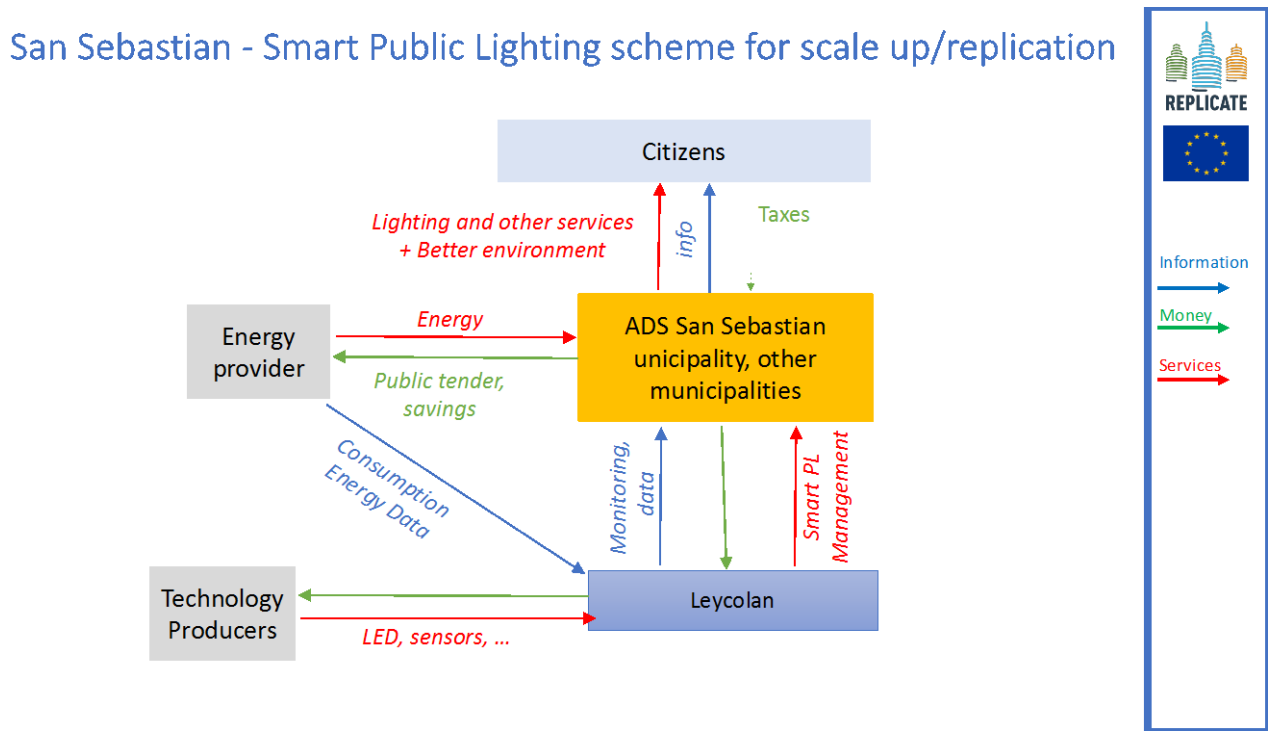

Figure 8.3 – the possible future model for smart public lighting in San Sebastian

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Regarding solution 1, Leycolan should be able to further promote the action and its business model in other areas but even in other cities.

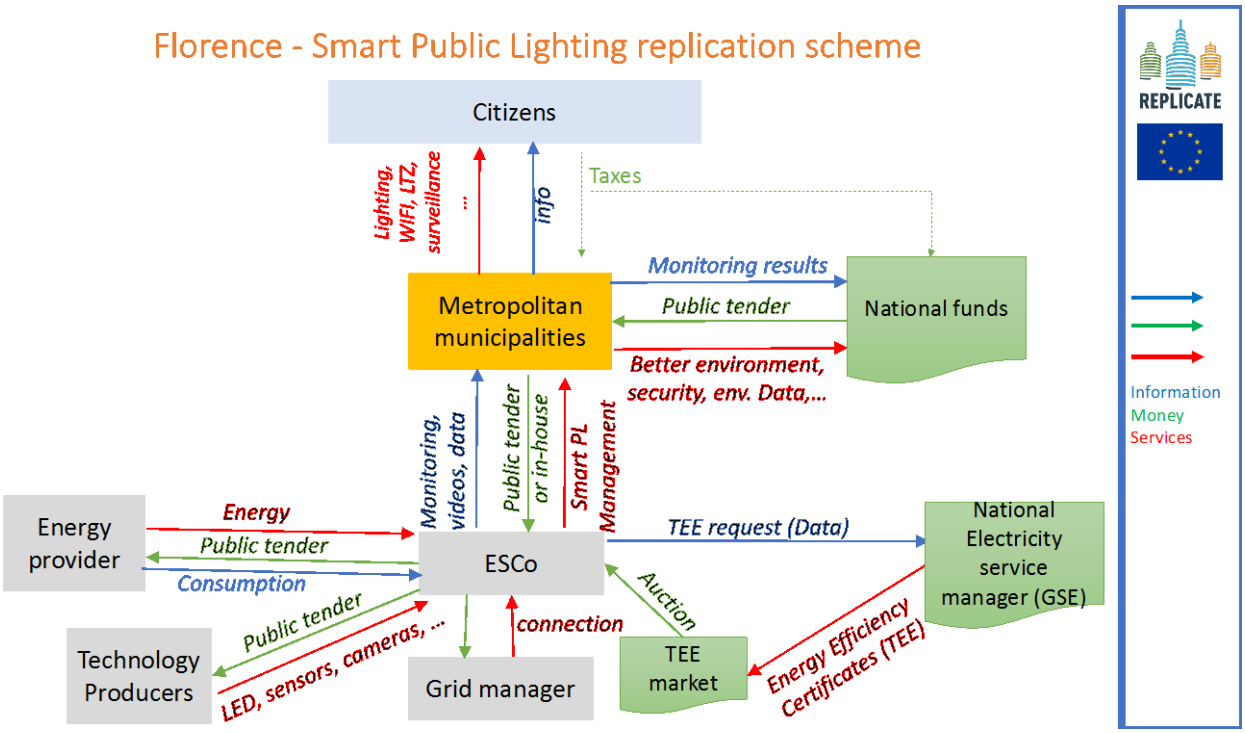

Figure 8.4 – the possible future model for smart public lighting

In Florence the extension of the Smart lighting measure is already following the scheme in use, with the only difference of the financing sources (PON METRO).

In case of extension to other municipalities, for example in the metropolitan area but also outside, the scheme could be replicated with an in-house Company or an ESCO selected following the public procurement procedures. The critical step could be represented by the technical design of the intervention which is not a standard led installation; the package, including additional services, needs transversal competences and it is not available as standard offer on the Italian PA centralised procurement system. Silfi could transfer its know-how and support other companies in the technical/administrative update starting a new activity.

Another interesting input from solution 2 is that the data collection and storage could be also managed by the service if some assets are fully in charge like traffic lights and video cameras.

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9. E-mobility

9.1 Solution 1: e-taxi fleet and fast recharging infrastructure

The action consists in enhancing the switch to electric vehicles of the Florence taxi public service both to increase its sustainability and to promote the electric mobility to city users.

The municipality published a dedicated tender exclusively for e-taxi service, 70 new licenses dedicated to e-vehicles (on a total project target of 100), with a 25% discount and provided agreements with vehicles producers for special purchasing conditions.

In parallel, e-distribuzione installed six new Enel Fast Recharge Plus 1G (EFRP) charging stations, for exclusive use of taxi in public areas identified together with the Municipality and with the taxi drivers' association. The stations have been installed in crucial points of the city (near the train station, the airport and the entrances). The EFRP charging stations are fully integrated in the LV (Low Voltage) distribution network in a "smart way", ensuring the security and the stability of electric system, with the possibility to modulate the current of each charging, thanks to the remotely control of Electric Mobility Management (EMM) Platform. Through the EMM Platform, all charging stations are managed in an interoperable way, non-discriminatory access and multi-vendor approach, thanks to the smart meter technology, thus assuring benefits to the end-user guaranteed by free market competition.

The full integration of the EVSEs in the low voltage distribution network and the management based on the EMM Platform provide the possibility to manage in a better way energy flows avoiding networks overloads on one hand and, and enabling new customer experiences based on innovative services and solutions in other hand, such as:

- the possibility to identify the closest charging point and reserve it through mobile phone (Mathema's app available for taxi drivers);
- monitoring and controlling of charging process;
- load modulation;
- payment of charging directly in the bill, according to the tariff profiles of their own retailer.

This will foster the development of electric mobility without compromising the safety of systems and the quality of supplying for other customers

Value proposition

In Florence the transport sector has the largest impact, counting for the 34.5% of the total CO_2 emissions according to the baseline inventory of the SEAP. What is required is a substantial, integrated action which makes possible – even in a difficult situation such as that of urban Florence, congested as it is by commuter and tourist flows – to achieve a significant reduction in the environmental impact of mobility in the context of the city.

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The municipality is promoting sustainable mobility and in particular e-mobility starting from the public transport system as tramlines, its own fleet, the e-sharing service, the incentives (LTZ access, public recharging network, free parking...)

Taxi fleet presents particular needs in terms of autonomy and charging periods while is a powerful dissemination channel for e-mobility to city users.

174 public electric recharging infrastructures are already available, remotely managed and included in the open data webpage of the municipality.

Players

Key partnership

Municipality of Florence (project partner), SILFI (third party), e-distribuzione (project partner), Enel X (project partner), Mathema (project partner), UNIFI (project partner)

Beneficiaries:

Taxi drivers, citizens and city users

Supporting Stakeholders:

Taxi drivers' association, Mobility APPs providers, e-vehicles producers, energy providers, multipliers (hotels and restaurants…)

Market analysis: enablers and obstacles

Legal framework:

Regarding electric mobility, the three supporting actions foreseen by the Government concern the recharging infrastructure, the road regulation and the incentives for the e-vehicles.

The National Plan for the recharging infrastructure (PNIRE) has been developed in 2014, updated in 2015 and finally approved and adopted on the 30th of June 2016.

At local level the main planning instruments foresee the promotion of electric mobility (structural plan, SEAP, Smart City Plan…) with targets for the next decades (to double the already high number of charging stations at 2050 and to reduce the number of fossil fuelled vehicles at least of the 26% at 2050). The technical equipment is subject to CEI (Italian Electrotechnical Committee) EN standards.

Incentives:

There are different kind of incentives available for e-mobility.

At national level, as reported in the framework paragraph, the national plan for e-mobility supports the development of a widespread and performing infrastructure for the recharge.

e-distribuzione is a DSO, a regulated entity and no regulatory remuneration is provided for DSO in Italy for recharging infrastructures.

National incentives with an economic value:

- 50% reduction on the cost of insurance, considered by the consumers the heaviest burden;

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- Exemption from payment of vehicle taxes for five years from the first registration
- up to 6.000€ for the replacement of a fossil fuel vehicle.

At local level many supporting measures have been made available to concretize the municipal plan for e-mobility development and the smart city plan measures about e-mobility and eco road pricing

Local facilitations have been more focused on the topic of circulation:

- Presence of a capillary infrastructural network of public charging stations (free of charge cost in the first phase – from Feb 2014 to Feb 2017);
- bonus Recharge for existing taxi licences switched into e-taxis
- Freedom of movement of electric vehicles in restricted traffic zones;
- prioritization of the green e-taxi service
- First 70 licences discount (-30%)
- app for fast recharge booking and real time mapping of the public network

Human factor (success factors, opposed sentiments, …):

The main obstacle from the taxi drivers' point of view is the high investment for the e-vehicle and the battery performances.

Counting on a widespread public charging network and a dedicated fast network (and the possibility of charging at home), the autonomy of the batteries seems not to affect the choice.

The multivendor opportunity offered by the charging network is very important from the users' point of view as well as the possibility to recharge all e-vehicles brands on the market.

The app and the possible prioritization of the greener e-service have been discussed and agreed with the association; the key factor for replicability and the deployment, is the decreasing in fast recharging infrastructure and e-vehicles costs.

Competitors:

Other typologies of recharging infrastructures are available on a fast-developing market. In general, the main competitors to fully electric cars are hybrid vehicles and traditional fuelled vehicles.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Low emission mobility	100 e-taxis means 225.000 litres of fuel saved and -200 CO_2t/y
Jobs creation	70 new e-licences (and management of the recharging network after the project)
Technology kick-off	Technology acceptance (e-vehicle and charging system) Test on wide scale of fast recharging to be replicated at metropolitan and national (Eva+ project) level

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Management model:

Economic costs and revenues:

Infrastructure: For the 6 fast recharge stations the total budget of e-distribuzione was around 0,37 M€ (0,24 M€ of EU contribution, 70%). e-distribuzione has an annual operation expenditure for the licensing of EMM system, a platform to remote control the fast recharging infrastructures. Additional construction works have been financed by the municipality to set the recharging areas.

Taxi drivers: The fee for the new 70 e-licences was of 175.000€ (-30% discount compared to a regular licence of 250.000€). The average favourable cost for the e-taxi within the project has been about 18-25.000€. The electricity tariffs for the recharge belong to the different contracts because the technology allows a multivendor offer; the market in this sector is under fast development and the offers (https://www.arera.it/allegati/elettricita/schede/TariffePrezziRicariche_st.pdf) are usually on consumption basis, but there are also some more convenient flat rates per month, with a range for kWh from 0,26 to 0,50€.The App is free for users.

Management model scheme in use:

Hereafter is reported the scheme in use in Florence for the e-taxi action: the municipality is the project promoter who started the process introducing new e-licences and facilitations also linked to agreements signed with providers.

e-distribuzione, as DSO, is testing the innovative technology providing the fast recharging stations connected with its Smart Grid and remoted controlled by the EMM system.

Taxi drivers could benefit from several discounts, from a new eco-service for the market and of possible costs savings for fuel and vehicle management.

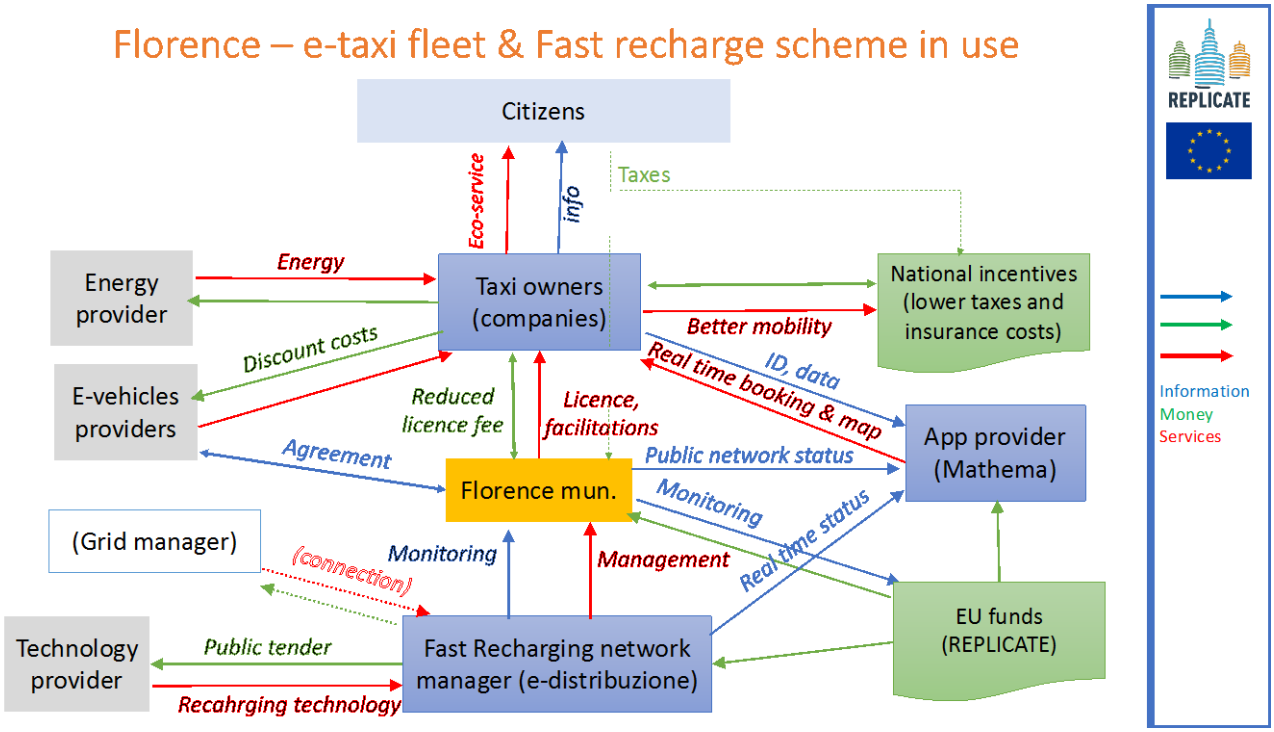

Figure 9.1 -the model in use for e-taxi fleet in Florence

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9.2 Solution 2: smart mobility service "WeGo" (formally Buzz)

In Bristol public transport services and dedicated cycle routes connect the district with the city centre. There are limited mobility options for journeys connecting to existing public transport routes (e.g. to Southmead hospital or the Filton and Severnside Enterprise Areas) and no motorised options for the last / first mile of journeys for those who are mobility disadvantaged.

An electric taxi (Hackney) "WeGo" will provide highly convenient, personalised 'A-to-B' journeys in a shared vehicle, offering new levels of service at an affordable price.

WeGo is both on-demand such as a connection to a rail or coach service or a trip, and events-based services, with passengers/event organisers booking transport to-and-from community events, clubs or "events". Organisers book the vehicle and then either passengers or event organisers book the passenger journeys. (They can also cancel journeys.) Once booking has closed (one hour before departure), passengers are texted their exact pick-up location and time. Passengers can monitor the real-time progress of their vehicle on an online map and receive an alert when their vehicle is a few minutes away. The price is £1 each way, payable online or in cash to the driver. Passengers will be able to book WeGo alongside the event it is serving, e.g. a link to book on the Eventbrite events platform or a link to book on a connecting rail service. WeGo improves mobility and helps combat loneliness and social isolation.

Value proposition

Ashley, Easton and Lawrence Hill have the lowest levels of car availability in the city with 46% of households with no car (many of the properties in the area are flats) and the Bristol average being 29%. It will offer a point-to-point sustainable and affordable mobility service for those who currently lack one, thus improving access to places and life opportunities.

Indirectly, the action aims to also help target perceptions of air pollution problems and noise from traffic (highest in the city) and will contribute to reduced CO2 emissions.

Players

Key partnership

Bristol City Council with its Transport Service, Esoterix Systems Ltd (project partner), Route Monkey (project partner), Electric Hackney Taxi.

Beneficiaries:

Citizens and city users

Supporting stakeholders:

There are several entities that will be involved (but are not individually critical to the deployment of the solution) including:

- Local community groups and centres
- Public health providers

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- Public sector employers who can promote the service to employees and administer fares through salary sacrifice.
- Vehicle manufacturers or leasing companies
- Private sector employers who can promote the service to employees and administer fares through salary sacrifice.

Market analysis: enablers and obstacles

Legal framework:

The legal framework influencing this measure concerns the need for the drivers of the Buzz services to be licenced as 'private hire vehicle' drivers, one of two forms of taxi licencing in the UK. In addition, depending on the exact nature of the services, they may need to be registered as flexible bus routes. The vehicles owned would need to be registered as private hire vehicles or buses, and the operators would need to comply with the legal requirements of being a taxi or bus operator, which concern variously depending pun the bus and taxi legislation, responsibilities for the vehicles being roadworthy and the operator being professionally competent and financially solvent. The Buzz business model also seeks, where possible and appropriate, for any commuters using the service to pay by salary sacrifice from their gross salary, as if they are taxpayers this reduces the amount paid. Tax authority rules (Her Majesty's Revenue and Customs) govern the use of this practice.

Incentives

Operators of services which meet the legal definition of 'local bus services' can claim Bus Service Operator's Grant, which is usually paid as a subsidy for fuel costs incurred.

Human factor:

the key success factors have been detected in:

-understanding the potential demand across the area and across the time of day

-ensuring the service is affordable (more comparable to a bus fare than a taxi fare)

Message: make this: 1) Accessible – for everyone

2) Sustainable – ecologically & financially

3) For the benefit of the community

Sentiment: "intervention fatigue"

The main obstacles are

- Raising awareness of the service to all those who might use it.
- Encouraging car users to try a new mode of transport.
- Difficulty accessing the service for those who aren't online.

Competitors:

Another company ("Slide Bristol") has started operating on-demand shared mobility services in other parts of Bristol but they don't operate in the target area and their fares are more expensive than those the project is seeking to deliver. This service ceased in December 2018.

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Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Better Access to training and employment	Providing sustainable transport to-and-from employment and education or transport hubs from which they can reach those destinations
Change transport behaviours	Reduce the need to own / use a private car, particularly for the first/last mile of longer transport journeys and relatively local trips to retail & leisure facilities
Mitigate climate change	Reduce CO_2 and NO_X for the journeys undertaken using the minibus.

Management model:

Economic costs and revenues:

It is proposed that two vehicles will be leased by Esoterix for £16,000/month. The principal other costs will be labour (typically a 40-50% share of bus or taxi operational costs), energy/recharging costs, vehicle stabling costs, and insurance. Revenues will be up to £120,000 per operating vehicle per annum.

Management model scheme in use:

The municipality is the project promoter while the service is operated by Esoterix. The supporting travel planner is delivered by Route Monkey.

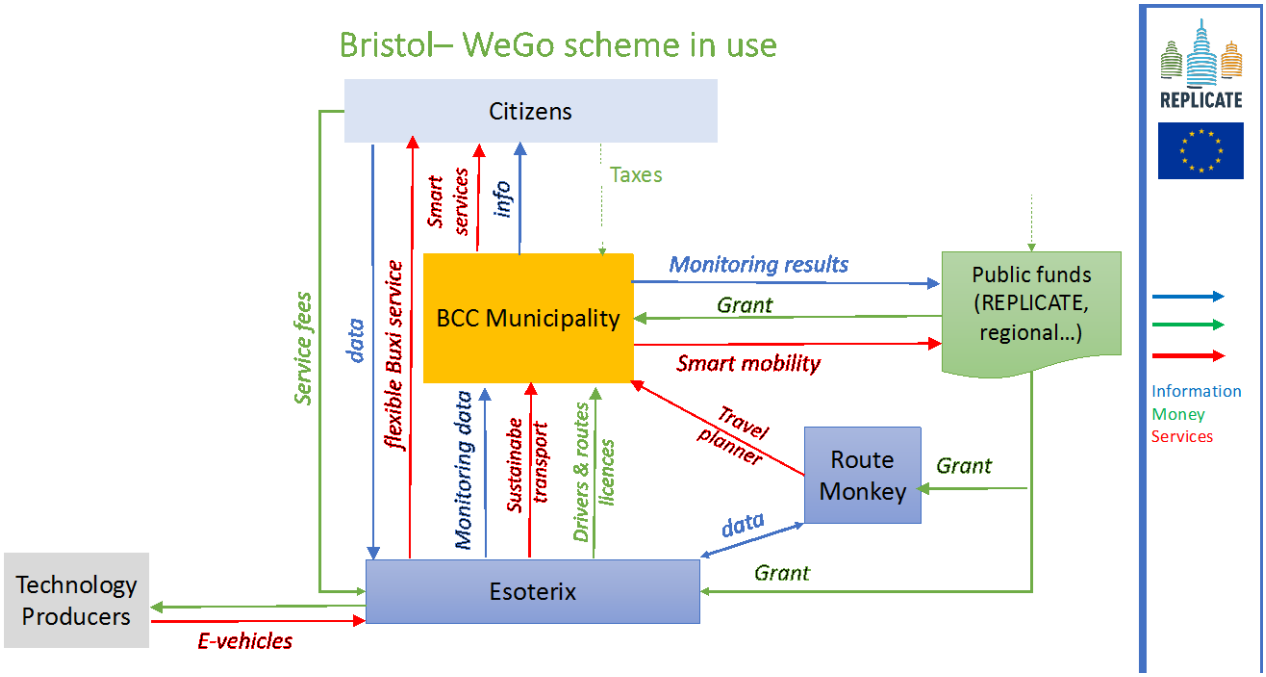

Figure 9.2 – the model in use for the e-bus service in Bristol

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9.3 Solution 3: e-bikes

Implementation of 12 electric bikes in corporate, community and public sector settings in the Bristol project area. The bikes are housed and charged by the organisations. The bikes are serviced and maintained by Co-wheels. Each bike will have a bespoke tracking unit installed and managed by University of Bristol. The option also exists for the bikes to be integrated into Co-wheels online booking system.

Value proposition

Enabling greater sustainable and active mobility Increasing health & wellbeing Enabling better access to employment Reducing congestion and carbon emissions Breaking down barriers to active and sustainable travel.

The e-bikes will also enable better access to clients in the course of work, with improvement in the way employees carry out their job.

Players

Key partnership:

Public: UWE, University of Bristol, Bristol City Council, OLEV, Energy teams.
Private: Co-wheels, Sustainable Travel Solutions (STS).

Beneficiaries:

Ashley, Lawrence hill and Easton Neighbourhood Partnership area residents, businesses, public sector and community organisations

Market analysis: enablers and obstacles

Legal framework:

There are no legal enablers for using e-bikes. Planning permission is an essential element in placing cycling infrastructure in Bristol.

Incentives:

There are financial enablers such as a significant reduction in costs for businesses in comparison with pool cars and paying mileage for staff to use their own cars.

Human factor (success factors, opposed sentiments, …):

- Knowledge of the area - consider whether the scheme is suitable for the target area by looking at the demographics. Will people living in the area make use of an e-bike scheme that has a greater cost than a conventional pedal bike scheme? Also look at whether there are organisations operating in the area that would benefit from e-bikes for whatever reason (cutting carbon, health & wellbeing, facilitating regular short journeys, cost savings etc)

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- Knowledge of the market – consider the existing and upcoming schemes in the area. It is important to be competitive.
- Ease of use – create a model where the client has to do as little as possible (e.g. provide regular service and support package, integration of bike onto booking system etc)
- Customer Service – Build relationships based on trust and respect – offer clients a trial period with the bikes and make sure that you are prepared to signpost potential clients to other options if the e-bikes are not for them. Make sure that you provide a support package that is prompt, responsive and effective with the aim of keeping people cycling (e.g. provide a courtesy bike if you need to take a bike away for repairs).
- Quality bikes – do not opt for the cheapest bikes as these will cost you more in the long term through maintenance and support. Use a quality mid-range e-bike from a reputable manufacturer and ensure that elements such as warranty and technical support are sufficient to cover the bikes when they are being used in a public scheme.

Competitors:

It must be mentioned that the introduction of a dock less bike hire scheme in Bristol soon after the start of the project had the impact of changing the market completely.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Social inclusion	improve access to sustainable and active transport options by providing access to cars and e-bikes without the expense of ownership
Change transport behaviours: modal integration	acting as a catalyst to making more trips by cycling, walking and/or public transport. This in turn will make steps towards locking in behaviour change and cultural change for both individuals and organisations.
Mitigate climate change	The CO_2 saved is estimated about 0.36t/y per bike.

Management model

Economic costs and revenues:

Co-wheels are trialling two versions of a business model for this scheme.

Firstly, there is the ownership model where Co-wheels purchases the bikes and works with a partner organisation to provide the service and support package. For this, Staiger Sinus BC30f electric bikes were purchased through Raleigh UK Ltd with two years warranty. Co-wheels have been working in partnership with Sustainable Travel Solutions Ltd (STS), a Bristol based company specialising in supplying and supporting businesses and public sector organisations with bicycle fleets, for provision of the servicing, maintenance and support for the bikes. As the bikes run on a Bosch

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system, it was essential that STS were Bosch trained and certified to enable swift diagnosis and resolution of any technical issues relating to the bikes.

To prepare the e-bikes for deployment, puncture proof tyres and cycle panniers are fitted, a D-lock is provided, and a pre-deployment inspection is conducted.

Once deployed, STS provide basic quarterly services, a full annual service, maintenance and repairs relating to wear and tear, and emergency call-out support (Mon-Fri 9-17 excluding bank holidays).

Each bike is replaced with a new bike after two years of use. In the event of a bike being stolen, this has been replaced with a Raleigh Motus e-bike due to its similarity to the Staiger and its faster availability through Raleigh.

Secondly, there is the e-bike lease model where Co-wheels leases the bikes from a 'one stop shop' that provides the full service and support package in addition to the bikes. For this, Co-wheels has been working in partnership with STS, who provide the bikes and the service and support package all together. The reason for trialling these two models relates to cost and convenience.

The table below shows the cost comparison, based on a two-year contract:

	Purchase*	Lease*
Bike cost	£1083.34/ €1,213.34 + VAT	£1995/ € 2,234.40 + VAT
Service & support	£720/ € 806.40 + VAT	Included
Puncture proof tyres	£74.64/ € 83.60 + VAT	Included
D-lock	£30/ € 33.60 + VAT	Included
Panniers	£75 / €84 + VAT	£75 / €84 + VAT
PDI check	£20/ € 22.40 + VAT	Included
Insurance	£120/ € 134.40	Included
Total	*£2122.98 / € 2,377.74 + VAT*	*£2070 /€ 2,318.40 + VAT*

*Using official conversion rate of 1.12EUR per 1 GBP for November 2018.

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Management model scheme in use

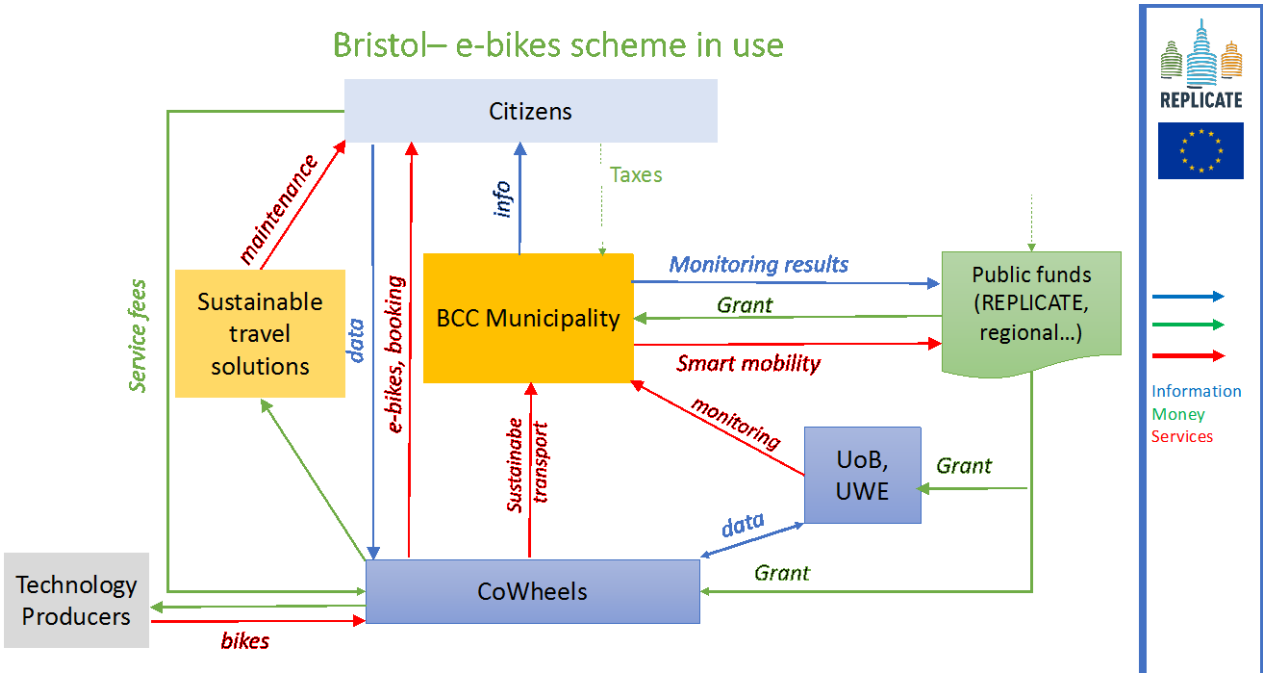

Figure 9.3 – the model in use for the e-bikes service in Bristol

9.4 First scale up SWOT & USP analysis

The SWOT analysis:

Solution 1 e-taxi fleet and fast recharging infrastructure	
USP: e-TAXI: a green taxi is catchy for smart users, urban friendly (no noise and pollution) and it is cheaper for the owner. Fast recharge: the fast recharging infrastructure is what any e-driver dreams about.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Taxi operational needs fulfilment (fast recharge) • Lower operational costs and incentives for e-taxi drivers • Low emission mobility promotion • Smart grid potential exploited	Some aspects to be improved: • Administrative iter for the building works and the location of the recharging stations • Public room for the recharging areas • Investment costs (both for the recharging infrastructure and for the e-vehicles)

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Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• national/regional supporting schemes • private (energy providers, fleets. Freight transport) interest tourists' and city users' awareness	• technologies (vehicles, batteries and recharging stations) and their fast upgrade • drivers' skills (training for the recharge) • impact of e-mobility on the grid • impact in the restricted areas

Solution 2 smart mobility service "WeGo"	
USP: advantages of a shared public service (in terms of energy efficiency) with the flexibility close to the user experience of an exclusively-used taxi service.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Transverse and flexible route option. • ICT supporting infrastructure (real time position, website, app,…)	Some aspects to be improved: • Data analysis of service and travel patterns • Demand prediction • Intelligent routing & scheduling
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
The service will scale with success – the routing and scheduling will be efficient for larger demand and larger numbers of vehicles.	• Possible conflict with existing public transport or private hire operators. Esoterix may begin to subcontract journey delivery to other existing operators. • Low revenues and no supporting facilitations

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Solution 3 e-bikes	
USP: e-bikes can break down barriers to active and sustainable travel reducing congestion, energy & emissions and sedentary without ownership problems	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Existing booking system (car club) • Reduced costs compared to cars • Municipal sustainable mobility policies • Modular design	• Maintenance service reliability • Monitoring system development and data storage
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• Externalities (health, trips time in traffic,…) • intermodality	• Bike sharing service competition

The possible scheme for replication:

The replication model of the e-taxi and fast recharge action will see e-distribuzione as DSO/grid manager and another player as recharging network manager.

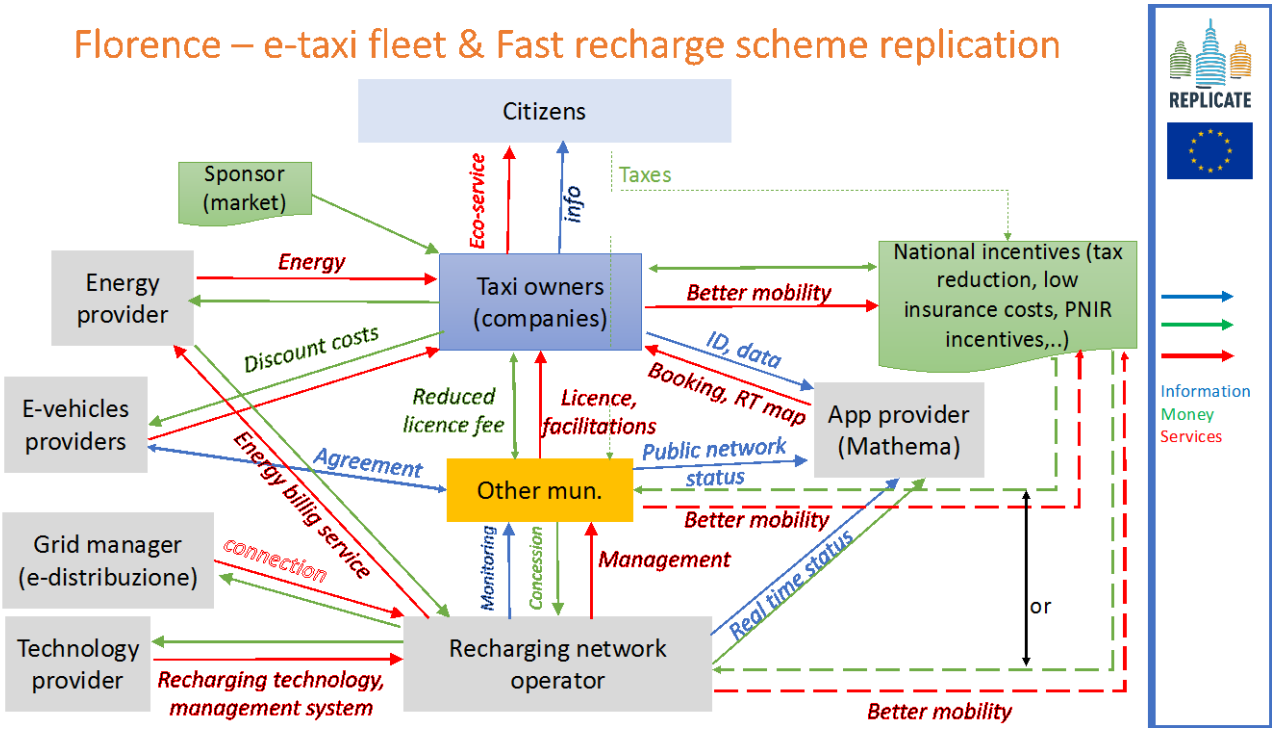

Figure 9.4 – the possible future model for e-taxi fleets

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The facilitator could be any other municipality or group of them (starting from the metropolitan area to widen the service) and there could be also an external sponsor (linked to tourism sector or energy) supporting the investment costs or the communication/promotion. Externalities should be taken into account to understand the possible involvement of sponsors and the commitment of the city itself. The approach with the municipality as facilitator signing agreements with the different stakeholders could be replicated also for other kind of fleets.

In solution 2, it is intended that demand for the service will develop so that in the replication phase WeGo will operate in a broadly similar manner (although learning from the project experiences) the changes except for the REPLICATE funds which will be no more necessary: the e-WeGo service should be self-standing and the travel planner development supported by all the mobility stakeholders (municipality and mobility services providers).

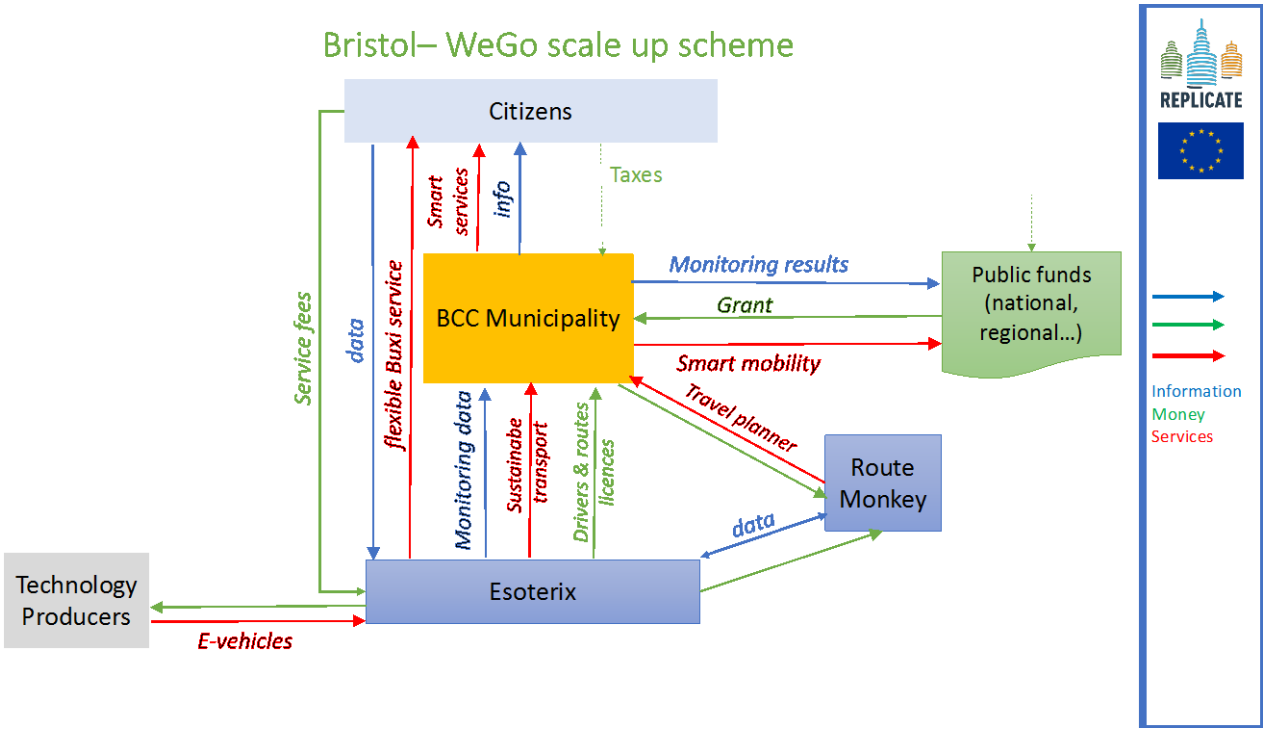

Figure 9.5 – the possible future model for the WeGo service in Bristol

The key factors for replicability of solution 3 e-bikes are

- Integration of key elements (e.g. bike booking) into the existing infrastructure of the car club
- Build a network of delivery partners (bike mechanics etc) that you can trust and rely on.
- The e-bike monitoring system has been designed with scalability and replicability of deployment in mind. On a manufacturing side, the modular design speeds up the building of each unit, while the use of COTS components reduces the unit cost.

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- For the scale up of the back end and communications links, e-bike specific data formats have been developed to compress the transmission of data sent over LoRaWAN. Scalable technologies have been used all along the data pipeline, and work is currently being done to port the pipeline into Openstack, which will automate backend system scale up.

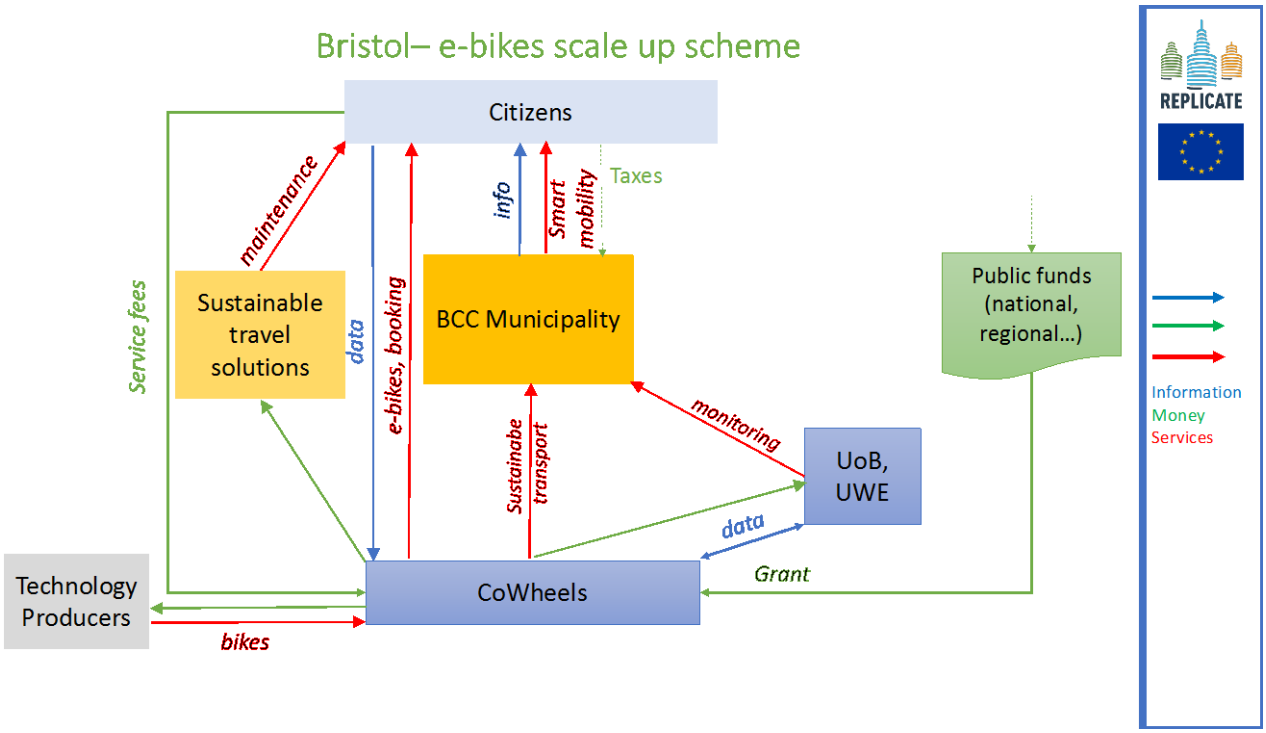

Figure 9.6 – the possible future model for the e-bike club in Bristol

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10. ICT

10.1 Solution 1: Smart mobility platform

A Smart Mobility platform has been developed in San Sebastian during the project in order to optimize the urban mobility services. Applying Business Intelligence and Big Data technologies, the information collected from the sensors and operating systems of the city will be exploited. In this way, managers, service operators, municipal planners and citizens can obtain information in a simple and orderly way, which allows them to better understand the reality of the city.

The solution has a comprehensive web tool that allows users to exploit the ability to analyse and interact with different content through a centralized, secure and multi-user global vision. This interface shows information adapted to the needs of the different municipal departments (public transport, parking, traffic, etc.). The information can be displayed in different formats, such as dashboards or key performance indicators. All this information can be filtered to access only the specific data that interests the user. It also includes a tool to generate reports and a module to manage the events (incidents that occur in the city).

Regarding data analytics, the platform includes predictive capabilities. For this, several multiclass classification models can be implemented and trained with the data coming from the city. In this context, a prediction model has been developed to predict the level of bicycle occupancy of each station in the bicycle sharing system of San Sebastian.

Value proposition

The value proposition of the platform focuses on offering to managers and technicians of the Mobility Department answers providing useful information for the performance of their services (What has happened? Where is the problem? What actions are required?).
Most of city transport sensors are outsourced. The integration of all those services in a common platform will be a challenging task, in order to adapt all particularities of each system.
Thanks to all the information stored and processed by the platform, operators can make decisions based on real and truthful data, increasing therefore confidence and consensus in decision-making.
In short, establish a comprehensive and effective management of urban services for optimal use of available resources.

Players

Key partnership

San Sebastian City Council (project partner), IKUSI (project partner) Dbus (project partner).

Beneficiaries:

Municipal planners, operators, transport authorities, citizens.

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Supporting Stakeholders:

Service operators (cycling mobility, parking, public transport, etc.), sensors suppliers (parkings, control cameras, open parking ticketing systems, public bike sharing stations, etc.). The ICT sector and local companies, for the promotion of innovation, cooperation and the development of new businesses related to urban mobility.

Market analysis: enablers and obstacles

Legal framework:

UNE 178104 standard of AENOR: Comprehensive systems for a smart city management. Requirements of interoperability for a Smart City Platform.

The platform interfaces for managers, urban service providers and citizens comply with the W3C accessibility standards, specifically the "Web Content Accessibility Guidelines 2.0" standard that has been in force since 2012. This makes the platform strongly aligned with Directive (EU) 2016/2102.

Incentives:

In order to contribute to the achievement of the objectives of the Europe 2020 Strategy, the European Structural and Investment Funds intend to support the Sustainable and Integrated Urban Development. For this, it is necessary to have a coherent, balanced strategy with a long-term vision. In the case of Spain, more than 1,000 million euros have been allocated for the development of these Strategies: the DUSI Strategies should be developed in cities or urban functional areas of more than 20,000 inhabitants. The digital transformation and the practical use of data analytics are some of the aspects that will be promoted through these initiatives.

Human factor (success factors, opposed sentiments, …):

The key success factors have been detected in:

- ensuring that the platform is easy-to-use and with a clear content
- selecting macro indicators easy to understand
- Disposal of a great quantity of data and information from multiple sources
- combining as much information as possible in a holistic way
- flexibility in the data visualization

The main obstacles are:

- Most of city transport sensors are outsourced. The integration of all those services in a common platform will be a challenging task, in order to adapt all particularities of each system
- ensuring full compliance with the current regulations regarding the protection of personal data both at European and national level
- guarantee the highest level of accuracy of the indicators trend projections

Competitors:

Other web-based platform developers. Another type of competitor may be companies that have a platform for a specific vertical of the city (energy, water, security, etc.) and want to integrate other verticals to give a more global vision of the city.

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Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Better planning and decision making	Thanks to the mobility platform the municipal planners and operators can have an instrument to check mobility indicators and receive alerts in real time for the proper management of urban mobility services.
Change transport behaviours	A better planning of the planning transport and an improved quality of all the services related to sustainable mobility (bikes-sharing, car sharing, EV), based on the information collected and elaborated by the platform, can change citizens transport behaviours and reduce the need to own / use a private car.
Mitigate climate change	A change in transport behaviour, resulting from a better management of the mobility related services, means lower CO_2 emissions levels.
Users' satisfaction	For the improved efficiency of the mobility services

Management model

Economic costs and revenues:

The total cost in the project (covering exchange of experiences, design, implementation and project management activities) is about 400.000€ cofunded by the EU. The model of sale of the platform will be based on the one hand on depreciation through the sale of licenses and on the other hand, on the marketing of services associated with the solution.

Management model in use:

The city is the promoter and the owner of the ICT platform while the service is operated by IKUSI.

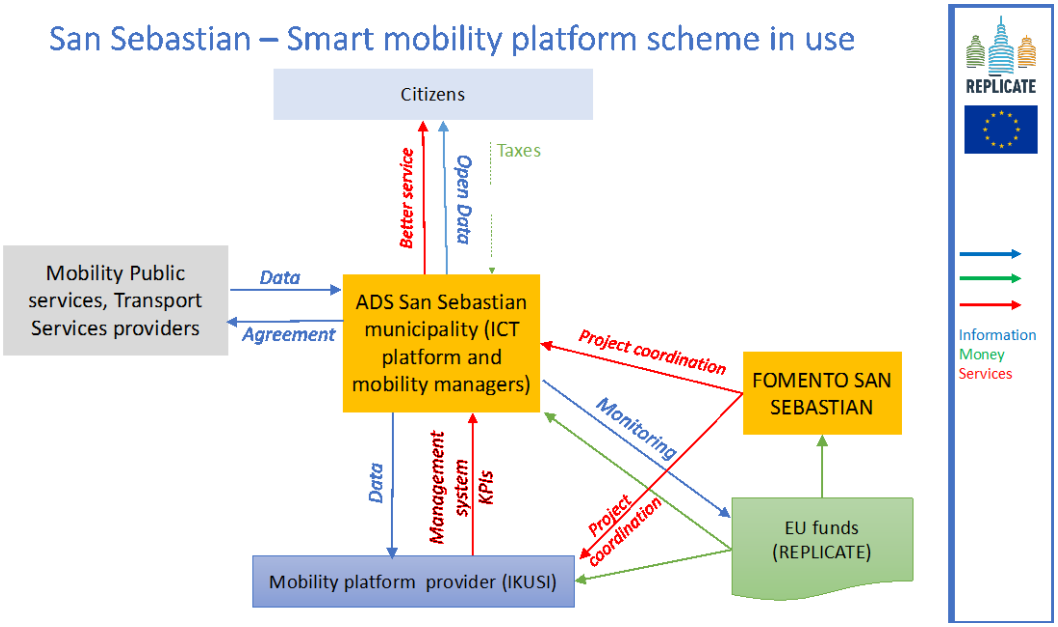

Figure 10.1 – model in use for Smart mobility platform in San Sebastian

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10.2 Solution 2: Big data for mobility services

Big Data are more and more useful to guarantee a higher quality in services of interest for cities and telecommunication companies.

The urban mobility patterns are a critical task for transportation planning and management in San Sebastian as in the other cities. Traditional methods, such as household or street surveys, although they provide detailed information, are slow and costly processes for the acquisition and analysis of information, preventing the possibility of generating transport demand models with the desired frequency and quality.

A large amount of geo-located data can be collected over time through mobile telephony and with high representativeness. In addition, the traces associated with a private WiFi service are also integrated to improve the accuracy and success of the algorithms.

Based on the data managed by the biggest operator in the Basque Country, Euskaltel, advanced data analytics methods can provide very exact aggregated information about mobility of people in the city as mobility heat points, origin-destiny matrix, etc.

In the project framework, value of the information has been contrasted, to improve real-time knowledge of urban mobility in San Sebastian pilot. To achieve this goal, a Data Lake, the Big data

infrastructure built to store and transform the data coming from the network into people movement information, and a set of mobility analytics algorithms, have been developed, defined to extract aggregated information. Additionally, an Application Program Interface for the information of the third parties (in this case, San Sebastian Municipality) is now available.

The area selected for the pilot action is Donostialdea.

Value proposition

The aim of the project is to collect the most reliable data on mobility behaviours in San Sebastian in order to plan the most suitable actions in the transport sector, so to reduce operating costs in services and optimally coordinating resources, anticipating problems and future trends and disseminating useful information to citizens.

The most common methods for gathering information on mobility behaviour were in fact interviews, questionnaires and surveys, all of them facing a number of limitations relating to its accuracy, representativeness and reliability. Replicate proposal is to obtain an aggregated characterization of urban mobility based on operational information from mobile network companies. Analytics of this data can provide very exact information about means of transport, origin-destiny matrix, etc.

Players

Key partnership:

San Sebastian municipality (project partner), Fomento San Sebastian (project partner), Euskaltel (project partner)

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Beneficiaries:

Municipal planners, operators, urban transport authorities, citizens.

Supporting Stakeholders:

Other telecommunication companies, transport service operators (cycling mobility, parking, public transport, etc.). The ICT sector and local companies, for the promotion of innovation, cooperation and the development of new businesses related to urban mobility.

Market analysis: enablers and obstacles

Legal framework:

The main regulation related with the analysis of location based in mobile devices is the General Data Protection Regulation (EU) 2016/679 ("GDPR"). This is a regulation in EU law on data protection and privacy for all individuals within the European Union (EU) and the European Economic Area (EEA).

According to this regulation, a Privacy Impact Assessment (PIA) has been carried out in Euskaltel to ensure the absence of risk of privacy loss for the end users.

There are also other two regulations related to the project:

• "Norma Técnica de Interoperabilidad de Reutilización de recursos de la información" (BOE-A-2013-2380). It defines the URIs and compulsory metadata (DCAT based schema) for resources published by official institutions.

• "Ciudades Inteligentes. Datos Abiertos (Open Data)." (UNE 178301:2015). It defines the technical requirements for the Open data provided by an intelligent city. It provides a scale to assess the compliancy level of a given city.

Incentives:

None

Human factor (success factors, opposed sentiments, …):

The main innovation and success of the proposed work are due the data richness and large overage of Euskaltel in the pilot geographical scope. Specifically, the composition of trajectories manages the fusion of complementary CDR and WiFi Kalean data.
Additionally, another innovation relies in the fact that without deploying additional infrastructure for sensing, the information provided included both vehicles and pedestrian, those last, very difficult to be monetarized with other sensing techniques.
As for the critical aspects, currently an annual data consolidation is carried out, with insufficient frequency to assist in the operation. The information is not exploited in a coordinated way, data sources are not merged, they are treated separately, so it is even difficult to assess whether the information that is already available is sufficient or not. Additionally, only vehicular information, conventional traffic sensory information and transactional public transport information were addressed.
Another critical aspect was ensuring proper data anonymization through aggregation procedures before making the data available to the Consortium, so end users' privacy is always preserved.

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Competitors:

Other telecommunication operators can provide similar information, if they develop similar platforms, but up to know, Euskaltel is the only Telecomunication operator in the Basque country that provides public wifi, which provides more accurate localization.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Better planning and decision making	Thanks to the collected data the municipal planners and operators dispose of reliable information on which base decisions.
Locale economy impact	The small commerce and tourism will have information of the surroundings and with it will be able to realize performances allowing catch more visitors, offering promotions and measuring the impact of their marketing campaigns.
Environmental impact	The possibility of aggregating mobility information, will allow a continuous monitoring of mobility indicators helping to detect areas where correction/improving actions are needed for a major urban sustainability, in environmental, social coexistence and economic terms.
Social impact	A good understanding of the demand and mobility needs in the city, contrasted with the current transport offer, will identify neighbourhoods or areas with particular needs.

Management model

Economic costs and revenues:

The availability of data extracted from telecommunication operation logs about the mobility of people in the city, both vehicles and pedestrians, could minimize the development and installation of additional infrastructures in the cities for mobility management. As result, an efficient business model can be created, where the cities can save money in deployment and management of infrastructures, and network operators can monetize the data of the network.

The total cost in the project for design, experience exchange and management is around 300.000€ co-funded by the EU.

Management model scheme in use:

The management model adopted is a private-public partnership that can show how the use of Big Data can serve to produce services of interest for cities and telecommunication companies. Based on the data managed by the biggest operator in the Basque Country, Euskaltel.

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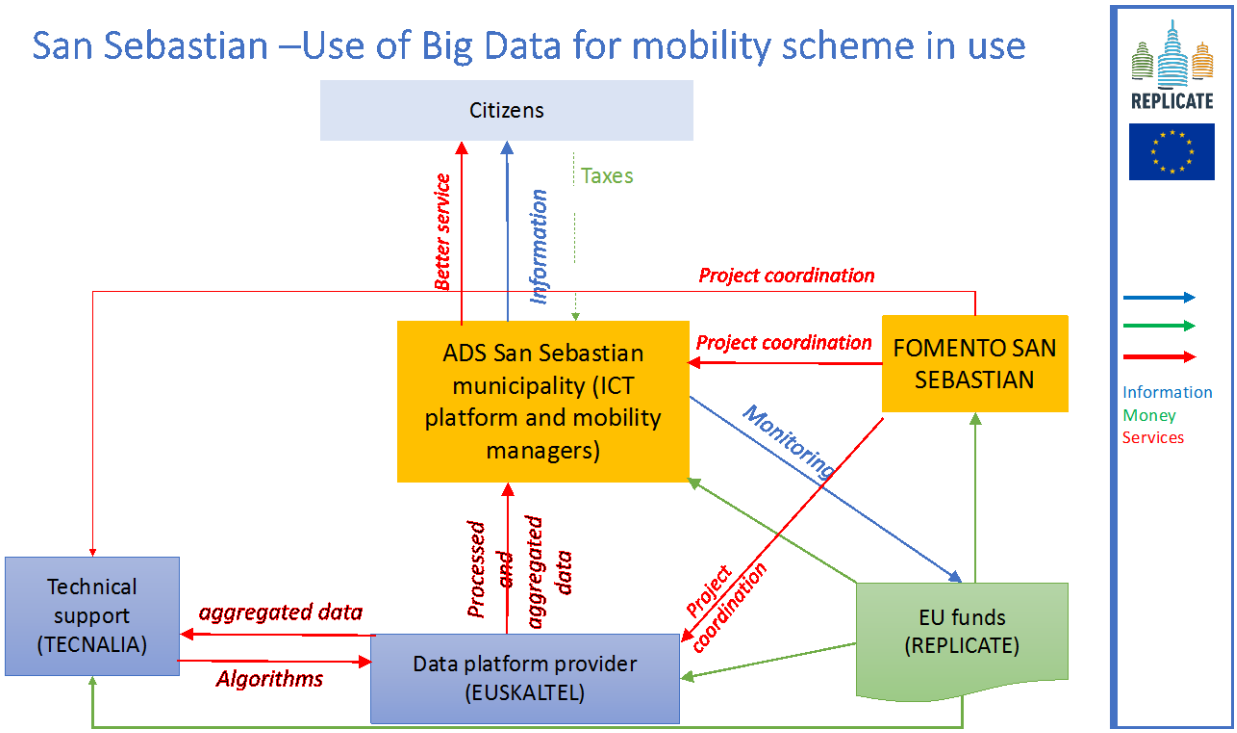

Figure 10.2 – model in use for Big Data for mobility services in San Sebastian

10.3 Solution 3: Linked open data

The publication of interoperable and rich Open Data is paramount for the citizens to truly take advantage of the Smart City solutions deployed in San Sebastian.

Eurohelp has designed, developed and deployed the Open Data platform to publish the data resulting from different Smart City realms, in traditional, file based Open Data (Open Data Portal) and in the Linked Open Data system. DonostiaTIK has provided the hosting machines for the platform. Fomento San Sebastián has coordinated the collaboration between Eurohelp and the San Sebastian municipality, in order to gather requirements, design and deployment of the platform.

Value proposition

The publication of high quality, rigorous, and up to date Open Data in non-proprietary formats, with open licenses like Creative Commons BY 4.0, adds a substantial value to the smart city, allowing:

1) Ease of access for citizens, in order to reuse the data, remain informed in real time, and assess the activity of the city council through deep analyses.

2) Ease of access for machines, in order to improve the discoverability of the data, and the creation of sophisticated applications and services by 3rd parties. This is specially the case for the Linked Data system.

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Players

Key partnership:

Fomento San Sebastian (project partner), San Sebastian City Council (project partner), EUROHELP (project partner), DonostiaTIK (third party)

Beneficiaries:

Citizens, services operators.

Supporting Stakeholders:

Public Services operators, ICT sector.

Market analysis: enablers and obstacles

Legal framework:

There two main regulations related to Linked Open Data in the Spanish context:

- "Norma Técnica de Interoperabilidad de Reutilización de recursos de la información" (BOE-A-2013-2380). It defines the URIs and compulsory metadata (DCAT based schema) for resources published by official institutions.
- "Ciudades Inteligentes. Datos Abiertos (Open Data)." (UNE 178301:2015). It defines the technical requirements for the Open data provided by an intelligent city. It provides a scale to assess the compliancy level of a given city.

Incentives:

Not many Linked Data solutions' providers were (and are) on the market, so the experience achieved with the Replicate project elevated significantly Eurohelp's position, allowing the company to compete in public tenders against organizations far from the type of company that is Eurohelp: universities, technology and innovation centres, etc.

Human factor (success factors, opposed sentiments, …):

Citizens perceive the improvements due to Linked Open Data publication in a long-term, indirect way. An information campaign on the advantages of Linked Open Data, by DonostiaTIK, would be helpful.

Competitors:

Linked Open data technology offering is growing, and there are some companies that offer services analogous to Eurohelp. Most notably, GNOSS has been contracted by the Government of Aragon to build a full Linked Open Data solution for the Aragon Open Data portal, similar to the Linked Open Data solution built by Eurohelp. Eurohelp itself has designed, developed and deployed the Linked Data Platform for the Basque Government.

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Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Better planning and decision making	The availability of Linked Open Data increases the ability of the city managers to assess the state of the city through, and build more sophisticated analysis tools
Citizens' participation and support	Transparency increases
Economic Impacts	A more efficient management of public systems and facilities means a reduction in management costs.

Management model

Economic costs and revenues:

The development of the Linked Data platform deployed in the ICT infrastructure of DonostiaTIK (municipality of San Sebastian) allowed Eurohelp to compete in public tenders on a field (Linked Data) reserved until then to technology and innovation centres and universities.

Thanks to the experience acquired in Replicate, Eurohelp was awarded the design, development and implementation of the Linked Data platform for the Basque Government, placing Eurohelp as a benchmark in the world Linked Data at the state level.

In the next link, Open Data Euskadi announced the release of the Linked Data capabilities developed by Eurohelp: http://opendata.euskadi.eus/comunidad-open-data/-/2018/open-data-euskadi-estrena-nueva-infraestructura-linked-open-data-con-motivo-de-la-open-gov-week/. This development had an impact of 87.191,58 (VAT included).

The Open Data path in Eurohelp did not end there, we continue in it. In 2018, for example, Eurohelp participated in the Ideas and Applications Contests organised by Open Data Euskadi(http://opendata.euskadi.eus), where the reuse of open datasets of any Open Data portal was demanded.

Eurohelp ended in the 4th place in the Applications Contest with a reutilization of datasets regarding Spanish Civil War events, battles and victims. The application can be accessed in this URL: http://guerracivileuskadi.eurohelp.es. It involved Linked Data capabilities, accessible here: http://guerracivileuskadi.eurohelp.es/playground.html. The source code of the whole solution is publicly available in a GitHub repository: https://github.com/Eurohelp/GuerraCivilEuskadi

In the Ideas Contest, however, Eurohelp ended in the 1st place, getting a 4.000€ price award with the idea 'Adjudication of public tenders'. These contests results can be found here: http://opendata.euskadi.eus/comunidad-open-data/-/2018/open-data-euskadi-estrena-nueva-infraestructura-linked-open-data-con-motivo-de-la-open-gov-week/.

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Management model in use:

Hereafter is reported the scheme proposed for the Open Data Action.

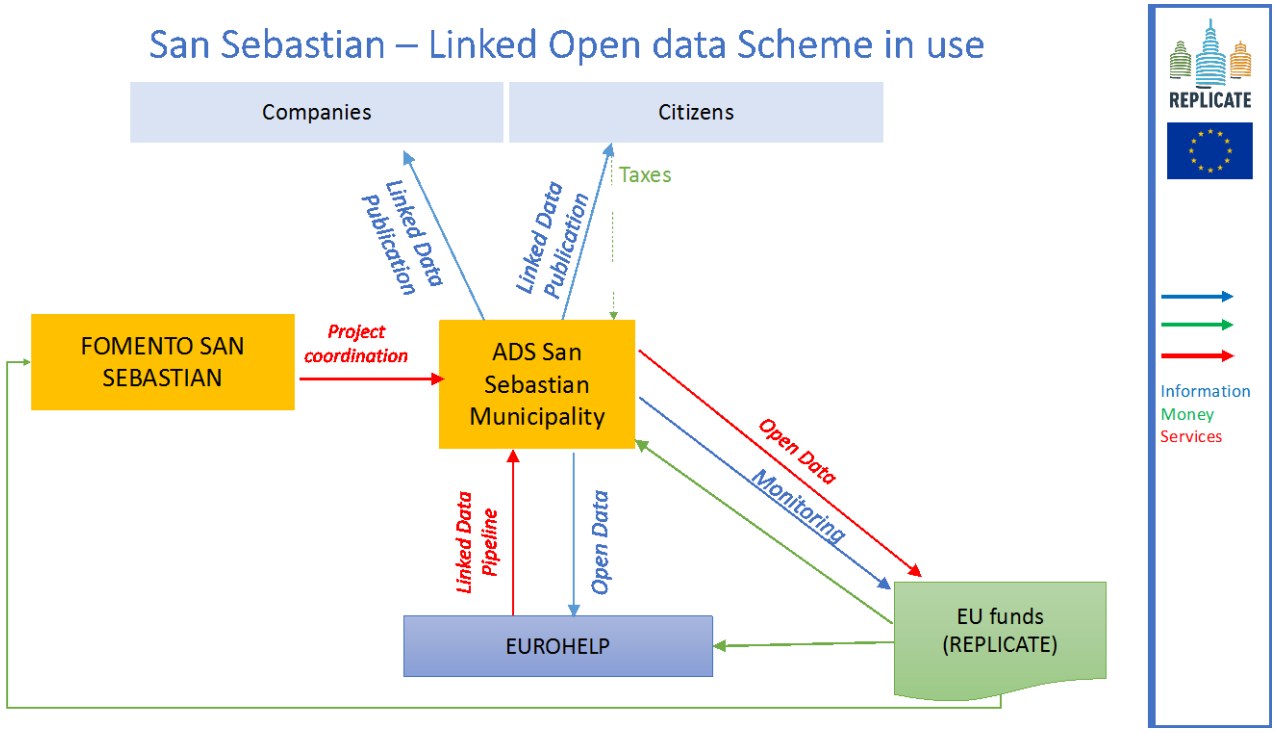

Fig. 10.3 – the open data scheme in use in San Sebastian

10.4 Solution 4: High speed mobile network based on postWIMAX technology

This intervention aims at installing the best in class of current market provider technology based in the Post-Wimax technology in order to deploy a multipurpose backbone network, completely managed by Fomento de San Sebastian that can support several high bandwidth and low latency services like video surveillance, digital voice calls. The difference between the previous wireless technologies and this high-speed mobile network, will be the scope and its bandwidth: It offers transfer rates of 250 Mbps over distances up to 30 km from a base station.

The main features of the network are:

- High bandwidth
- Latency < 7ms
- Easy to deploy
- Complementary with other solutions (WiFi)
- Great performance
- Coverage (Los, nLos and NLos)
- Multi-purpose network

Feature	Post WIMAX	802.16 (WIMAX standard)
Throughput	>= 250Mbps	Up to 140Mbps (4 radios)
Latency	5~ 7 ms	10~40 ms
Channel Bandwidth	40 /20/ 10/ 5 MHz	10 / 7 / 5 / 3.5 / 1.75 MHz
Multi Band	4900 - 5925 MHz	4900-5875MHz
Max users/Sector	238	50
MIMO	MIMO 2x2	SISO
Spectral Efficiency	6bps/Hz	3.5bps/Hz
Remote Management	Web access by HTTP and HTTPS/TLS NMS by SNMP	Web, SSH, XML-RPL, SNMP v1, 2 y 3

Figure 10.4 – Post WIMAX features vs WIMAX standard features

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Sistelec, in collaboration with Fomento San Sebastian, has carried out coverage studies and selected the best sites to implement the postWIMAX technology and also the backbone communications with maximum resilience, interconnecting both using wireless and fibre.

Thanks to the project there will be an improvement of the network coverage, from the 25% deployed currently, to a %75. This will help to increase the capacity of the network and include more quality services around the city.

Value proposition

The main purpose of the project is to provide a future proof backhaul platform that is able to provide several and very different services from the lighthouse cities to the final users such as citizens, small business and other services providers.

The project wants to provide a wide access to both municipality services but also to other project partners in order to get a transparent network through high speed broadband wireless network. So other municipality services and also third party could be deployed, quickly, without incurring new costs and in an easy way. No adaptors are needed except an RJ45 Ethernet standard connectivity. Thus generate a great infrastructure to deploy current and future proof services and projects that will be supported by the Post WiMAX, broadband wireless network.

Players

Key partnership:

Fomento San Sebastian (project coordinator), San Sebastian City Council (project partner), Sistelec (project partner)

Beneficiaries:

City Authorities, operators, economic activities, citizens.

Supporting Stakeholders:

Telecommunication companies, wireless technologies manufacturer

Market analysis: enablers and obstacles

Legal framework:

Below is a list of the main regulations that apply to the high-speed network project:

- EN 301 893 V1.7.1 (5.4 GHz)
- EN 302 502 V1.2.1 (5.8 GHz)
- EN 302 326-2 V1.2.2 (3 Ghz)
- EN 302 326-3 V1.3.1 (3 Ghz)
- CE Marked
- R&TTE Directive 1995/5/EC (health)
- Low Voltage Directive 72/23/EEC

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Technologies used are committed to meeting the requirements of the European Union (EU) Waste Electrical and Electronic Equipment (WEEE) Directive. This Directive requires producers of electrical and electronic equipment to finance the take back, for reuse or recycling, of their products placed on the EU market after August 13, 2005.

Incentives:

None

Human factor (success factors, opposed sentiments, …):

The success factors identified are the following:

- Own municipality network. Thus, allows to complete control of the network facilitating for instance the priority of traffic and some services against others, reduce the dependency from a network operator, and in the unlikely event that something goes wrong within the city, there is always the possibility to control (reconfigure or reuse services) or to add new deploys in a very short time.
- Services in places without any other way of communication. Sometimes because the orography or because it is very complicated to install a wired connection.
- Quick deployment of new services.
- Really easy to integrate service within the municipality network.

A complete re-engineering process was required to design the new sites and coverage and evolve the current network to provide the backbone connectivity and coverage to provide Urumea district with a broadband transparent wireless network.

Competitors:

The main competitors are other companies RADWIN, PROXIM, ZTE (LTE), Huawei (LTE)

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Monetary savings	The high-speed mobile network, applied in all the Smart City related area (Smart lighting, mobility platform, etc), increases synergies and efficiency which means reduced costs, thanks also to the robust wireless protocols of safety included in the technology.
Social inclusion	The High-Speed network installed in the district of TXOMIN/URUMEA will increase network capacity and security, supporting the connectivity of the district with the entire city of San Sebastián.
Economic impacts	Businesses with special connectivity needs can be launched successfully in those area where before fast connection network couldn't be installed.

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Management model

Economic costs and revenues:

The Project budget is around 400.000€ co-funded by the EU as part of the replicate project including design, exchange, implementation and management activities as well.

Revenues: The costs of new connections will be payback in terms of months as there is no need to undertake civil works to provide a wired mean of communication. In addition, there is an annual saving for the administration as they own the infrastructure and there is no need to pay a monthly fee to an Internet Service Provider.

Management model scheme in use:

The management model adopted is a public-private collaboration in which Fomento de San Sebastián is the owner of the network, while Sistelec is the company that has been in charge of its deployment, monitoring and maintenance.

The public property allows a complete control of the network facilitating for instance the priority of traffic and some services against others, reduce the dependency from a network operator, and in the unlikely event that something goes wrong within the city, there is always the possibility to control (reconfigure or reuse services) or to add new deploys in a very short time.

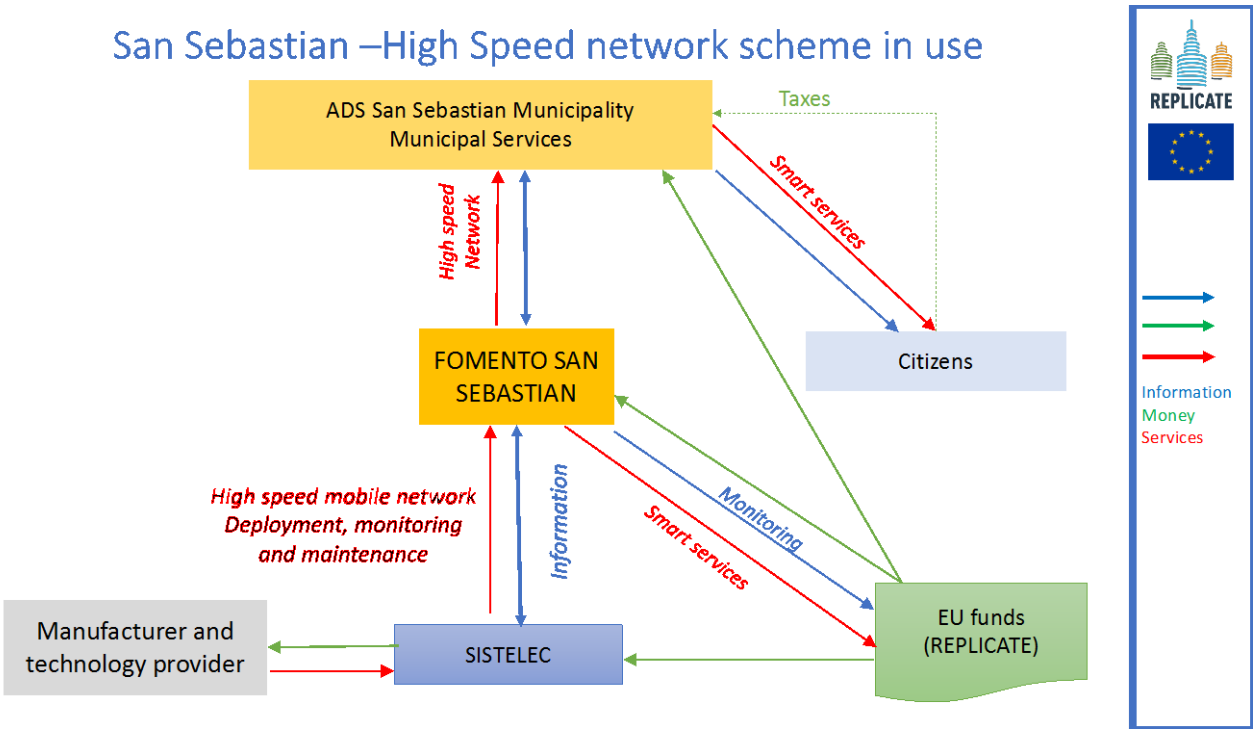

Figure 10.5 – model in use for the high-speed network (postWIMAX) in San Sebastian

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10.5 Solution 5: IoT

The aim of the activity is to test in the urban environment of Florence some IoT solutions connected with the city platform by the ONE M2M system developed by Telecom.

Three different kind of solutions are foreseen in the project to explore a wide range of implementations:

1. A smart bench collecting data from the environment and offering services to the city users. The Smart bench provides the following functionalities: Hotspot Wi-Fi, Captive Portal for interacting with the smart bench, Environmental sensors, Audio Station, Bluetooth connection, Automatic and configurable external lighting, USB re-charging, Administration and management portal for remote management and configuration of the smart bench (from the Internet and from the WIFI local connection).
2. A smart watering system for parks and gardens to reduce the use of water and energy (water on demand, when it is needed)
3. A smart waste system with intelligent bins which could be able to optimise the waste collection and consequently the costs and the service for citizens. The Smart Waste service provides the real time measurements of filling level of the Waste Bins. The Waste Bins tested were located in the Santa Maria Novella area of Firenze.

The first IoT Smart bench has been installed in Firenze, Museo del Novecento, in May 2017 while the other smart benches are in the Cascine Park area.

The Smart Bins and Smart Waste services have been deployed directly by the Waste Utility and integrated with Firenze ONE M2M Platform by TIM.

The ONE M2M Platform instance for Firenze has been delivered for testing of the I/F with the smart city control centre. The ONE M2M standard Platform is based on Ocean Open Source Platform and provides all the functionality specified by the standard. Ocean has been chosen by TIM after a benchmark of the available Open Source solutions.

Data coming from the devices are stored in the Platform and are exposed through open and standard APIs to the Smart City Control Room.

Where applicable, upcoming standard technologies for IoT solutions will be analysed and then possibly evaluated in the implementation, such as LoraWan for sensor-to-gateway communications. The Municipality has analysed the different attitudes and operational capabilities by OneM2M and LoraWan, also in connection with FiWare Generic Enablers such as Orion Context Broker.

Value proposition

The main purpose is the integration of IoT Data coming from the IoT devices into the Smart City Control Room to optimize the management of the waste collection and watering services, to provide citizens with info and alerts and to gather data about behaviours and environment.

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Players

Key partnership:

Municipality of Florence (project partner): Telecom (project partner), UNIFI (project partner)

Beneficiaries:

ALIA (waste service manager), citizens

Supporting Stakeholders:

MUSE (museums management company)

Market analysis: enablers and obstacles

Legal framework:

The supporting planning tool at local level is the Smart City Plan which foresees a wide use of ICT within the city connected to the Smart City Control Room, the municipal platform for the city smart management. The implementation of Florence Digital Manifesto implies the data exchange with the service managers (like waste, water,…). In general, the most important restrictions that affect such measures belong to the heritage and landscape regulation and the data/privacy management.

A relevant issue with IoT is related to the wireless frequencies licensing schemes. While OneM2M platform does not require specific approval processes, some IoT technologies require specific authorisation processes from the Central Authorities, and this has been taken into account within the municipal analysis of the different available options.

From the architectural point of view, the approach followed is very agnostic with respect to a single technology and modular in the envisaged framework. This will allow to add/remove single sub-systems according to technological, law or market state of the art.

Incentives:

There are no specific supporting schemes for IoT, but both the devices and the platform development could be supported by different national programs for cities (metropolitan cities program, suburbs program,…).

Human factor (success factors, opposed sentiments, …):

Due to the fact that citizens are not used to this kind of innovative devices it is important they provide to them useful services. For example, the smart bench could be used by young people to navigate in the Internet and to meet and listen to music together. The usage of the smart bench shall be very immediate and user friendly.

It is important to start promoting the concept that typical un-animated city object can now be exploited – on one side – by the Administration to provide new, more effective, and useful service, and on the other side by citizens to "play", interact and learn new types of digital channels to receive useful info from the City.

Competitors

There are not many competitors on the market, but the evolution is very fast in this field.

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Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Smart waste	Smart Waste service will: • decrease costs for Waste Bin Management • increase efficiency of the service reducing the unsorted waste production and the travel of trucks for emptying the Bins. • Person/Hours reduction obtained by optimizing the truck routes sending truck only when the Waste Bin is really full. Reduction of Waste scattered on the floor when the Waste Bins are full. • Decrease of CO2 emissions close to optimized truck routes (on demand/when it is needed and not fixes times)
Smart watering	Water saving, energy saving, dissemination among citizens of best practices for smarter usage of natural resources
Smart benches	• Data gathering • Enhancing municipal communication with citizens and social aggregation • Increasing safeness

Management model

Economic costs and revenues:

Public/Private financing Smart bench per unit cost = 6000 Euro.

Smart Waste Bin sensors per unit cost estimation = 500 Euro

Smart bench Opex (Per Unit Maintenance = 600 Euro per year, Connectivity Costs depends on the traffic).

Smart Waste Opex (Per Unit maintenance = 20 Euro per year, connectivity per unit cost per year = 12 Euro)

Management model in use:

Hereafter is reported the scheme in use in Florence for the IoT action: the municipality is the project promoter and the final user for the Smart watering service

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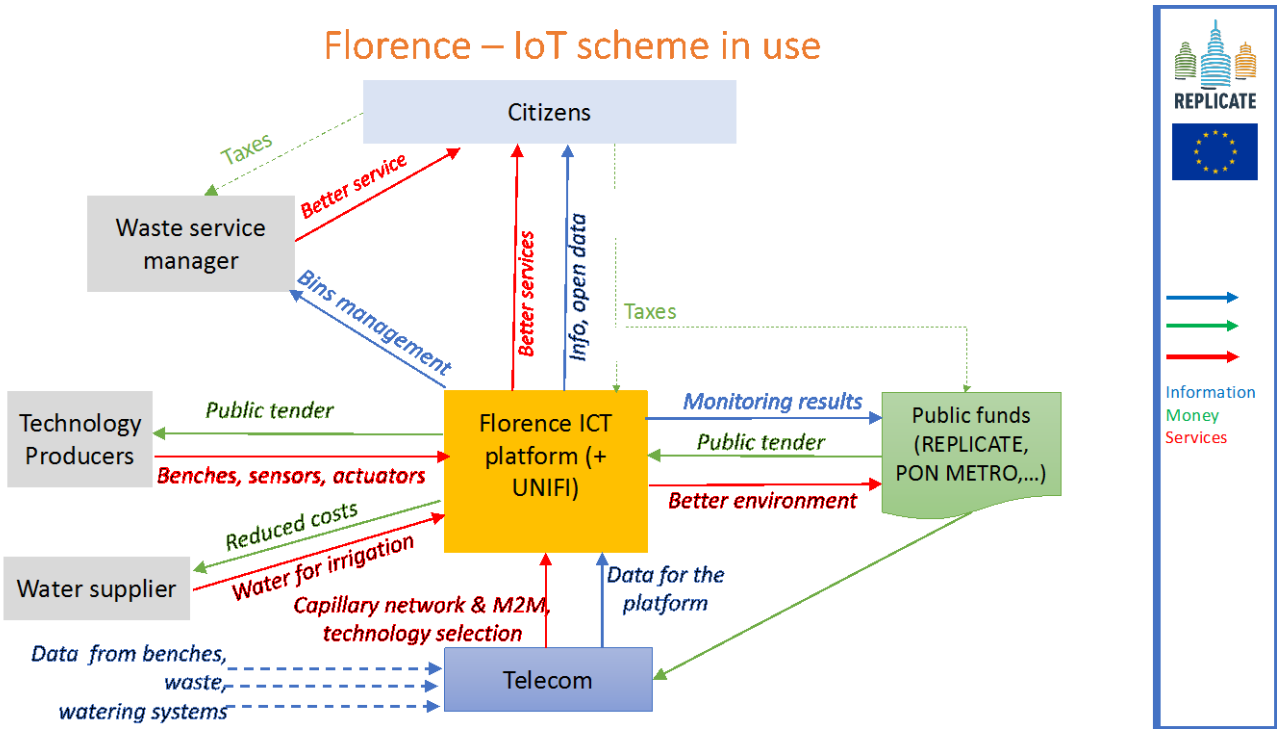

Figure 10.6 – model in use for IoT implementation in Florence

10.6 Solution 6: Smart City Control Room

Replicate is providing the city of Florence with an ICT platform on which its Smart City Control Room is built upon. The main functions of the platform are:

- Collecting data about the territory and the related services from available sources (with specific agreements)
- Integrating new infrastructures in the database (IoT, e-mobility, …)
- Storing and processing the data collected
- Analysing some data set (benchmarking, warning alerts, trends…)
- Visualising the data in tailored dashboards for the different city users
- Enhancing data transferability (thematic platforms, open sets, APP developers…)

The ICT Platform developed, listed on Fi-Ware official web site, includes all the following Open Source Components:

- Km4City Ingestion Processes based on ETL and DISCES tool.
- Km4City ServiceMap.
- IOT FiWare Orion Broker.
- IOT Applications.
- Dashboard Builder.

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A specific focus has been made about the security of the platform thanks to the expertise of the consortium partners. Two Apps have been developed linked to platform data.

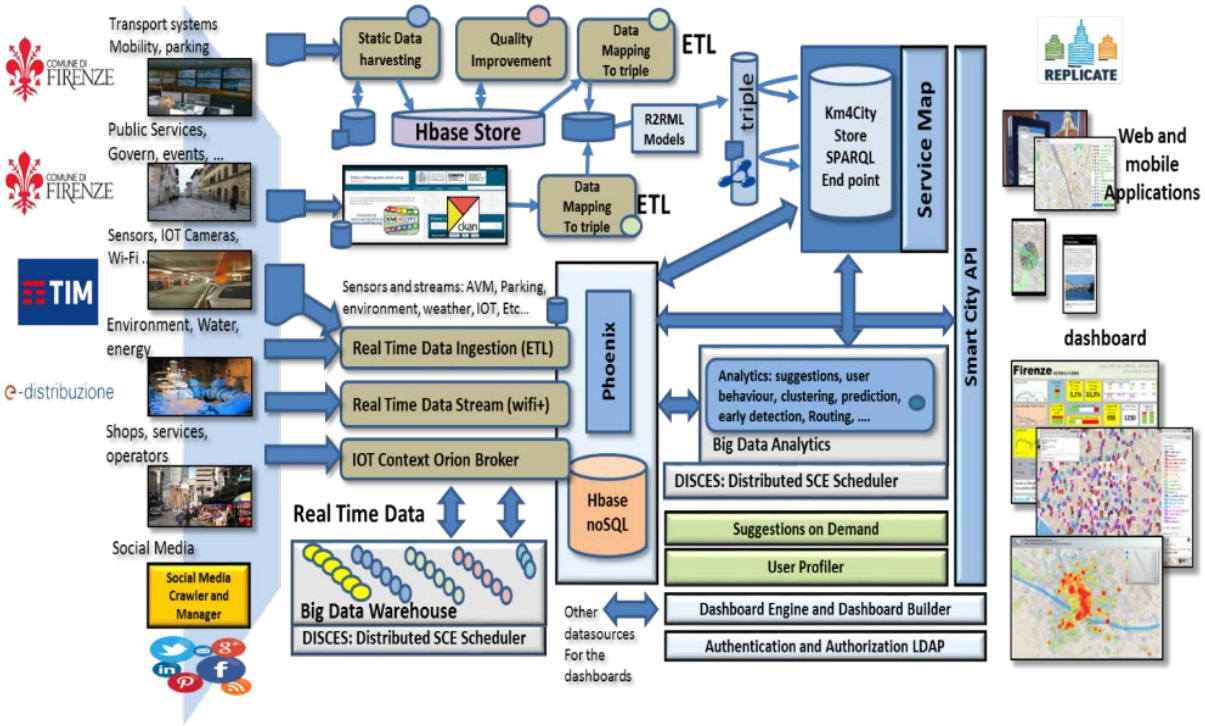

Figure 10.7 – Florence data aggregation architecture developed by UNIFI.

Value proposition

The main target of a city platform is to support the city management and the citizens' quality of life collecting, processing and providing data. The Florence specific solution has been realized to allow integrating a large number of heterogenous data, static and real time, obtained in Push and Pull, provided via multiple protocols and different format and standards, from files, streams and IOT protocols as well. The market solutions are not adequate to cope with the above described complexity.

The security issue has been targeted as well as the privacy to optimise the customization of the Florence ICT platform technology.

Players

Key partnership:

The development has been performed autonomously by DISIT Lab in close connection with the municipality of Florence with the support of Silfi and Thales.

Beneficiaries:

The main beneficiary is the city of Florence which is building its Smart City Control room upon the Replicate platform. The whole set of tools, those developed in REPLICATE and those reused are

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licensed in Open Source (except for the Twitter Vigilance tool as declared above and in the past reports). Most of them as Affero GPL.

Supporting Stakeholders:

All the data gathering procedures needed for acquiring data have been developed by UNIFI DISIT Lab by using ETL modules and tools, in close cooperation with data and cloud providers like Telecom Italia, E-distribuzione, Comune di Firenze and its services managers (Silfi, Casa Spa, traffic supervisor system, Parking managers, etc).

Market analysis: enablers and obstacles

Legal framework:

Within the framework of the European Digital Agenda, Italy has developed its own national strategy, identifying priorities and methods of intervention, as well as actions to be carried out and measured on the basis of specific indicators

The European Parliament and Council in the Directive 2003/98/EC approved on the 17/11/2003, enhanced the re-use of public sector information. The EU General Data Protection Regulation (GDPR), updating the Data Protection Directive 95/46/EC, has been adopted in 2016 to harmonise data privacy laws across Europe; it entered in force finally all over Europe on the 25th of May 2018 (https://ec.europa.eu/commission/priorities/justice-and-fundamental-rights/data-protection/2018-reform-eu-data-protection-rules_en)

The whole smart city platform is open source, thus removing the problems of vendor lock-in and it is compliant with many national and European directives of the Public Administrations stating that the software for public application should be open source.

Among the international standards about ICT, it must be reported the DIN SPEC 91357 – Reference Architecture Model "Open Urban Platform" (OUP).

Incentives:

Above the H2020 SCC and ICT framework, there are several EU and national programs supporting the development of city platforms (UIA, PON METRO, …). In case of the single services/data sources, the chances of finding a supporting program are generally high depend on the specific theme (public lighting, E-mobility infrastructure, district heating systems, IoT solutions, mobility, …)

Human factor (success factors, opposed sentiments ,…):

It is necessary to provide tailored dashboards for different user roles and a specific training. The dashboards developed with the solution realized are very user friendly and graphically appreciated. A relevant amount of work is foreseen in the project to improve some aspects, but the results will be very attractive and easy to use.

Competitors:

Ultimately, no single platform will be able to offer all features for all verticals in a smart city environment characterized by a "platform of platforms" approach, with open, interoperable

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platforms interacting with and complementing each other in a "system of systems" constellation and open ecosystem ('next-generation smart city IoT platforms' ABI Research, March 2018)

There are many competitors among the industries such as the solutions of IBM, HP, CISCO, Siemens,... but they are almost focussed on creating a specific solution for very large cities and propose largely proprietary solutions. On the contrary, the solution produced is totally open source, and thus can be installed on premise at zero licensing costs and may be adopted on cloud as a service as well. Among the open source platforms for smart city: Indra, Fiwoo, Bosonit, etc. We think that our solution is the most powerful for realizing a control room since it allows to: (i) gather any kind of data type via ingestion processes; (ii) render on graphics a large set of high level types (KPI, POI, external services, sensors, actuators, selectors, tvcam, weather forecast, triage, DSS, heatmaps, microapplications, etc.); (iii) fully integrate multiple IOT protocols and networks; (iv) support GDPR in managing personal data; (v) support private chat rooms for each dashboard; (vi) create full interactive applications with drill down on time, space and relationships of city entities and their data.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Social	Improved data accessibility and transparency
	Facilitating Citizen Engagement
	Encouraging digital entrepreneurship
	Improving citizens' quality of life (less time for travelling, better air quality, lower fees for services or improved services, security,…)
Environmental	Consumption savings due to mobility, buildings, services sectors
Financial	City management could be improved also during critical events

Management model

Economic costs and revenues:

According to our state of the art and market analyses, the market of smart city does not present a 100% open source solution providing the features of the solution proposed. In addition, the solution is grounded on Km4City sematic approach for data ingestion and reconciliation which is strongly innovative, providing semantic search, smart city API and MicroServices for IOT Apps, and thus a perfect platform for developing web and mobile Apps. The UNIFI DISIT Lab has invested time and money in the development of the whole system, and they intend to recover the investment with consultancy, developing extension, training, installations, etc. Moreover, the solution realized can be also proposed as Smart City as a Service for those that do not like to invest time and money in installing the solution on their premise.

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From the city point of view in the case of Florence, the Smart city control room under development is financed by different sources:

- SCC1 REPLICATE supporting the work of UNIFI, the municipality and other involved partners (SILFI, Casa Spa, Telecom Italia, E-distribuzione, Thales, Mathema,…)
- PON METRO, Conto termico 2.0, PNIRE, …, national programs
- Regional incentives about mobility

The market value of such a system has been assessed by the municipality around 800.000€

Management model:

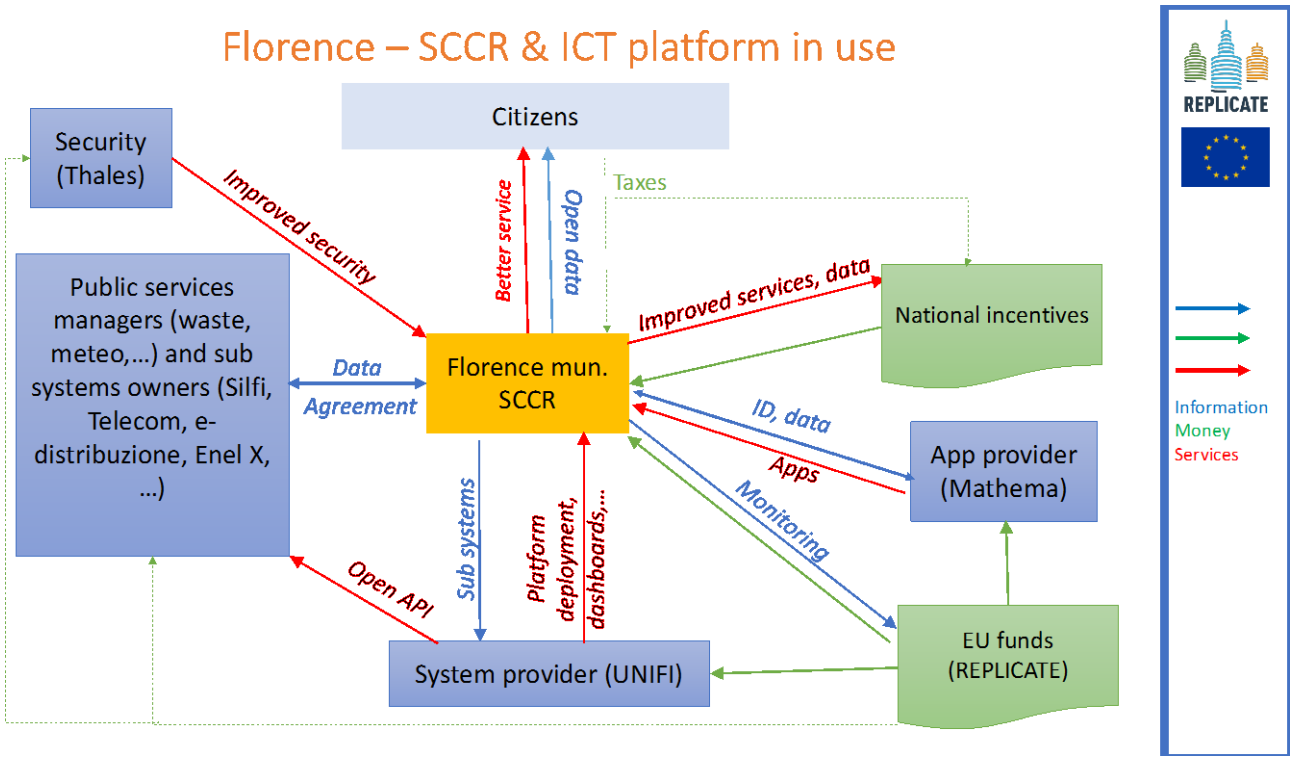

Figure 10.8 – model in use for the Smart City Control Room in Florence

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10.7 First scale up SWOT & USP analysis

The SWOT analysis:

Solution 1: Smart Mobility Platform	
USP: A huge amount of data and information displayed in a simplified, neat and simple manner.	
Strengths	Weaknesses
• Several connectors with the main sources of mobility data of San Sebastian have been developed (cycling mobility, parking, public transport, etc.). • Comprehensive webtool • Web layout following accessibility standards, adapted to all types of devices, well focused information architecture, clear and concise content, etc. • Algorithm trained allows the prediction of the demand with values close to an accuracy of 75%.	• transport sensors are outsourced • Trend data prediction • Data analysis
Opportunities	Threats
• ICT supporting infrastructure (sensors and operational systems of the city)	• Sensors reliability • costs

Solution 2: Use of Big Data for mobility services	
USP: Gather information about citizens' mobility habits in a no-intrusive way, with no additional infrastructures needed, in order to design the best mobility measures improving environmental sustainability and the urban life quality	
Strengths	Weaknesses
• large coverage of Euskaltel in the pilot geographical scope • Use of CDR data • Data is captured through a non-intrusive way • There is no active participation of citizens	Aspects to be improved: • Lack of coordination in the information exploitation activities

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• The data collected are not subject to subjective interpretations • Euskaltel already maintains the network in order to guarantee the service provided to end customers, so there is no need of additional maintenance of the solution.	
Opportunities	Threats
• Telecommunication infrastructures installed in the city	• Security issues • GDPR compliance • Agreements for data exchange

Solution 3: Open data	
USP: Greater Transparency and therefore citizens support for Smart Cities development because citizenship can easily access open data, remain informed in real time, and assess the city council activity.	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Selected datasets are made public and accessible for anyone and anything (agents, machines). • Published data becomes linked to other International Linked Data resources, augmenting the serendipitous discoverability of the published data. • Transparency	• Staff with no experience on those domains will have difficulties adapting to the new paradigm. • The main advantage of a Linked Open Data solution can only be perceived in a very long term (5 to 10 years).
Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• All the tools and pipelines produced by Eurohelp are Open Source and available in GitHub, contributing to the community.	• Data security

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Solution 4: High speed network (postWIMAX)	
USP: Provide a wide access a transparent network through high speed broadband wireless network to municipality services and third party without incurring new costs and in an easy way	
Strengths	Weaknesses
• Public property • Centralised management • Easy to manage, through web interfaces and through standard SNMP that facilities the integration between systems. • Deployment reduction costs compared with wired networks. • Easy interconnection with final services.	Aspects to be improved: • A complete re-engineering process was required to design the new sites and coverage.
Opportunities	Threats
• Other municipality services based on the HS network can be deployed, quickly, without incurring new costs and in an easy way.	• Urban topology • Great operators' coverage can make it very difficult to deploy new coverage • Number of subscribers needed • wireless base technology used evolution

Solution 5: IoT	
USP: with IoT devices the city itself is becoming more and more efficient and near to citizens who can now easily approach innovation in their everyday life	
Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• Platform availability • Interest in data collection	Some aspects to be improved: • external services managers formal involvement and commitment (Florence digital manifesto implementation) • Contents updating for the benches to be catchy for the public

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Opportunities (External: influencers and framework)	Threats (External: influencers and framework)
• People high digitalisation level • Tourism • Sustainability commitments (energy and water savings) • Other financing schemes related to innovation in urban context	• Sensors reliability • costs • vandalism • consolidated standards in IoT implementations

Solution 6: Smart City Control Room and ICT Platform

USP: The Smart City Control Room has a unique multi-level governance model (Firenze Digitale) which is paving the way for a successful collaboration among utilities, public bodies, private sector and the Municipality (win-win solution). The whole smart city platform is open source, thus removing the problems of vendor lock-in

Strengths (Internal: actions and infrastructures)	Weaknesses (Internal: actions and infrastructures)
• UNIFI know how and open tools • Governance model and Digital manifesto signed by major players (service providers) • Existing sectorial platforms (traffic supervisor) and ICT infrastructures • Existing Open data Library • ICT department • Smart city framework (SC Plan) and related targets	Some aspects to be improved: • Data transferability and graphical visualization tailored on each user • Training of dedicated personnel • Involvement of all the possible data providers • ICT focus in daily activities (tendering procedures, design, ...) of all the sectors
Opportunities (External: influencers and framework)	**Threats (External: influencers and framework)**
• Supporting programs (PON METRO, EU programs...) for the Smart City Control Room creation • Innovative technologies providers links (E-distribuzione/Enel X, Telecom, Thales…)	• Security issues • GDPR compliance • Agreements for data exchange • Technology fast development

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The possible scheme for replication:

The Smart Mobility platform, solution 1, has been designed as a highly replicable solution. The data models created for vertical are applicable in other cities and with the integration of the corresponding data provider systems, an instance could be configured for each city. In this context, the horizontal scalability of the platform allows starting the deployment with a certain number of compute nodes and scale up according to the needs that may arise.

Also, is important to note that platform can be easily scaled adding other data sources not directly related to mobility but to other management areas for the municipality. Such as environment, energy, water, etc. In this way, it can provide services to other municipal departments in addition to mobility area. It can be also replicated in other municipalities with similar assets and needs.

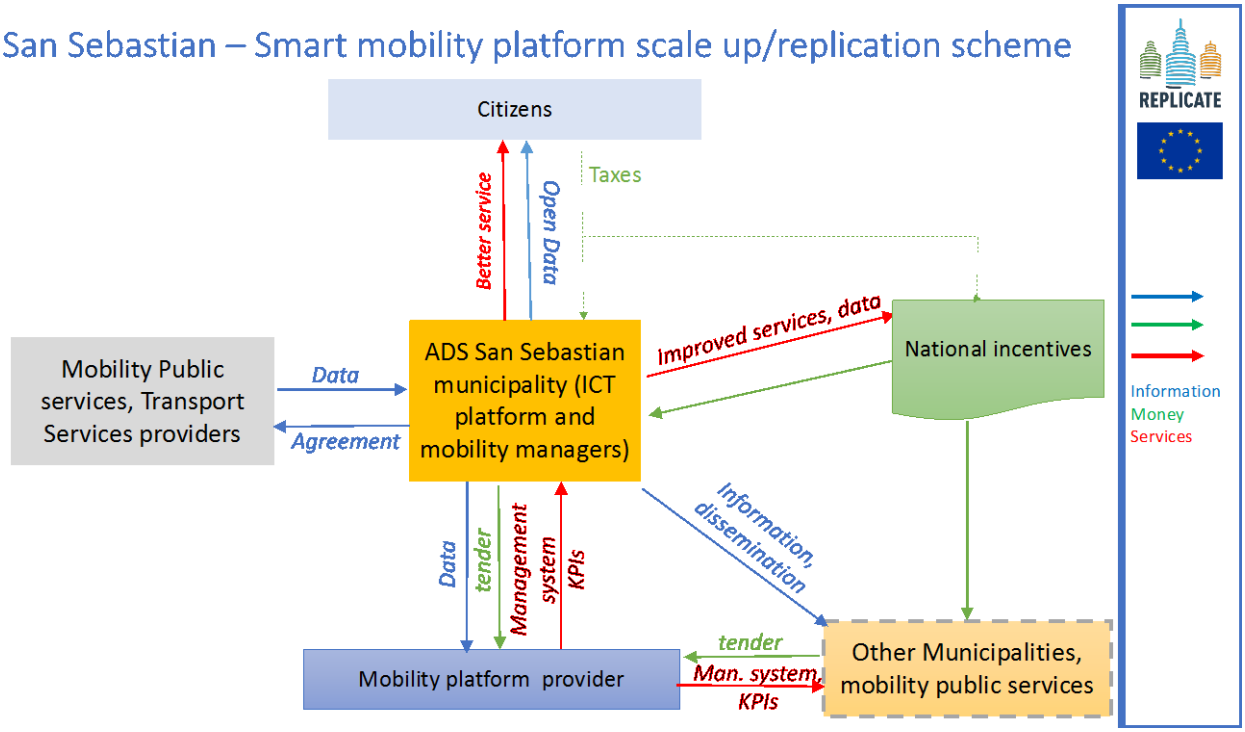

Figure 10.9 – the possible future model for the Smart Mobility Platform

In case of solution 2, Big Data, the deployed infrastructure and algorithms will be able to manage, from the ingestion, calculation and aggregated information provision of a more extensive region or higher temporal interval of analysis.

The availability of data extracted from telecommunication operation logs about the mobility of people in the city, both vehicles and pedestrians, could minimize the development and installation of additional infrastructures in the cities for mobility management. Specific, mobility analytics algorithms applied to this data can provide very exact information about mobility heat points, origin-destiny matrix, etc. As result, an efficient business model can be created, where the cities can save money in deployment and management of infrastructures, and network operators can monetize the data of the network.

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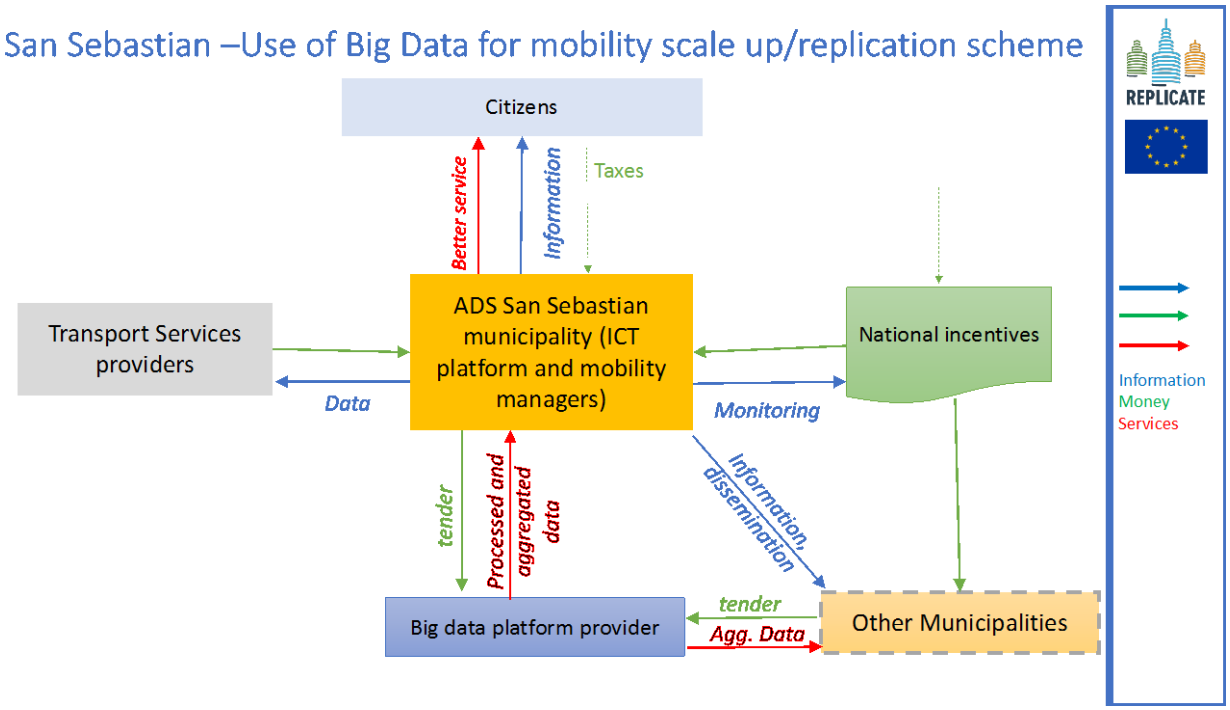

Figure 10.10 – the possible future model for Big Data use

Regarding solution 3 – open data, any scale is possible, given that the appropriate computational resources are assigned. It is important to notice that Amazon has released Neptune, a fully managed graph database service for RDF, SPARQL, Property Graphs and Gremlin, offering a very scalable, easy to use solution for implementing Linked Open Data systems backed by High Availability Triple Stores.

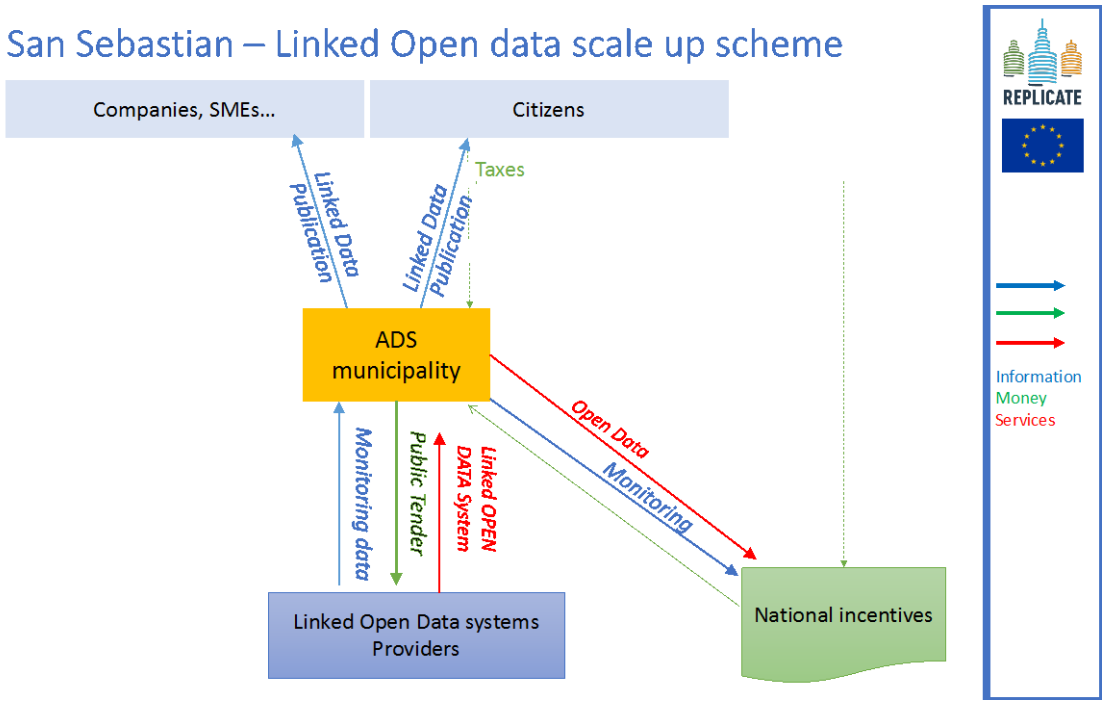

Figure 10.11 – the possible future model for Open Data extension in San Sebastian

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The high-speed network based on postWIMAX technology implemented by Sistelec could be scaled up with the same scheme, except for funding sources.

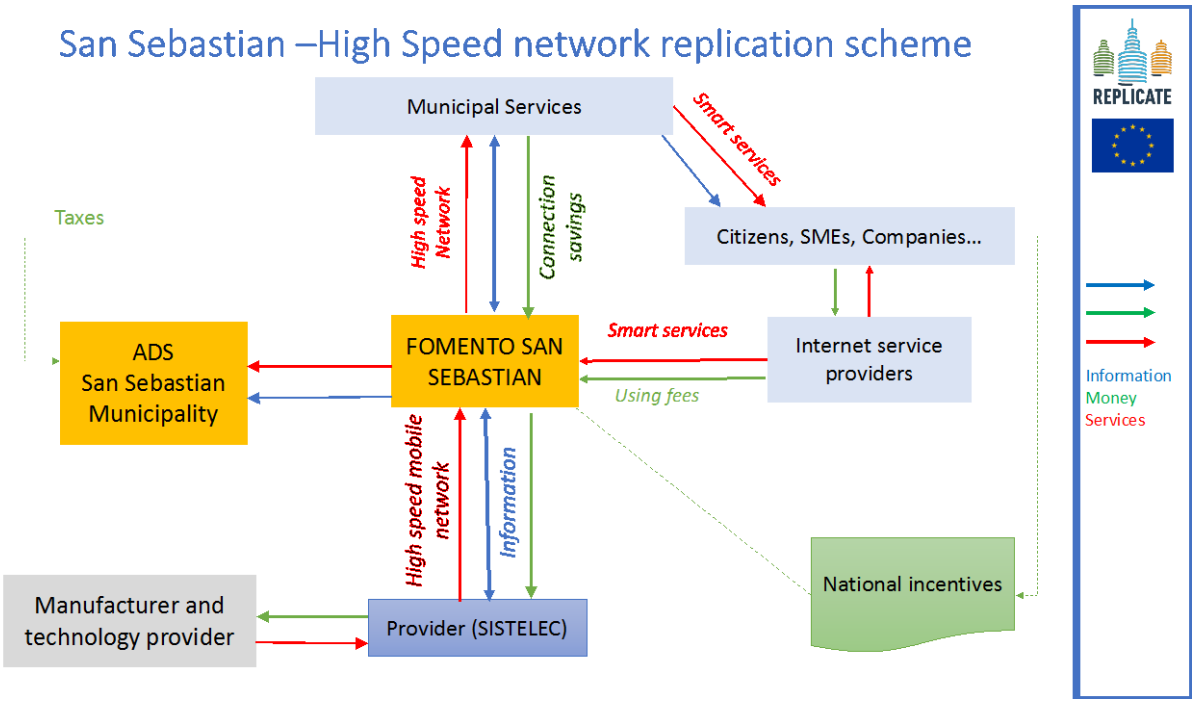

Figure 10.12 – the possible future model for high speed network (postWIMAX) in San Sebastian

For the IoT implementation, in the replication phase the smart devices will be required to dialog directly with the Smart City Control Room through the open API developed.

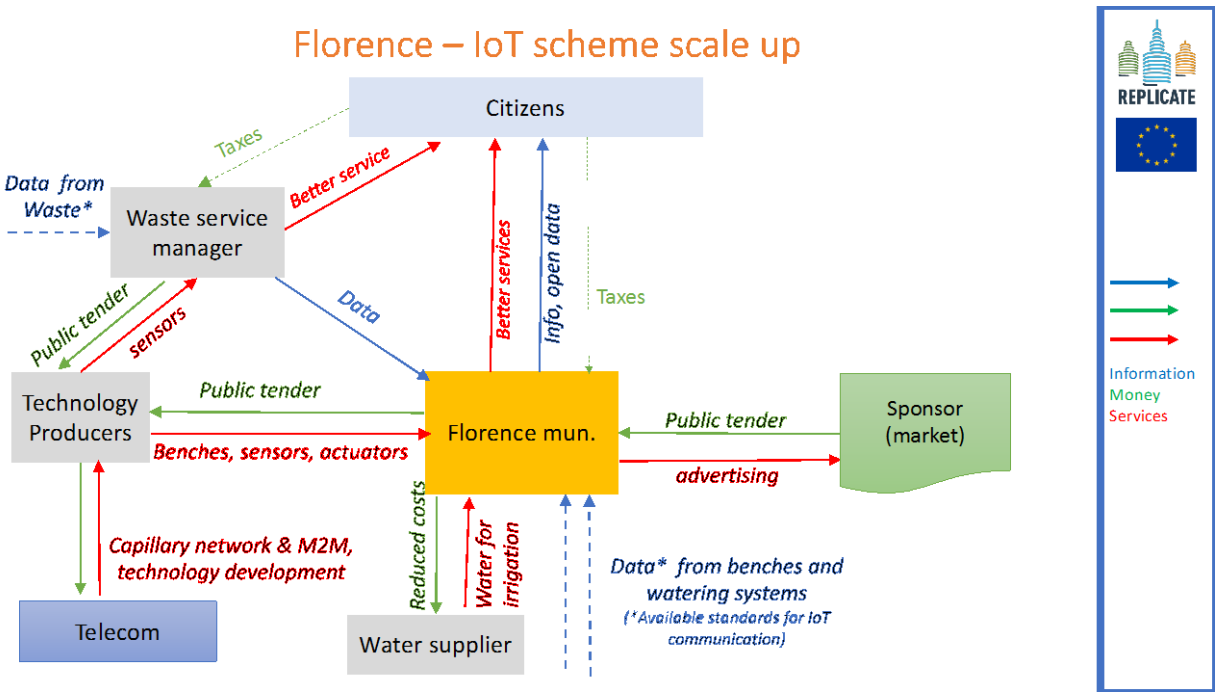

Figure 10.13 – the possible future model for ioT

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In case of scale up to other services within the municipal territory, the extension of the Smart City Control Room described in solution 6 will be done with the support of Silfi (in house Company) who has been appointed to host the SCCR. Since Silfi has been recently joined with "Linea Comune", a public Company providing ICT services to all the municipalities in the Florentine area, the platform is going to be easily extended to the neighbourhoods. An external technical support will be necessary as the presence of valid agreements for data exchange with external sources.

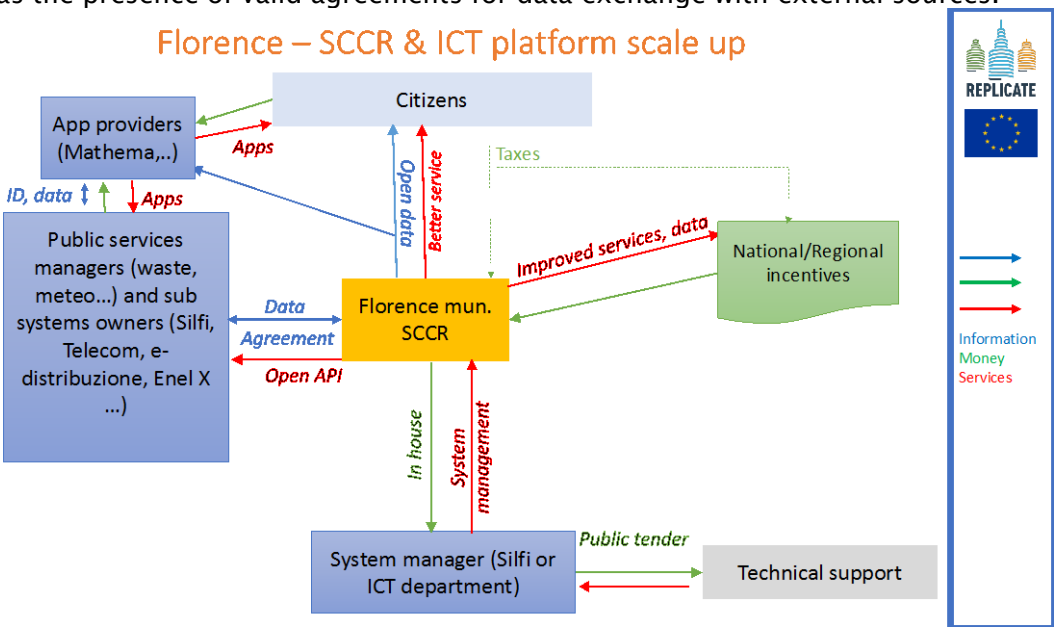

Figure 10.14 – the possible future model for SCCR extension in Florence

For a wider replication at metropolitan/regional level for example, the experience of Florence can be a reference both from the technical point of view (open assets available) as from the approach (governance and Digital manifesto).

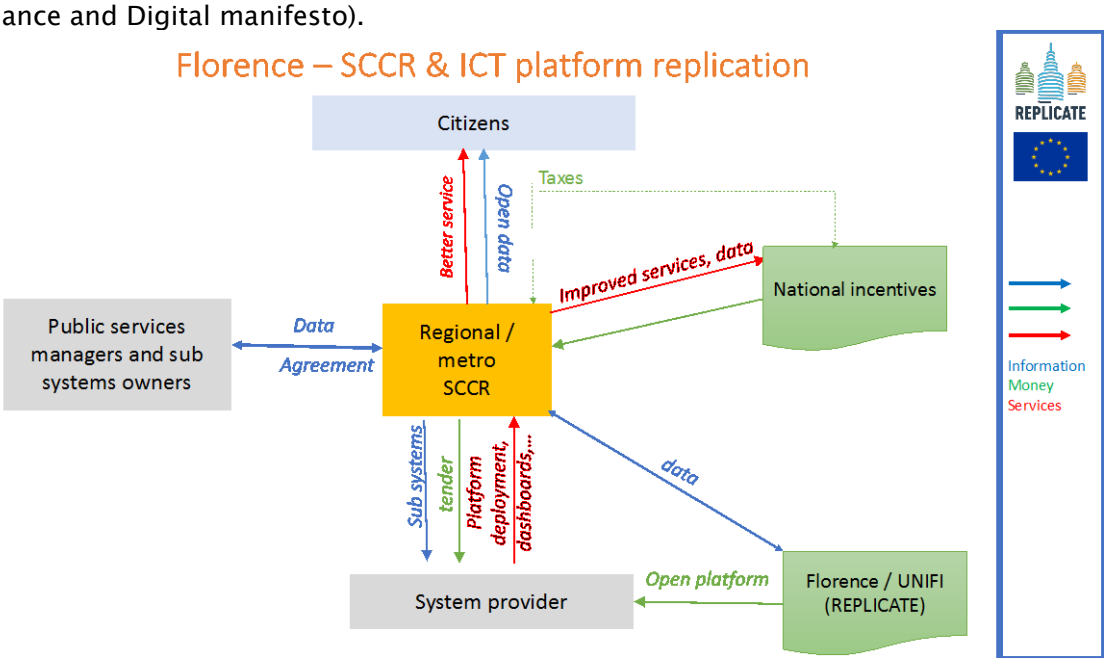

Figure 10.15 – another possible future model for SCCR extension in Florence

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11. Citizens engagement

11.1 Solution 1: Citizen participation platform

This action includes the analysis, design and creation of a citizen participation platform that will allow improving the management of the participation processes in San Sebastian.

The platform includes an internal private web to manage the overall project, open a project, include participants, upload information, define target citizens, define schedule and participation format. The platform also includes an open section that citizens can visualize, and where they can get information about a project and participate actively. The project responsible will define whether all the participation moments are open to all the citizens or are restricted to a specific group. All the results of participation can be also managed through the web, allowing decision taking for municipal departments in charge of the process.

Value proposition

The aim of this project is

- fostering citizen participation through new technologies, avoiding face-to-face surveys and voting processes.
- fostering data publication and participation of citizens in decision making
- develop an efficient information management, data sharing and decisional process

Players

Key partnership:

Fomento San Sebastian (project partner), San Sebastian City Council (project partner), EUROHELP (project partner), DonostiaTIK(third party)

Beneficiaries:

Citizens, local companies.

Supporting Stakeholders:

All the San Sebastian municipality's departments

Market analysis: enablers and obstacles

Legal framework

There two main regulations related to Linked Open Data in the Spanish context:

- "Norma Técnica de Interoperabilidad de Reutilización de recursos de la información" (BOE-A-2013-2380). It defines the URIs and compulsory metadata (DCAT based schema) for resources published by official institutions.

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- "Ciudades Inteligentes. Datos Abiertos (Open Data)." (UNE 178301:2015). It defines the technical requirements for the Open data provided by an intelligent city. It provides a scale to assess the compliancy level of a given city.

Incentives

In an era where Open Government is one of the main initiatives in citizen engagement, having a Citizen Participation platform could (and this has been confirmed) place Eurohelp in a good position to achieve public tenders.

human factor (success factors, opposed sentiments ,…)

- Financial support is needed for the co-ordination of citizen engagement programmes.
- Ensuring a clear and user-friendly web structure of the participation platform
- Point out and mapping the issues citizens care about across the city;
- Coordinate the platform with variety of stakeholders.

The obstacle is represented by lack of citizens sensing programme, expertise or interest. Citizen participation through new channels may be difficult to understand and apply for the municipality and difficult to use for some citizens.

Competitors

The main competitor is the open source project Consul: https://github.com/consul/consul this software is used in Decide Madrid citizen participation platform: https://decide.madrid.es/ However, it has some limitations as pointed by local Administrations from the Basque Country. Mainly from the point that citizen participation is left too much open, in the sense that all proposals are originated from the citizenship. Getting an effect contrary to the expected: many more proposals are created but few manage to get enough support, as they are diluted between the incessant number of new complaints and suggestions. The approach demanded by the Basque Administrations was to maintain this initiative from the citizenship, but also to facilitate the discussion of proposals made public by the Administration itself, achieving a greater impact and participation in the proposals and debates launched and, thereby, engaging more actively and effectively to the citizens.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Social inclusion and active citizenship	All the citizens are called to express their opinion on specific issues and assess proposals.
Better planning and decision making	The involvement of the citizenship in the decision-making process increases the likelihood of success in the policy implementation phase
Political stability	The process is based upon shared choices by incorporating the preferences of the interested communities. For this reason, the decisions adopted are more stable and have a greater capacity to face changes that occur over time.

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Management model scheme in use

Economic costs and revenues:

The Citizen Participation Platform developed by Eurohelp within the Replicate Project (available here https://www.donostia.eus/ataria/es/web/partaidetza/informazio-gehiago) has allowed Eurohelp to have a very valuable knowledge (both functional and technical) when it comes to facing Citizen Participation Platform projects. The impact has been so significant that Eurohelp is right now building the Citizen Participation Platforms for the Deputation of Gipuzkoa, the Deputation of Álava-Araba (both provinces of the Basque Country) and the Government of Aragon.

They are not platforms identical to the one developed in the framework of the Replicate project, but they do include common modules, which has allowed Eurohelp to be very competitive when bidding for public tenders. The overall impact of these solutions, all of them made possible thanks to the developments made within the Replicate Project, is more than 180.000€.

Management model:

Hereafter is reported the scheme proposed for the Citizen Platform Action

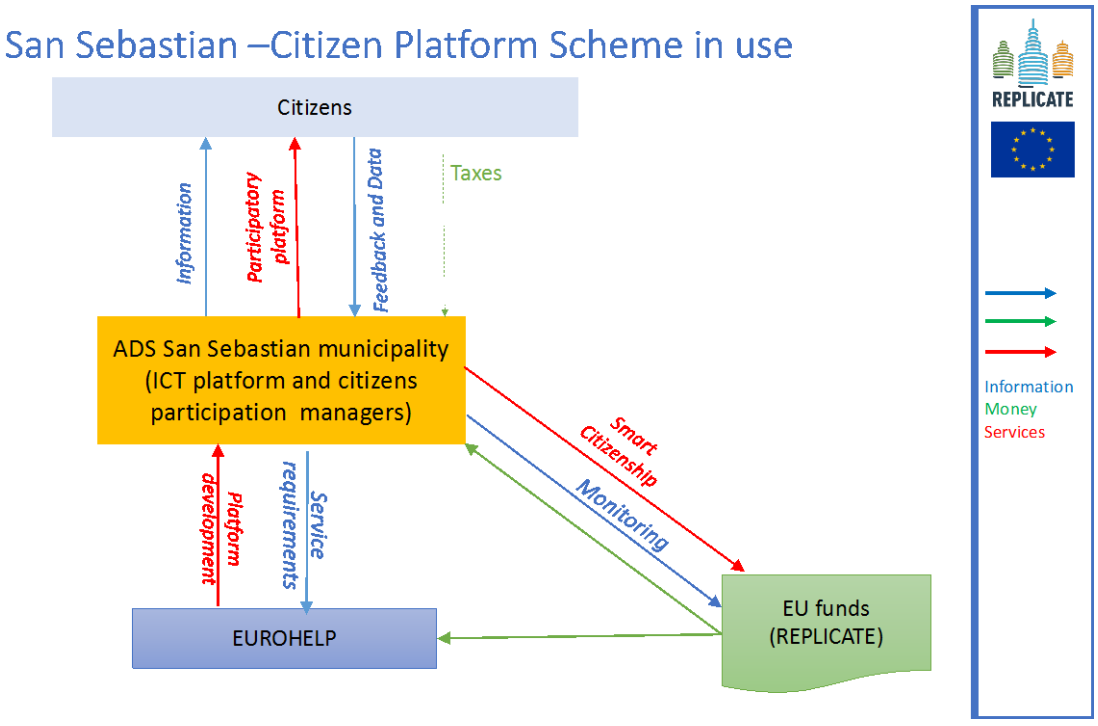

Figure 11.1 – the model in use for the citizens platform in San Sebastian

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11.2 Solution 2: the Bristol approach to citizen sensing

The Bristol Approach to Citizen Sensing is new framework for running inclusive, community-driven digital projects that involve sensor technologies.

Working with Ideas for Change and Bristol City Council, Knowle West Media Centre have developed The Bristol Approach: a way of working that ensures that new 'smart city' technologies address the needs and priorities of the people who will use them, particularly in communities that are in danger of 'being left behind" or excluded.

Figure 11.2 – the city common concept

Using the methods of The Bristol Approach enables technologists, businesses, artists and local people to work together to address relevant community issues using digital tools, creating a 'smart city' with 'smart citizens' at its heart. The overall aim of The Bristol Approach is to enable citizen-generated-data to be used for the common good and at the service of its citizens. The pilot project

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tested how the Bristol Approach Framework works in real communities on real issues and for the learning to inform the design and development of Smart City projects and programmes in Bristol and beyond. The overall aim of The Bristol Approach is to enable citizen-generated-data to be used for the common good and at the service of its citizens.

Year One: Over 45 events and workshops took place with over 717 participants aged 13-80 directly taking part and contributing. Year Two included another 18 community events engaging over 450 people. Workshops and events included neighbourhood events, co-design workshops, data jams, maker days and tech building skills days. All were creative, hands-on, participative, mixed up people with different backgrounds and skills, and together built a commons community to tackle the issues people cared about.

Three sets of prototype citizen sensing tools were devised, designed, deployed and tested through the pilot project:

1- Damp Busters: Frog damp sensors deployed in people's homes in Easton; an on-line citizen reporting tool and map; a Community Damp Busters team.

Figure 11.3 – the frog damp sensor

2- Wastey Food co-created the idea to develop a 'SMART bin', later named 'Food Boy'.
Food Boy was designed to collect household data about:

- The type of food wasted
- The time of day food was wasted
- The amount of food wasted

3- It's Ok; co-created the idea to develop a 'Sensing Booth', later named 'Mo'.
Mo was designed to:

- Sense how people felt about mental health issues
- Sense if people agreed or disagreed that services needed to be diversified

In year Two: the best of the processes was repeated and streamlined; the issue identified and framed through the community engagement network analysis was air quality (and exploring this

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as a motivation to mobility behaviour change). With a core of 8-20 people, depending on which tech solution was created (e.g. depending per home or on street) and has potential to be rolled out to reach hundreds within the area affected by the issue. There were also a series of schools' workshops - with up to 60 additional people involved.

Co design of sensor casings through the facilities at KW will be considered by KWMC; "the Factory": a community access digital manufacturing maker space, as appropriate and as part of exploring acceptance issues related to IOT devices, and the integration of citizen sensors with more 'city sensing" technologies. For example, issues have been raised about the calibration and accuracy of citizen sensors, so we are envisaging opportunities to explore how different sensing technologies (e.g. the Array of Things sensors) might compliment and contribute to greater shared understanding, and 'ownership' of smart city tools.

Value proposition

Tackling the overall problems highlighted in research such as a recent NESTA report which identified seven factors that have prevented Smart City initiatives from delivering real value to the cities where they were deployed:

(i) Not taking human behaviour as seriously as technology;

(ii) Lack of use, generation and sharing of evidence, leading to little evidence of ROI;

(iii) Lack of focus on data skills;

(iv) Lack of integration with other work in cities;

(v) Over reliance on hardware and technology;

(vi) No role for the citizen; and

(vii) Closed and proprietary projects. (Saunders, 2015)

In the pilot project three issues were targeted: food waste, mental health and damp homes. Future themes transpiring from community engagement so far include cycling routes/security skills (railway path especially - links to mobility and e-bikes and possibly smart lampposts), internal traffic congestion, parking, speed, public transport and how it relates to the community using streets and public spaces and getting out (linking to mobility interventions: ParkUs app, and the WeGo), business waste being dumped in streets (links to smell, clean environment and so mobility, scope for using waste oil as energy so links to energy), public waste - issues with litter and recycling (linking to NP and U.O.S and possible use of sensors and arts practice/'fun theory' interests)

Players

Key partnership

Bristol City Council with its Transport Service, Knowle West Media Centre (project partner).

Beneficiaries:

Citizens and technology/service developers.

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Supporting Stakeholders:

Energy Companies (Centre for sustainable energy, Easton energy group), Local community organisations (Talking Money / Shelter), Acorn, local residents with damp & mould in the home, Altitude tech, Creative Youth Network, Off the Record. This list will expand as we develop more citizen sensing projects such as Barton Hill Settlement, Easton Community Centre, Up Our Street, Bristol Older People's Forum, Wellspring, neighbourhood Partnerships. Current work around Air Quality has led to new stakeholders such as ClairCity, local schools in East Bristol, Kidikal mass cycling group and local taxi drivers.

Market analysis: enablers and obstacles

Legal framework:

Supported by legal partner and KWMC trustee: Ed Boal. The Bristol Approach has been trademarked. ODI Bristol supporting on licensing around open data sets and templates for contributor agreements.

Incentives:

The Bristol Approach Trade Marked and agreement template developed for spin off business ventures.

Human factor (success factors, opposed sentiments, …):

Financial support is needed for the co-ordination of citizen-led engagement programmes. A shared understanding of the methodology / framework and guiding principles of the commons is needed to use The Approach. To enable The Approach to be more widely shared and used, there is some essential infrastructure to develop. This includes a set of integrated and open digital tools that enable:

- Mapping the issues emergent communities care about across the city;

- Transparent analysis and diagnosis of issues that are suitable for and amenable to a citizen sensing approach;

- Commons action groups to form, communicate, organise, and make decisions together;

- Mapping and visualising citizen generated data in order to make it meaningful and useful.

These digital tools could be bespoken for The Approach or integrate existing tools.

- Clear governance and open data licensing and infrastructure standards, and the tools/templates to put the standards into practice. This includes contributor agreements for 'citizen producers' and open standards for infrastructure. This could, for example, take the form of a city charter setting out the standards and set of templates and guidelines for citizen sensing projects. - Coordinating digital tools, platforms and networks, communication with variety of stakeholders.

Lack of understanding with some partners of The Approach or buy into the value of the commons. Lack of open, accessible tools that adhere to open standards for communities to follow the Approach, lack of city wide internet connectivity or commons data infrastructure, no current ability

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to store citizen generated data within project partners or data analytics (hopefully BIO/UOB can align), resources for citizen sensing kit and the expertise needed.

Competitors:

A common based approach reframes 'competitors' as potential partners – bringing them into the conversation around solutions and working on ways to distribute, open, and share mutually beneficially market resources and knowledge. We could bring competitors into the discussion around open standards and sharing protocols.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Economic development and skills build up	Engaged a diverse range of citizens in live issues that they care about and enabled citizen-generated-data to be collected and used to create positive change in communities. Skills development and knowledge exchange between and within communities of area, interest and expertise. Learning gained that can inform the design and development of Smart City projects and programmes in Bristol and beyond. Over 700 people engaged, 3 useful prototype tools made, 1 user guide created (v1 and 2), 4+ skills training workshops delivered, 60+ people gained new skills, no. of adopters/users of products developed. The Bristol Approach website was created to encourage further engagement http://www.bristolapproach.org
Social inclusion, active citizenship	Partners better understood citizens motivations for taking part in community action and the range of contributions that different people can make to Smart City initiatives. Creative and participative teams of people with a range of skills and experience, including artists, local residents, technologists, programmers, SMEs etc. brought together. Useful tools built that explore how to integrate new and existing tech and other capabilities to address the issues citizens care about. Opportunities provided for people to learn new skills and try out different technologies and forms of data. Partners learnt more about the logistics of linking citizen initiatives up with existing Smart City initiatives, such as Bristol is Open and the Data Dome.Better understanding of the infrastructure and process design needs, to enable participation of 'citizen producers' to contribute. More mainstream understanding gained of key ideas and concepts underpinning The Bristol Approach, including 'the commons', 'open data', and the 'citizen producer' and their value to cities. People engaged in experiential and peer-to-peer learning.

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Management model

Economic costs and revenues:

Depending on solutions developed responding to issues identified and framed through Bristol Approach. Current funding covers identifying and framing issues with community, and co-design of prototype. Phase 2 development of Bristol Approach and phase 1 of air quality project: infrastructure and development have investment and financing from partners.

Management model scheme in use:

Hereafter is reported the scheme in use in Bristol for the citizen sensing action: the flows analysed consider money transfers, services provision and information/data exchange.

Bristol City Council and KWMC have registered the trade mark and with the support of REPLICATE funds they are testing the methodology in several applications.

KWMC is the facilitator and coordinator of the citizens groups which have been co-defined with the main stakeholder associations representing citizens. The benefits to the involved groups are capacity building and knowledge exchange. The smart technology and smart service developers are able to test their products in a real close-to-market context.

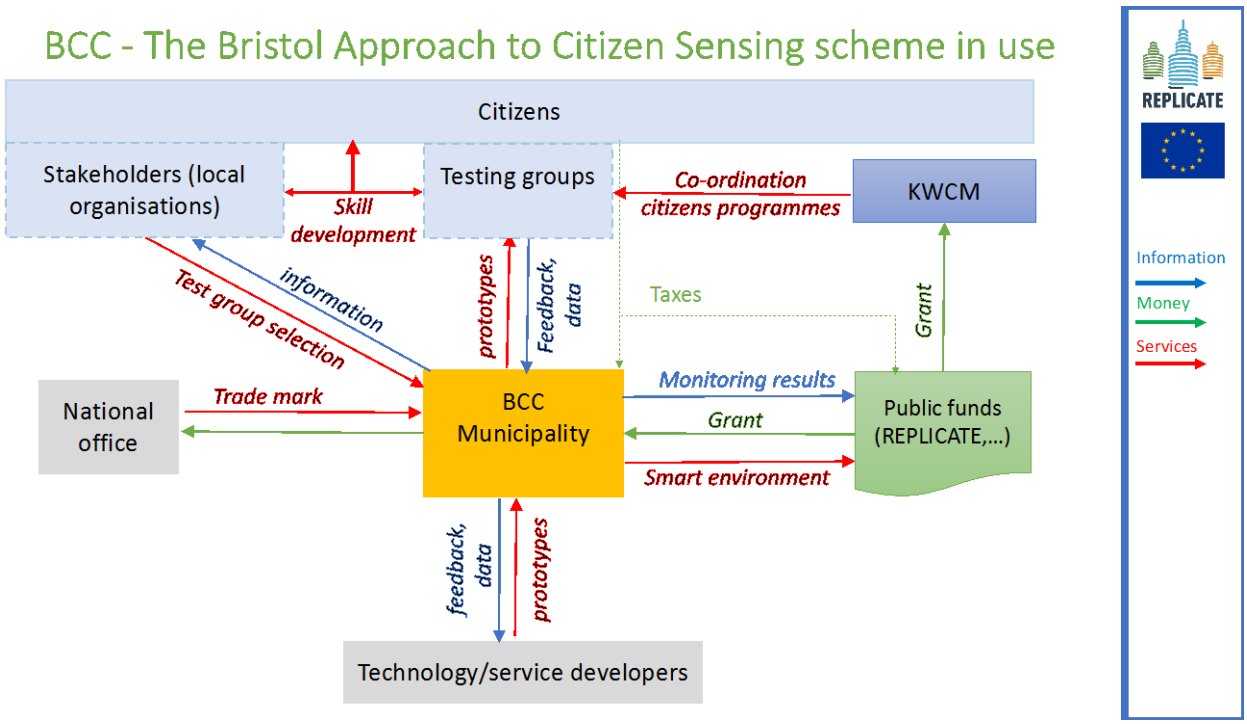

Figure 11.4 – the model in use for the Bristol citizens sensing

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11.3 Solution 3: energy gaming App

The Energy App, named "GoalGreen" has been designed in Florence to foster the "environmental awareness" of the users. It is intended to bring citizens closer to conscious consumption and to the improvement of their habits, with the aim of giving a positive push towards energy saving and respect for the environment.

It is addressed to general public (household users), mainly living in the Florence Metropolitan area, in order to increase their awareness on energy consumption and energy saving. The users are invited to record their consumptions in some fields (e.g. gas, electric energy, mobility, etc.) and guided by some stories, developed for this purpose, in a gamification perspective. The app is also designed to allow users connected to smart meters to automatically record consumption data. The aggregated, collected data will be transferred towards the Florence Platform to make possible an estimation of aggregated data of energy consumption and, hopefully, to measure an improvement in a correct behaviour through time.

Value proposition

The GoalGreen app has the primary objective to raise the environmental awareness and a correct behaviour in energy consumption in order to foster the reduction of energy waste. To this end a gamification approach has been perceived in the design and development of the app.

The app has the following goals:

- Improving the knowledge of the environment through themed lessons
- Assessing the knowledge through quizzes and tests
- Allow the constant monitoring of energetic consumptions at home and the assessment of the building performances through a simplified "energy profile"

Players

Key partnership:

Mathema, Municipality of Florence, CNR (partner), E-distribuzione (partner), SPES (partner).

Beneficiaries:

Citizens

Supporting Stakeholders:

Schools and municipal helpdesks who support the promotional campaign. Casa Spa (project partner) has also supported the dissemination activity at the Piagge buildings.

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Market analysis: enablers and obstacles

Legal framework:

The EU has set new targets at 2030 and 2050 for energy efficiency and also at national level the newly adopted Energy Plan is in line with the European roadmap (-32% at 2030).

At local level, the municipality has been strongly engaged with sustainability since the adoption of the SEAP in 2011 and the "zero volumes" structural plan. Supporting measures for the replacement of old boilers and communication campaigns for energy saving in domestic sector (sportello EcoEquo) has been implemented.

Incentives:

At national level the programs like the "Conto termico" and the TEE (energy efficiency bonds) are financing efficiency measures regarding insulation, RES, lighting, heating and cooling…

Human factor (success factors, opposed sentiments…)

Climate change is becoming more and more popular and people are more interested in information about sustainable behaviours and environmental impact. Gaming could involve a wider range of population keeping them interested in the program.

Competitors

Many energy providers have developed APPs to monitor the consumption, but they are often restricted to a specific vector (electricity, gas). Being provided by market players, people are not relying much on the suggestions of those tools.

Main impacts of the measure (economical, environmental, social)

Expected Impact	Contribution
Social impact	Awareness rising on impacts and costs of energy use and about the buildings performances
Environmental impact	Energy savings (2-5% through behavioural changes, more with specific interventions on buildings or mobility habits)
Municipal policies monitoring	Data availability

Management model scheme in use

In the model in use, Mathema has been supported by the project for the APP development as the municipality and the other partners involved.

Management model:

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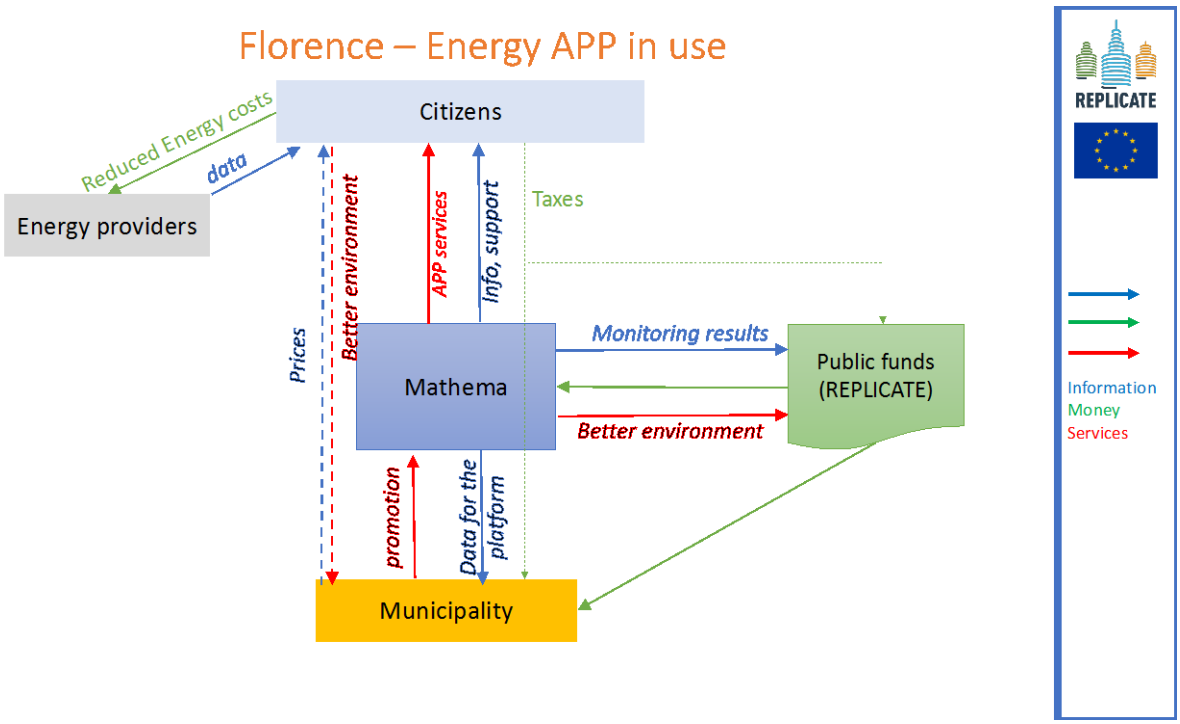

Figure 11.5 – the model in use for the gaming APP in Florence

11.4 First scale up SWOT & USP analysis

The SWOT analysis:

Solution 1: the citizen platform	
USP: A more responsible and engaged citizenship that means greater support in Smart City development because solutions are co-designed and participation is inclusive. The interest of citizens is protected in order to guarantee a more equitable society.	
Strengths	Weaknesses
• Easy and better management for the municipality of these participation processes. • Foster citizen active participation in decision taking	• Citizen participation through new channels may be difficult to understand and apply for the municipality • difficult to use for some citizens. • Lack of investment in citizen engagement activity and skills required to deliver programmes of engagement.

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Opportunities	Threats
Smart City narrative focus more on citizen centric innovation.	• Data security • Lack of interest among citizens

Solution 2: the Bristol approach to citizens' sensing	
USP: Greater understanding and therefore support for Smart Cities development because solutions are co-designed and participation is inclusive with the aim of achieving a more equitable society where all thrive and benefit from smarter citizenship	
Strengths	Weaknesses
• Citizen interest and engagement in tools to support changes they wish to see more inclusive smart city • Enables citizens to participate in decision making and actionable change • Innovative solutions to real problems • Uses and adapts "off the shelf" technologies • Iterative and agile approach • Identifies barriers to deployment • Identifies gaps both tech and systems.	• Technological challenges including connectivity (to BIO), data management and storage • Needs substantial resource for engagement work • Range of tasks required to address gaps require specialist skills e.g. work on data contracts • Timeframes need to work together – people disengage if tech solutions and barriers not addressed swiftly. Sometimes this presents difficulties.
Opportunities	Threats
• Need for greater engagement of citizens in decision making, and civic action in the face of public service cuts. • Smart City narrative focus more on citizen centric innovation rather than smart city control technologies and tech for tech sake.	• Lack of investment in citizen engagement activity and skills required to deliver programmes of engagement. • Proprietary business platforms replace more open source solutions • Sharing and commons approach to data constrained by business models…

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Solution 3: the energy gaming APP	
USP: a funny way to address actual topics like environmental impacts and families' footprint.	
Strengths	Weaknesses
• Partners know how (mathema, CNR, e-distribuzione, SPES,..) • User friendliness • Gaming/pricing method	Some aspects to be improved: • Data uploading • Lessons/tricks updating • Data storage and analysis
Opportunities	Threats
• Municipal vision • National supporting programs (Conto termico ,TEE…) • Climate change interest	• Reaching a critical mass of digital users • Reliability of data • GDPR compliance • Smart metering technologies

The possible scheme for replication:

Regarding solution 1 – the citizens platform, the chances for extension are high and any replication scale could be possible.

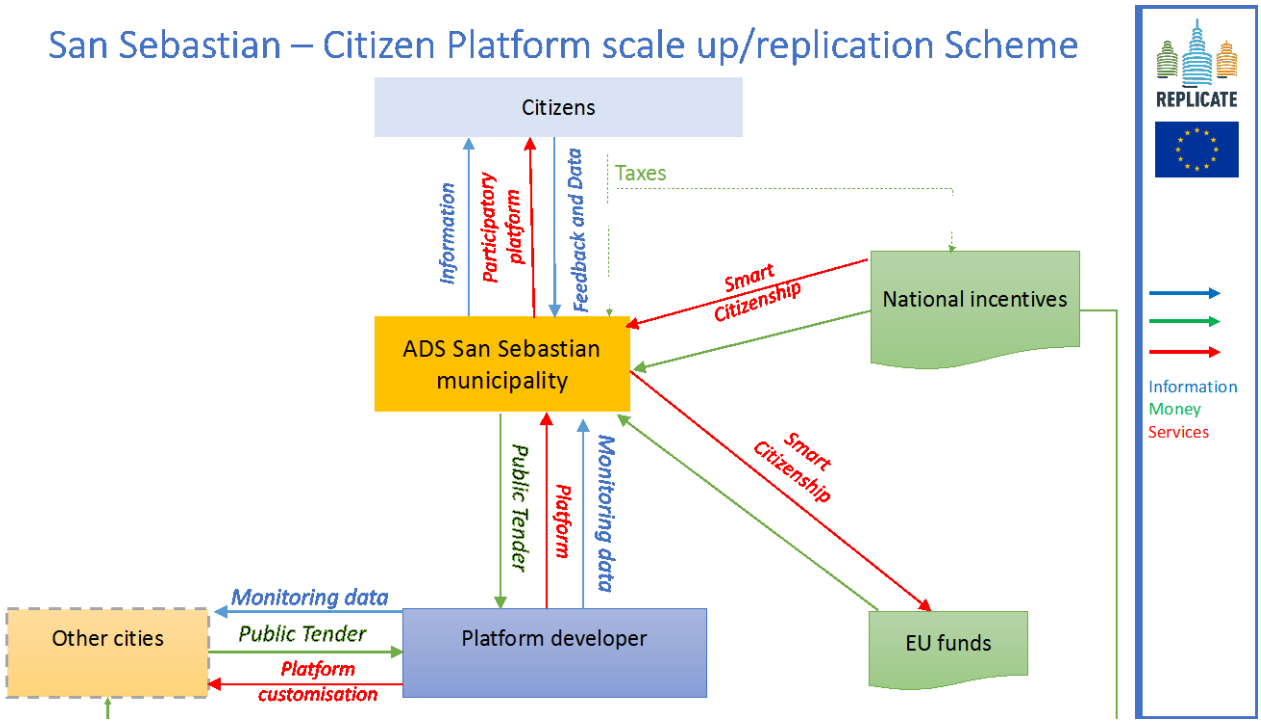

Figure 11.6 – the possible future model for the San Sebastian citizens platform

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The Bristol approach in the extension/replication phase will look for collaborating with external actors in the public, private and non-profit sectors interested in co-creating greater understanding of the social context of tailored technology solutions.

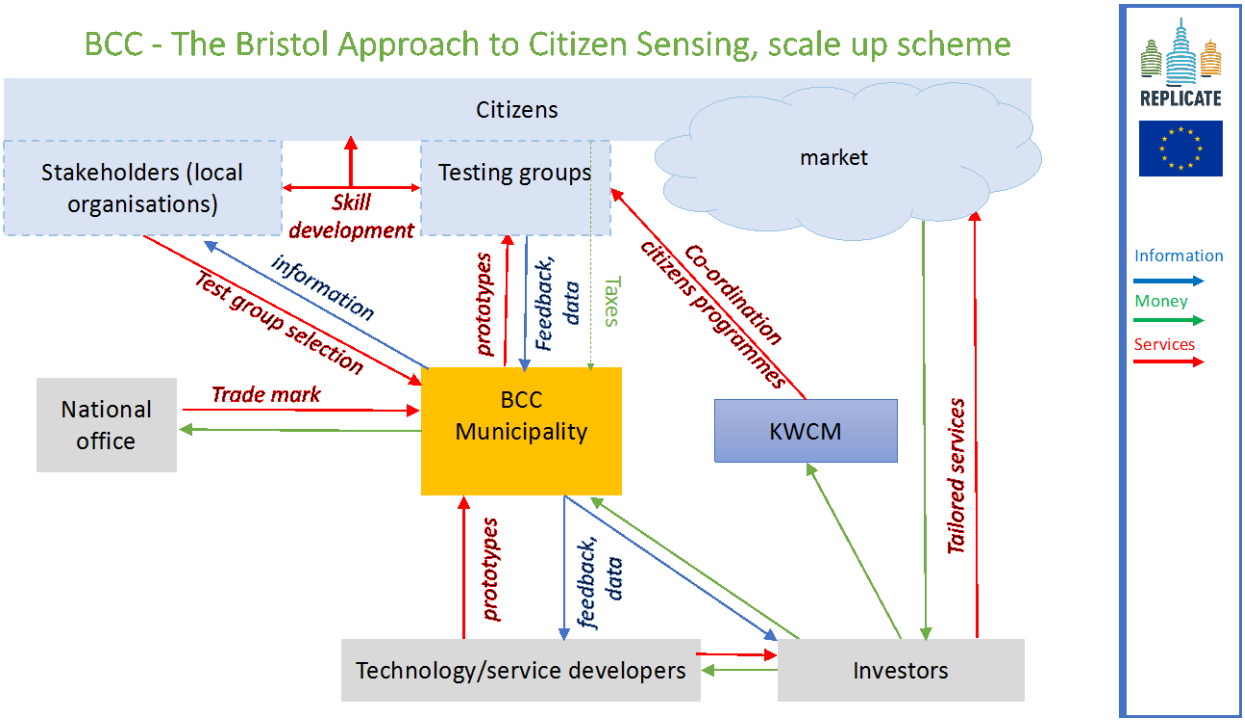

Figure 11.7 – the possible future model for the Bristol citizens sensing

The app has been designed to allow replication also in different contexts. Although its intended audience is made by local users (Metropolitan Area of Florence), it can be easily adapted also for different areas. In particular the multi-language has been considered in the way that the translation of the app can be easily made using the English version of the app as a "bridge language": GoalGreenal app has been designed to allow an easy update of environmental content (stories and quizzes) to ensure longevity also in the long period. From the economic perspective this kind of apps are intended for being used as complementary to environmental programs in local governments (municipalities, regions, etc.) therefore no direct economic revenue from the final users is foreseen. It is however possible, according with the Municipality of Florence, to propose the app to other local governments to be adopted: municipalities committed to sustainable targets (CoM and other initiatives) could be interested in promoting awareness rising and collecting data to analyse residential consumption and mobility habits. Another potential market consists in the small-medium ESCOs interested in enhancing the users' performances (higher savings could be shared among the two stakeholders). The blockchain development could also improve the possible links and market for the data collected.

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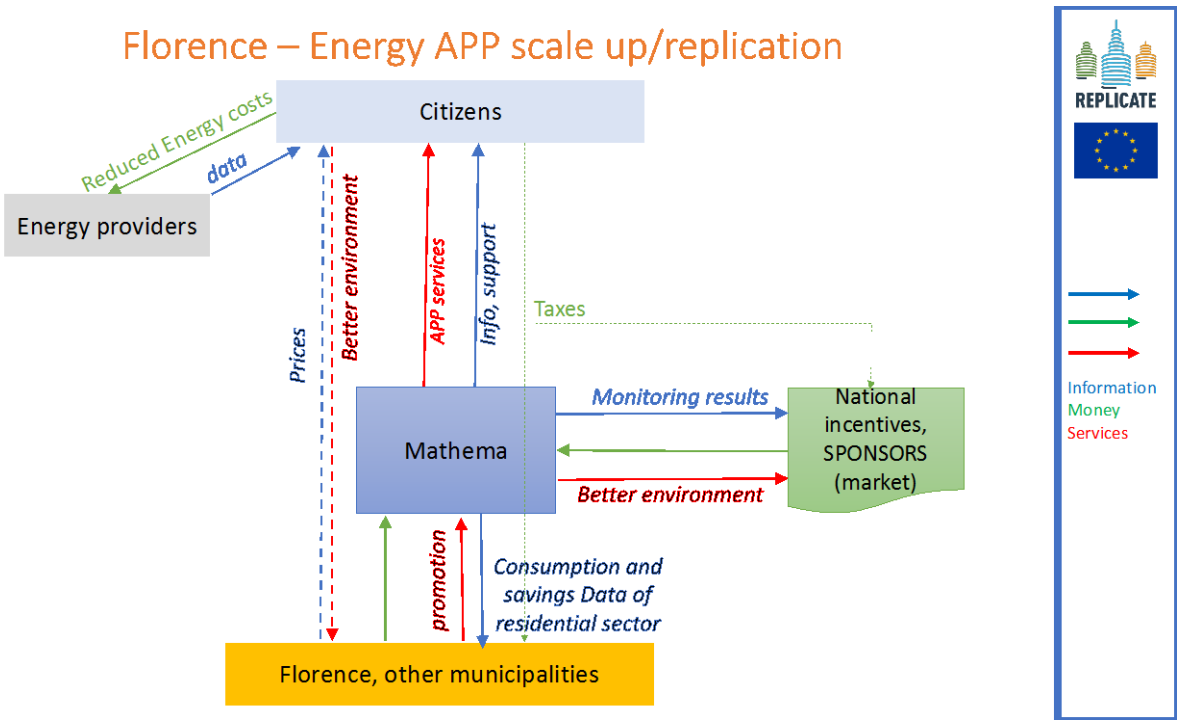

Figure 11.8 – the possible future model for the energy gaming APP

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12. CONCLUSIONS

After six years of cooperation between the three lighthouses (STEEP project www.smart-steep.eu and REPLICATE) and the pilot implementations, it resulted clear the "Smart City" to be a "liquid" concept with no rigid and static definition linked to the use of technologies: it is more related to a **continuous process** or an approach embedded into the municipal organization which has to respond to new challenges for its citizens' wellbeing and its own resilience.

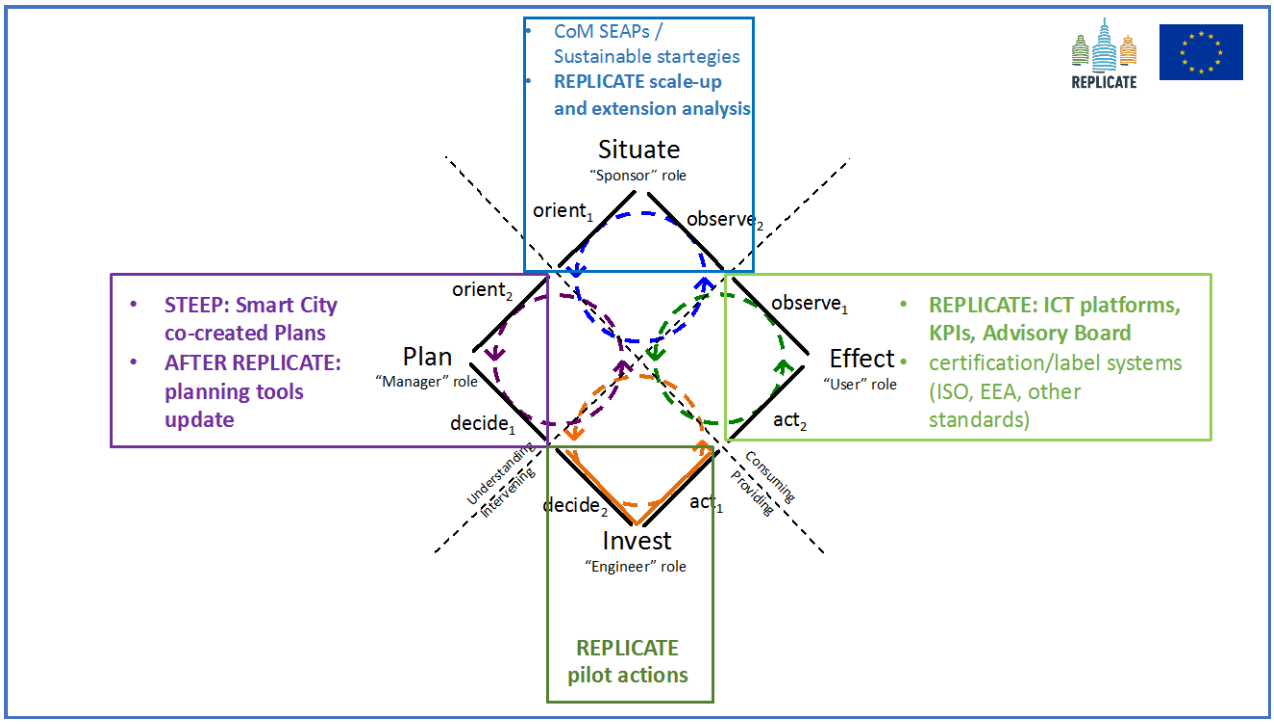

Figure 12.1 – the STEEP-REPLICATE process[1]

To become really smart, a city should spread innovations in different sectors with a wide territorial diffusion: it is therefore necessary that pilot actions have a strong replicability index or can easily adapt to other boundary conditions to be extended within the lighthouses roadmaps or to any other interested city. Smart measures present barriers to diffusion linked both to technological factors and to cultural factors (including those that are based on changing habits, bureaucratic aspects, ...) as well as financing: all the actions reported have found a balance and a possible solution tested in practice to boost the transformation.

[1] Yearworth, M., Willis Singer, J., Adcock, R., Hyberston, D., Singer, M., Chroust, G., & Kijima, K. (2015). Systems Engineering in a context of systemic cooperative praxis (SCOOPs): development and implications. In J. Wade & R. Cloutier (Eds.), *13th Annual Conference on Systems Engineering Research (CSER 2015)* (pp. 214-223). Hoboken, NJ. doi: 10.1016/j.procs.2015.03.048

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How should a Smart City prioritize its projects? Following the concept of the City Model Canvas, a business model assessment adapted to municipal vision in WP9 by ESADE, the city should take into account the sum of three different aspects, economy-social-environment, to define a **"Smart priority"**. The social and environmental impacts as well as the possible indirect externalities play a role also in the business model of the actions exploiting synergies from different funding opportunities.

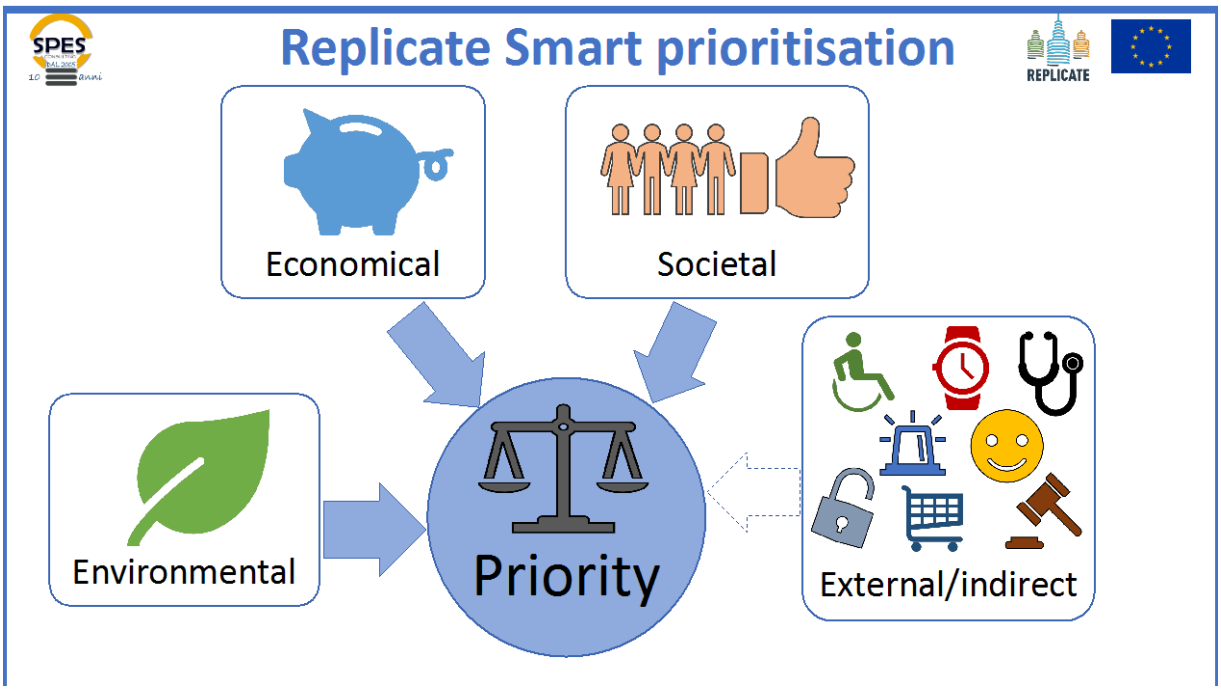

Figure 12.2 – the REPLICATE smart prioritisation process

Behind innovative technologies that are evolving faster and faster and, in few years, can also become cheaper changing completely their actual business models, the supporting factors for the diffusion of the Smart approach resulted:

- *Municipal internal organization*: the usual structure should be adapted to new challenges, able to manage an integrated vision and open to innovative schemes
- *Local legal framework*: a city can influence the diffusion of smart services also through its regulatory tools
- *Externalities*: as explained in the Smart priority definition, all the different impacts (direct and indirect) should be clearly pointed out in the decision-making process (health, social inclusion, poverty, …)
- *Co-creation*: empowering stakeholders and citizens can multiply ideas, create consensus and increase participation and awareness

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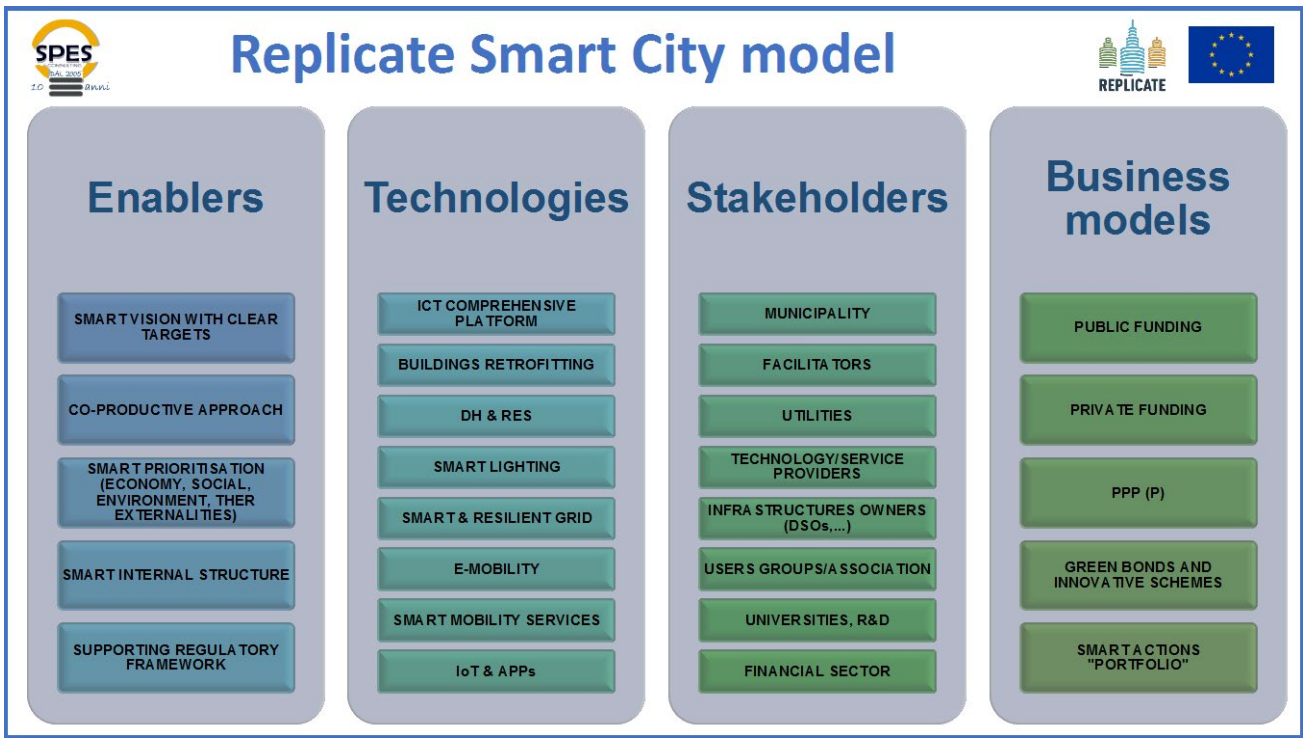

Figure 12.3 – the REPLICATE model for smart city transition

The stakeholders group is quite wide in all the three cities; among all the players listed in the previous figure and involved in the process, the "facilitator" role has resulted very useful for the successful transition: supporting agencies, third parties and technical external expertise have been crucial for the pilots realisation. Technological and process innovations often require paths that have not yet been explored for the Public Body, however, these solutions are attractive because they allow significant impacts (environmental and socio-economic) increasing the quality of life of citizens. These facilitators structures play a decisive role in overcoming procedural obstacles, internal silos and guaranteeing a path for implementation also through the involvement of political decision makers and stakeholders. It is an important role started in the planning and confirmed in the implementation phase that will find application in the scale up and repeatability of the solutions experimented in the pilot actions.

The experience showed a big gap between the business as usual (technologies, stakeholders and management/financing models involved) and the implementation of the Smart City concept adopted in the plans: the pilot action are trying to overcome this mismatch adopting Smart City project management mechanisms that allow to realign the interests of the various subjects in the field; the successful realization models are resulting from a different approach, which could enable the replication and the large-scale dissemination of Smart Cities: a possible key, to be defined during the scale up plans, could consist in how to **"pack" projects together creating a "smart city portfolio"** optimizing the impacts for the community but remaining interesting for business, as it

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happens for example on small scale in the public lighting evolution integrating different services or sometimes on buildings and e-mobility.

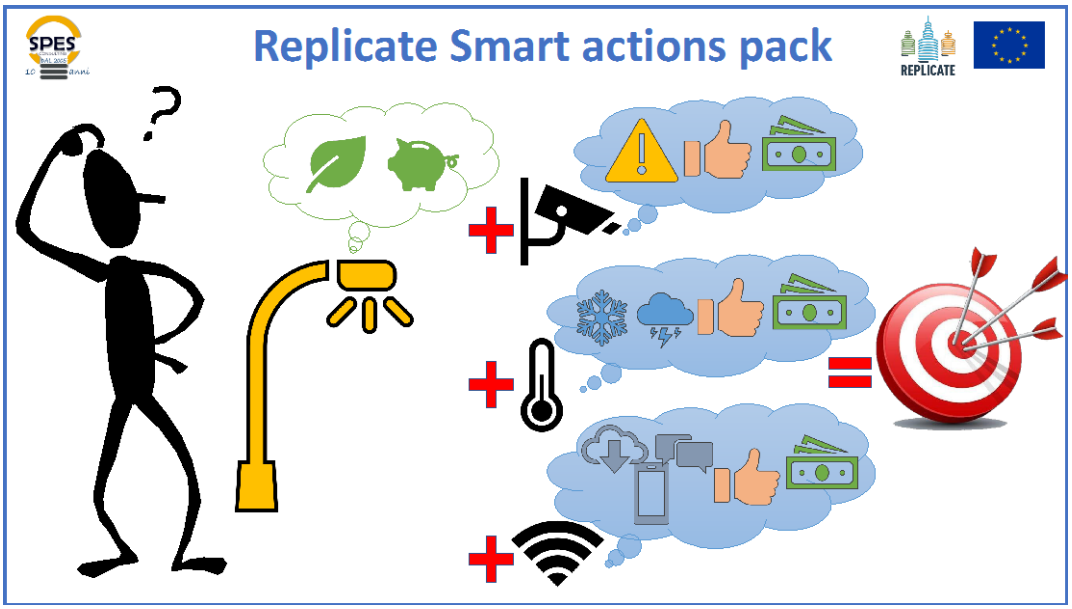

Figure 12.4 – example on small scale of the Smart packing concept for the roll out portfolio

Meeting cities' smart and sustainable commitments requires investment in a portfolio of projects of different sizes, involving many stakeholders: in the present document most of the actions have been analysed individually but they will need, to exploit possible cross-subsidies and synergies, to be included in a wide portfolio whose overall impacts and investment have to be defined by the municipality within the next interdepartmental and co-creating planning phase.

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ANNEX 1

Sommario

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1. The fast-evolving framework

Lighthouses, as every smart city, are based on a very dynamic environment following closely societal and technological evolution and at the same time they are located in multilevel national systems with own policies and strong influences in some sectors. It has been three years since the development of the project idea or even more since the definition of the actions with the participatory processes and in the lighthouse cities the framework has slightly changed influencing the actual implementation. The analysis of the changes from the national to the local level has become important to understand the adaptations and the optimal conditions for the replication/scalability of the measures.

Hereafter a short update from the three cities to contextualize the actions and a focus on energy prices for residential sector.

1.1 San Sebastian

Donostia/San Sebastián, as capital of the Province of Gipuzkoa, is a municipality with a population of less than 200.000 inhabitants. In 2014 a consolidation of the population occurs that could be seen as a turning point in the dynamics of population since it does not seem to produce significant increases in the coming years, unlike what happened in previous years.

This is an aspect that influences the socio-economic development and that should be considered as a basic analysis element when proposing a city strategy, on the one hand the city should respond to the needs of citizens and, on the other hand, that strategy may also help to provide to some extent such development and its consequences, promoting therefore a particular strategy consistent with the foreseeable scenario. Under this socio-economic and energy-environmental context that will be explained in the next points, it is possible to say that Donostia has been for years a pioneer town in the development of policies on sustainability and combating climate change. The main initiatives in this regard are detailed below:

- 2002: approval of the Action Plan Local Agenda 21 (2002-2007)
- 2004: Strategic Plan 2004-2010
- 2007: Second Action Plan LA21 (2008-2013)
- 2007: Municipal Program of Combating Climate Change
- (2008-2013)
- 2008: Urban Sustainable Mobility Plan (2008-2024)
- 2008: Adherence to Covenant of Mayors
- 2011: Donostia / San Sebastián 2020 Strategy
- 2011: Action Plan of Sustainable Energy (SEAP)
- 2013: Donostia Lagunkoia
- 2015: Donostia HiriBerdea 2030

In addition to that initiatives, San Sebastian has been working in the transformation of the city to a smart city for many years and an action plan was developed for the years 2016-2020 to stablish a strategic line with shared goals. The plan takes as reference the previous works that have been done

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in the city. All the implementations and actions are very much influenced by the European trend that increasingly seeks more sustainable cities based on smart cities and smart specializations.
Another important element promoted from Europe is the Smart Specialisation Strategy (RIS3), which in the case of Euskadi has defined three main priority axes as described in the Science, Technology and Innovation Plan (PCTI 2020): Advanced manufacturing, energy and Bioscience-Health.

Energy efficiency

The city council of Donostia/San Sebastian has made the commitment to reduce the energy consumption of its own infrastructure by 40% of 1990 levels by the year 2020. These policies are specified in the Covenant of Mayors, which Donostia/San Sebastian has signed, and are in agreement with the National Energy Plan established by the Spanish central government and with the Basque Energy Plan set by the Government of the Basque Country. To achieve this goal, the city council has selected several tools that it would use. These include the establishment of local policy requiring new construction projects to meet several energy efficiency criteria, a tax incentive (i.e. reduction) for people who use energy efficient vehicles or invest in energy efficient appliances at home, and direct subsidies for building retrofitting.
The reforms of the façades are common to find today. In fact, many dwellings perform this in order to reduce the energy consumption, although in recent years, the technological progress of insulating materials has evolved greatly improving the performance of them. With the heat networks and the production of heat with biomass something similar happens, even though it has been used for a long time especially in countries with a high climatic rigor, the technology has evolved allowing higher yields, which makes more feasible its application in milder climates as in the case of San Sebastián.

Apart from the implementations in the Replicate project framework there are two buildings managed by Fomento San Sebastián that use biomass. This reflects the involvement of the city promoting energy efficient buildings.

A notable aspect to be noted in the residential sector is the fact that over 30% of the building stock has more than 50 years old, so there is great potential for the reduction of the demand through rehabilitation actions.
Regarding legal framework about energy efficiency new regulation and requirements reflect the evolving situation both at local and at national level
At local level there is the Municipal Regulation about buildings energy efficiency and environmental quality (year 2009) which aims to regulate a sustainable building development. The City Council is working on a Municipal Regulation about Energy Efficiency on buildings that will be approved during 2019. The aim of this new regulation is to promote the implementation of the design, savings and energy efficiency measures, and the promotion of renewable energies in buildings, installations and constructions, new and existing, whether they are public or private. Thus, it is the objective of the regulation to obtain a new and existing energetically efficient building development and give continuity to the path started with the previous energy efficiency ordinance. For this purpose, the

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limitation of consumption and energy demand, the use of energy efficient facilities and the introduction of renewable, alternative and clean energy. The Regulation also seeks to solve and improve the structure, comprehension and the procedures related. This Municipal Regulation has been open to the citizen participation in order to collect opinion about citizenship.
At national level the 15/2018 Royal Decree of urgent measures for energy transition was approved in 2018. The objective of this regulation highlights among other aspects that the renewable electric self-consumption is an essential element to achieve that the consumer can obtain a cleaner and cheaper energy. Regulatory actions aimed at accelerating the transition to a decarbonised economy are included, in order to eliminate the regulatory barriers that prevent agents from making the decisions that could impulse the mentioned transition.

Mobility

The energy consumption of the town has undergone a growth in recent decades and it is possible to see that the greatest contribution to it is due to the transport sector (58%), followed by the residential sector (24%) and services (15%) and finally by the industry sector (3%). GHG emissions whose values referred to 2014 in the case of Donostia are: 42% of GHG emissions are due to the transport sector, 28% due to the industrial sector, 13% due to residential sector, 9% due to the services sector and 8% due to waste processing.
Donostia / San Sebastián has made a major effort to promote the use of public transport by improving the service besides of the information available for citizens. This way, it is intended to motivate a change in the mobility habits in the town minimizing as far as possible the use of private cars. To this end, important adaptations have been carried out in the city, prioritizing pedestrians and bicycles as means of sustainable mobility. Bidegorris network (bike paths) and rental services of electric bicycles on the one hand, and the pedestrianisation of several streets on the other, have represented important steps towards the promotion of sustainable mobility.
The city is involved in several projects apart from Replicate whose aim is to improve the sustainability of the city's transport and infrastructure. One such project is the EU-financed European Bus System of the Future 2 (EBSF-2), which aims at improving the efficiency and attractiveness of public bus systems, partly through the design of the actual bus. Another was SmartCEM (Connected Electro Mobility), another EU project that ran from 2012 to 2015 that aimed at analysing how electric and hybrid vehicles could be better integrated into the urban infrastructure.
The local bus operator (Dbus) company and publicly owned company, participates in the different projects and contributes to improve sustainable mobility. Likewise, the city counts with the support of other stakeholders that also contribute in the improvement of the sustainability. Dbus has tested the electric buses in different bus routes drawing conclusions and lesson learnt for the improvement of this type of vehicles.

Central Government through the ministry for the ecological transition has been launching promotional campaigns since 2009 (MOVELE, MOVEA, MOVALT and VEA) aimed to the purchase of electric vehicles

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The city is working in the promotion of EV and the deployment of the charging infrastructure across the city.
Deployment of recharging infrastructure (together and very linked to the EVs) represents a key factor in the city considering the pollution issues that most important cities of Spain are currently facing. That provision will be part of the promotion of clean vehicle in order to provide a green and clean city not only to citizen but also to city visitors which will be one of the most important target group. The recharging infrastructure is not only a key factor at local level but also at national and international level.

ICT

The ICT sector together with the technologies evolve very fast and due to this fact, the consumption of ICT services is increasing.
The city of San Sebastian is working in different areas regarding ICT/Infrastructures. Information and Communication Technologies are with innovation and citizen participation gear levers for the smart initiatives of the city. These include data collection with sensors, connectivity of the city, the development of a management platform apart from other actions such as intelligent lighting or the high-speed mobile network. Outside the context of the REPLICATE project, the SmartKalea project that is an initiative led by Fomento San Sebastian establishes a public-private collaboration model that engages citizens, business, local technology companies and municipal departments in the testing, validation and replication of smart applications, such as smart energy meters to help users regulate demand and smart lighting posts that increase or dim the light according to car and pedestrian traffic, and that are also equipped with sensors that provide free WiFi connection and collect data on activity on the street.
The ICT´s sector is closely related with data; the protection of this data is a key factor to take into account when developing services. The security of data must be a structured process that must be taken into account when selecting technologies and developing the ICT structures.

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1.2 Florence

At national level in 2017 the national energy strategy that defines the long-term objectives was approved and defines the framework for the next years.
The National Energy Strategy is the ten-year plan that the Italian Government drew up to anticipate and manage the change of the national energy system: a document looking beyond 2030 and laying the groundwork for building an advanced and innovative energy model.
The objective of the Strategy is to make the national energy system

- More competitive: aligning Italian energy prices with European ones to the benefit of both companies and consumers; opening up new markets to innovative companies; creating new employment opportunities; and fostering research and development.
- More sustainable: contributing to decarbonization, in line with the long-term targets of the Paris Agreement on Climate Change; improving energy e efficiency and encouraging energy conservation to mitigate environmental and climate impacts; promoting environmentally conscious lifestyles, from sustainable mobility to wise energy usage; and confirming Italy's environmental leadership role.
- More secure: improving the security of energy supply, while ensuring its flexibility; and strengthening Italy's energy independence.

Here are some of the core targets of the National Energy Strategy 2017: reducing final energy consumption by a total of 10 Mtoe by 2030; reaching a 28% share of renewables in total energy consumption by 2030, and a 55% share of renewables in electricity consumption by 2030; strengthening supply security; narrowing the energy price gap; furthering sustainable public mobility and eco-friendly fuels; and phasing out the use of coal in electricity generation by 2025.
The Strategy has ambitious and complex targets, requiring efficient public policies guiding citizens towards responsible energy usage patterns. By reducing energy demand, energy efficiency will provide a cross-cutting contribution to lowering emissions and securing energy supply.
At the end of 2018 a new proposal for the National Plan for energy and climate PNIEC has been submitted by the new Government to EU: the foreseen targets are -43% consumption, 30% RES and -33% GHG emissions. The proposal should be adopted by the end of 2019. It contains an important forecast about electric mobility: more than 6 millions electric vehicles will be circulating in Italy at 2030, of which 1,6 millions full electric.

After the adoption of the Smart City Plan, the municipality of Florence has started to implement measures or supported the implementation of private actions in line with the defined policies to achieve the targets at 2030.
The smart district model developed had to comply with as many aspects as possible of those included in the Smart City Plan to become a real bed test for its implementation.
Many specific actions have been already started in the city with different implementation sizes (from the small test for the adaptive lighting and the smart waste to the open data portal and the big infrastructural interventions regarding the tram lines and the electric mobility)
In the last years the air quality issue has become more and more popular in Italy supporting the enhancement of sustainable mobility and affecting at the same time the use of biomasses and

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biofuels. Florence policies regarding electric mobility, started some years ago and defined in the electric mobility plan developed in cooperation with Firenze Parcheggi, have benefit from regional and national subsidies for the recharging infrastructure, making the city the most advanced at national level and enabling also some private initiatives like the two e-sharing systems now available.

There has been also other public funding which contributed to make further useful steps through the smart and sustainable urban vision like the national PON-METRO, the suburbs program (available also in many other big cities and useful for the replication) or the sustainable mobility program and other EU projects about resilience and new technologies.

Other national subsidies are available also for private players ("Conto termico", "white certificates", tax deductions for energy efficiency and seismic retrofitting) and, even if the bureaucracy takes a lot of efforts and the regulation has been modified several times, the amount available is very interesting and could support many scale up or replication activities in the field of energy efficiency.

Despite all those positive contributions, there are some aspects, mainly related to the local and national regulation framework, which had to be overtaken and must be considered also from the scalability point of view. At national level the most important changes regarded the procurement code (definitely completed in May 2017) which have revolutionized the public authorities' procedures. Also the restrictions about landscape and historical areas have to be taken into account in each measure in Florence, finding different solution for each specific implementation:

- for example, the seasonal thermal storage has to be totally built underground (but not too deep due to the aquifer legislation) and the technical rooms limited as much as possible not to build new visible volumes (according to the "ZERO Volume" structural plan);
- the lampposts have to be approved by the art superintendence authority and can be different for each area as well as the other street furniture like the smart benches (for the cultural heritage and the landscape permit);
- also in case of fast recharging stations for e-taxi fleet, the permits procedure took more time and the action had to start in advance; moreover is under definition the possibility of creating "recharging islands" to exploit more and more the locations already in use from one hand making the recharging points search easier and from the other side fastening the building procedure;
- the data collection for the platform has to comply with the privacy legislation and formal agreements have to be provided for the data usage.

Regarding <u>energy prices</u> at national level, it can be stated that:

- The market opportunities are much interesting for big consumers than domestic sector and for electricity than for gas.
- Prices for electricity increased steadily from 2005 since 2014 (more than 100% in industry and 56 % for households) while was much more stable in the recent years.
- Electricity contracts for mobility purposes are much more expensive than for domestic use (generally double)
- As the natural gas prices are linked to the oil price, the gas price development is much more fluctuating with decreasing prices since 2013, especially in industrial sector.

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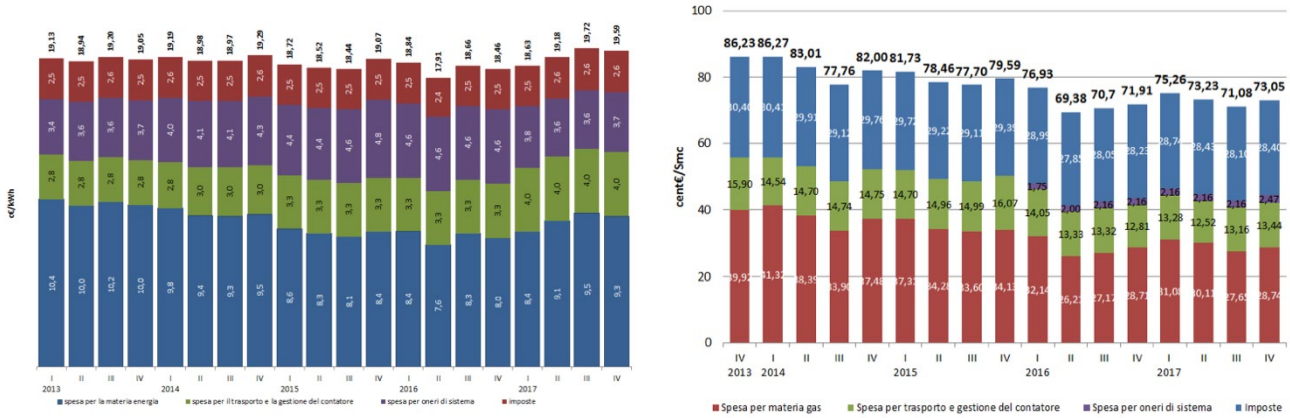

Figure 1 – Electricity and gas tariffs for typical domestic client (Source: AEEG 2017)

Energy efficiency

The municipal Structural Plan, approved in 2015, defined the strategy of "governance" of the territory aimed at the concept of "zero volume" to contain the anthropic pressure on a single environment. The planning document also contains precise indications on sustainability as a transversal element that integrates with policies and actions.

Much of the choices of the Structural Plan, for the environment, transport and widespread quality, reflect this fundamental perspective, which must find specific operational translation in the Urban Planning Regulations: redevelopment of the existing building heritage to the sign of energy saving, realization of new buildings characterized by high performance in terms of energy efficiency and well-being, integration in urban areas of renewable energy sources, promoting the construction of integrated systems, etc.

The attention paid to sustainability in the Structural Plan, briefly recalled, must be translated into operational rules in the Urban Planning Regulations, but also and above all in a campaign to raise awareness among citizens by providing basic knowledge elements that allow to make more informed choices in the purchase of an accommodation, requiring the energy efficiency class, in the choice of a heating / cooling system, etc.

The national legislative framework development has represented the main obstacle in the deployment of the energy efficiency pilot action in Florence. The new regulations which mostly affected the implementation were:

- national procurement code (DL 18/04/16 n.50; DL 19/04/2017 n.56)
- excavated soils regulation (Dpcm 14/07/2016)
- national incentives framework ("Conto termico" DM 1702/2016)

The new procurement code sets rules for the design and tendering procedures causing a delay (and some additional costs i.e. the one to verify the design) in the scheduled activities, which has been

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cut down separating the "Piagge" project (buildings retrofitting, district heating & RES hybridisation) into three lots; this approach could also support the exploitation of the national incentives whose availability is uncertain and limited in time.
The excavated soils regulation affected the overall business model of the seasonal thermal storage which has been resized trying to balance the costs with the energy demand side and the expected performances.
The lessons from Florence experience are that the schedule of such projects has to comply with the new rules and the public procurement timing and that should be taken into account also in the definition of the incentives income supporting the realization; another lesson is that some works have different costs in each nation and have to be analysed in detail.

On the other hand, there are several national programs which could support the implementation and also the scale up and replication of the REPLICATE measures at metropolitan and national level as well:

- the "thermal account" incentives are dedicated to energy efficiency and heat production from RES (shell insulation, condensing and biomass boilers, solar thermal, heat pumps, thermal regulation and buildings automation…);
- the "White certificates" scheme is supporting the efficiency in general, considering all the measures included in the thermal account also district heating and centralized systems, lighting, small PV, … Projects may be submitted by the electricity and gas distribution companies with more than 50,000 final customers ("obliged parties"), the companies controlled by these companies, the non-obliged distributors, the companies operating in the energy services sector , companies and entities that have an energy manager or an energy management system in compliance with ISO 50001. Since October 2017 there are new rules to apply for white certificates, requiring an accurate activity plan and a final payment only at the end of the construction works.
- Another program, open to anyone, to stimulate efficiency is the one related to tax deduction (max -65%) awarding efficiency measures or seismic retrofitting.

All these schemes are setting higher thresholds than business as usual, enhancing good efficiency levels.

Another important support to Smart cities strategies is the national Smart metering policy; the term "smart metering" refers to systems that allow remote reading and remote management of electricity, gas and water meters. The advantages of smart metering systems are numerous: in addition to the reduction of costs for readings and contract management operations (e.g., change of supplier, deactivation, etc.), smart metering systems allow other advantages, like:

- For all sectors with individual meters: higher awareness of the final customers in relation to their consumption and promotion of energy efficiency and rational use of resources;
- For all sectors (electricity, gas, water, district heating): better management of the network and better identification of technical and commercial losses.
- For the liberalized sectors (electricity and gas): more competition in the change of supplier.

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Italy was the first European country to introduce large-scale electric smart meters for low-voltage end customers and is still the world's leading country in terms of the number of electricity smart meters in service (over 35 million). According to a recent report from the European Commission, the Italian smart metering system, replacing traditional meters since 2001, has been the most efficient in Europe.
The next step, started in 2017, is the 2G Smart metering and the costumer awareness; the costs for the technological intervention will be recognized by the national Authority for electricity and gas to the distributors.
The replacement of traditional gas meters with smart meters was initiated by the Authority, starting from the highest flow meters (G40 class and above) and was progressively extended to the first intermediate meters and, from 2013, to the gas meters of lower flow rate for domestic use (G4-G6 class). The Authority has progressively updated the plan to replace gas meters, taking into account the implementation difficulties. Currently, a target of 50% of G4-G6 smart gas meters in service is expected to be reached by 2018, having completed the installation of the smart gas meters of the upper classes for that date.
Smart metering is the first step through the implementation of Smart grids which, at the moment at national level, are in charge of distributors. Smart Grids are intelligent networks that combine the use of traditional technologies with innovative digital solutions, making the management of the electricity network more flexible thanks to a more effective exchange of information.
One of the most immediate applications of smart grids is the integration of renewable energy into the grid, which contributes to the achievement of the environmental objectives set by the European Union. The development of innovative digital technologies also allows monitoring of the entire network to promptly intervene on failures and ensure an optimal supply of electricity.
In this constantly evolving system, the customer becomes a protagonist thanks to the use of electronic supports that make consumption transparent, encourage its active participation in the energy market, promote a rational use of energy.
Finally, the Smart Grids improve the quality of the service. Operating costs are lowered, the competitiveness of network operators increases. There are advantages for environmental sustainability and for the whole system, which is more accessible and reliable.
The innovation level of the pilot Smart grid in Florence is very high and it is also related to the resilience of the network which is becoming more and more interesting for Italian cities due to the extreme natural phenomena occurred and the importance of the service linked also to security and mobility sectors.
Regarding market operators in building sector, there is plenty of construction companies and materials producers and providers at national level, and the ESCO market in Italy [1]is still considered to be among the biggest and most developed ones in Europe. ESCO projects, including EPC, have been present in the country for decades, although the market has been developing in an uneven pattern. The EPC market has been on a rise in the period 2014-16 (JRC 2016), although the

[1] JRC 2017: Energy Service Companies in EU
Horizon Guarantee project: Market Report on Italian EPC market

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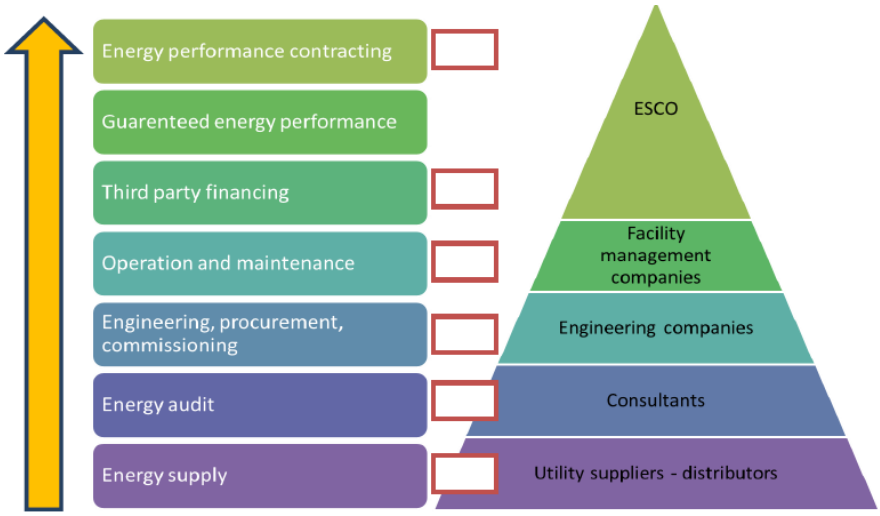
development of the whole ESCO sector is less evident and experienced a rather stagnant period. There is room for further expansion both in terms of possible projects and sectors.
The Italian ESCO market is particular in being supported by a relatively strong legislative background and standards by UNI/CEI and the ARERA (Italian Regulatory Authority for Energy, Networks and the Environment); nevertheless, only a limited number of companies have the technical and financial capabilities to provide and sustain a long-term EPC contract
EPC supply companies are mostly small or micro sized (0-10 employees), a few SMEs (up to 50 employees), with a split between these and the few large energy supply and facility management companies. Typical energy savings are below 30% of the baseline energy consumption (mostly between 5 and 15%).

Today, the composition of the ESCO market is varied in Italy. The "utility market" carries the largest potential since all final users have the same need for reducing energy costs while meeting other agreed performance criteria (comfort)



Source: (Piantoni, ESCO activities and current characteristics - Italy, 2014)

Figure 2 – Market composition of the Italian energy services market.

The so called "heat supply contracts" (or "Servizio Calore" in Italian), which are equivalent to "chauffage", are the most common contract types in Italy, and the "Energy Service Plus contracts" ("servizio energia plus") are somewhat stricter, more modern versions, which also include a commitment by the provider to reduce the consumption of primary energy for winter heating by at least 10% with respect to what is indicated in the building certificate. Furthermore, in the latter contracts, the ESCO commits to the installation of a temperature control system.

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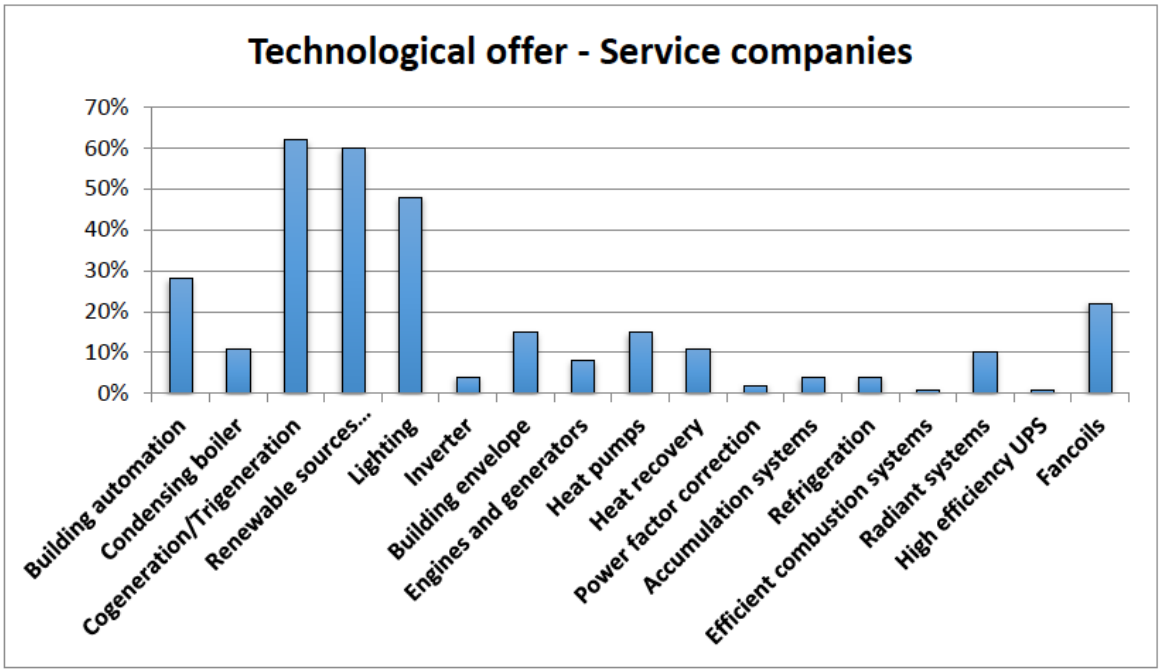

Figure 3 – ESCO technological offer in Italy – Source FIRE on CESEF data

The public sector in Italy is less open and less capable to engage in ESCO contracts than in other countries, because this sector is characterized by a lot of barriers.

The Italian ESCO market is mostly focused on the industrial sector, due to the difficulties related to public sector projects and to the high yields delivered by the White Certificates program when applied to medium/large size energy recovery projects in manufacturing plants[2]. The residential sector is not attractive for ESCOs, mainly due to the high transaction costs and the small sized projects.

Market players indicate institutional barriers as the most crucial ones, and they are very unsatisfied with the government policy supporting EPC, while disappointment is not so high (only half of the interviewees) about energy efficiency policies in general.

Some interventions are too complicated because of bureaucratic obstacles (such as authorizations to construct and operate, connections to the energy networks, etc.). The definition and establishment of a baseline further increases the transaction costs. The scope of an ESCO project can be limited by the fact that Italian final customers cannot ask their energy suppliers to disclose their billing data to a third-party service provider (e.g. an ESCO) designated by the final customer, unless the supply contract is made in the service provider's name (Italian Government, 2014), thus an ESCO cannot provide the full range of service provision. Furthermore, public building clients are limited due to the lack of proper technical and financial in-house resources to manage ESCO projects. Besides, financial institutions are still not technically prepared to finance EPC and ESCO projects.

[2] ESCO Europe, 2015; Di Santo, 2015

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Mobility

Italy weighs only about 1% in the European market. In 2015, 2,560 electric cars were sold, about 0.1% of the entire Italian car market and the trend is stable (and therefore against the trend) compared to 2015.
The market share of the electric car is in Italy about a tenth of that of the other major European countries. This gap becomes even wider when compared to the countries of the North: in Sweden the registrations of electric vehicles accounted for 2.4% of the total, in the Netherlands 9.7% and in Norway even 23.3%.
It is evident that one of the reasons that can explain a different trend in the sales of electric cars is the presence of incentive mechanisms.
There are about 20 full EV models available on the Italian market, produced by 12 different players and in the next years the models offer will almost triple (54 full EV models will be available on the market at 2020).
If the number of recharging stations and the number of vehicles circulating in the same period is compared, an average ratio of about 0.86 vehicles per single column is obtained for Europe, where a total of 70,000 public recharging stations were installed, 37% of the global, and around 400,000 private points, 30% of the total.

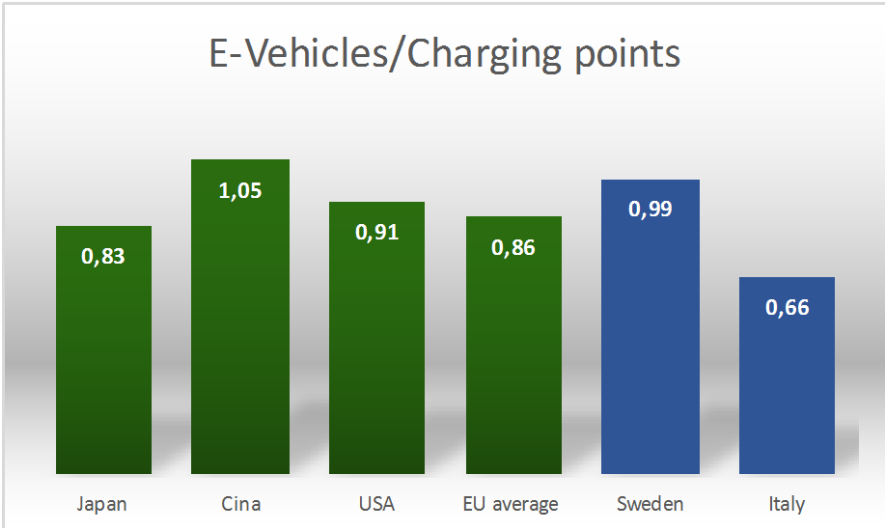

Figure 4 – electric vehicles/recharging stations ratio (Data Source: Energy&strategy group POLIMI)

In a "mature" market, this ratio should be around 1 vehicle per charging point, as the result of the sum between 0.9 private charging points / vehicle and 0.1 public / vehicle charging points. It is no coincidence that countries such as China (1.05 vehicle / recharge point) and Sweden (0.99) are approaching this value. Italy, with an index of 0.66 electric vehicles / charging points, once again confirms to be particularly behind.

In the last years the Italian Ministry for transport is working on four main issues:

- Soft mobility (bikes, safety, life quality & health)
- Public transport
- Innovation (e-mobility and new technologies)

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- Planning (sustainable mobility plans, urban plans, infrastructures)

Regarding electric mobility, the three supporting actions foreseen by the Government concern the recharging infrastructure, the road regulation and the incentives for the e-vehicles (up to 6.000€ for a new e-car, no ownership tax for 3-5 years depending on the region and 50% reduction on the cost of insurance).
The National Plan for the recharging infrastructure has been developed in 2014, updated in 2015 and finally approved and adopted on the 30th of June 2016.
It foreseen to install 13.000 recharging stations and 6.000 fast recharging columns within 2020 to achieve the target of about 180.000 circulating e-vehicles.
For its financing, a special fund has been set up, with a budget of 33.3 million: the Ministry of Infrastructures and Transport participates in the co-financing of projects presented by the regions and local authorities, up to a maximum of 50% of expenses incurred for the purchase and installation of the plants.
To facilitate the construction of recharge points in buildings, a national decree provides that from 1st June 2017 the Municipalities are able to issue the building permit for new buildings for non-residential use with a surface greater than 500 m^2 and for new residential buildings with at least 50 housing units only if there is the predisposition of the connections, or, if the buildings can be equipped with electrical sockets to recharge the battery-powered cars.
Starting from early 2019, a bonus up to 6.000€ has been made available by the Government for the purchase of an e-vehicle.

Analysing its specific situation, it became evident what a particular city Florence is for the cultural, landscape and artistic heritage visited by millions of tourists every year.
The main weaknesses detected were

- Historical heritage and binding regulations (affecting mainly the possibility of installing PV and visible recharging structures)
- High number of "city users" (both tourists and commuters which are different targets)
- High number of traditional cars/scooters pro capita

With the SEAP adopted in 2011, Florence has started the path towards sustainability, especially in the transport sector which resulted as the most pollutant in the SEAP, and the milestones set for 2020 represent just a first step for its ambitious targets at 2030 set in its Smart City Plan.
In recent years, administration policies consisted of both the technological modernization of the circulating fleet and the promotion of low-impact mobility and public transport.
Some results so far include:
- Florence is currently the most pedestrianized city in Italy, with restricted areas extending for 400,000 m2, or 1.07 m2 per capita; two times more than the second Italian city;
- 4.13 km2 of limited traffic zones (LTZs) restricted for non-EURO 4 vehicles (even motorbikes) and night LTZs with a 30% discount on parking fares and fixed-rate taxi service;
- 137 km of bike lanes and a parking garage for 800 bicycles at the main train station;
- Car-sharing services with 600 cars, including 200 electric vehicles, and bike sharing systems with about 5000 bicycles.

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ATAF manages the local public road transport, with 85 bus lines, 2,319 stops, and a fleet of 450 urban buses (25% less than 3 years old and, overall, 40% less than 8 years old, while for the historical centre 10 vehicles are electric and small sized). All buses are equipped with an AVM System, allowing to know their position in real time and calculate the time necessary to reach the stops, keeping in mind traffic flow; since 2014, an e-ticketing service is active. Florence's public road transport carries about 70 million users, with a daily average of about 190,000.
The tramway system has proven its efficiency: Line 1 began working in 2010 and transports an average of over 1,000,000 monthly passengers. Currently, two more lines are undergoing construction and will be finalised by 2018 (Line 2 Peretola airport – Piazza dell'Unità d'Italia and Line 3 Careggi hospital – Santa Maria Novella train station), for an overall investment of over 390 million euros, predicting 37.2 million passengers, avoiding the use of 28,600 cars.
This intervention is reinforced by other interventions under way, including: park-and-ride, optimisation of the integrated transport strategy, and information accessibility (Wi-Fi and Web 2.0 already on board)
City traffic has been subjected to traffic flow easing measures, such as the "green wave" system and the creation of a modern traffic management centre, capable of providing real-time information regarding critical traffic situations and alternative routes, linked to the existing publicly accessible information portal (the web-based and updatable message panels).

Since 2014 the main innovation in the mobility sector has been linked to the promotion of electric mobility with particular care to companies' fleets, both private and public, moving through the city to enhance their conversion into electric fleets.
During 2015 the municipality has already changed the most of its own fleet into electric vehicles to fulfil the commitment undertaken with the EU and to promote the best practice to citizens.
In the last two years 2015-2016, the City of Florence, with regional co-financing DR.5815 (for a total project value of 3.442.826,40 euro), has decided to expand the existing infrastructure of public charging stations with new 173 stations with two sockets each for a total of 346 electric charging stalls becoming the best infrastructure city at national level.
The new charging stations have been also adapted to the new technical regulations and provided with adequate diagnostic and communications systems on board, in order to provide real-time information about the status of the station.

ICT

The European Digital Agenda has precisely defined the objectives to develop the digital economy and culture in Europe within the Europe 2020 strategy. The Digital Agenda, presented by the European Commission in 2010, was established on March 1st 2012 following the subscription by all Member States.
Within the framework of the European Digital Agenda, Italy has developed its own national strategy, identifying priorities and methods of intervention, as well as actions to be carried out and measured on the basis of specific indicators, in line with the scoreboards of the European Digital Agenda.

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With the contribution of the Conference of Regions, the Italian strategy has been elaborated emphasizing the complementarity between the national and the regional level, as well as the integration among the regional initiatives themselves.
The Agency for Digital Italy (AgID) has the task of guaranteeing the achievement of the objectives of the Italian Digital Agenda in line with the European Digital Agenda.
As part of the 2014-2020 Partnership Agreement, the Council Presidency together with the Ministry of Economic Development, the Agency for Digital Italy and the Agency for Cohesion has prepared the national plans for the "Ultra Broadband National Plan" and «Digital Growth» for the pursuit of the objectives of the Digital Agenda. The Agency developed also guidelines for public authorities' web-sites, for open data and electronic payments.
Implementation of the Italian Digital Agenda requires the coordination of multiple actions by public administration, businesses and civil society, and requires integrated management of the various sources of national and Community funding (at central and regional level).
For this purpose, the Italian Digital Agency has the task of drafting the Three-Year Plan for IT in the Public Administration.

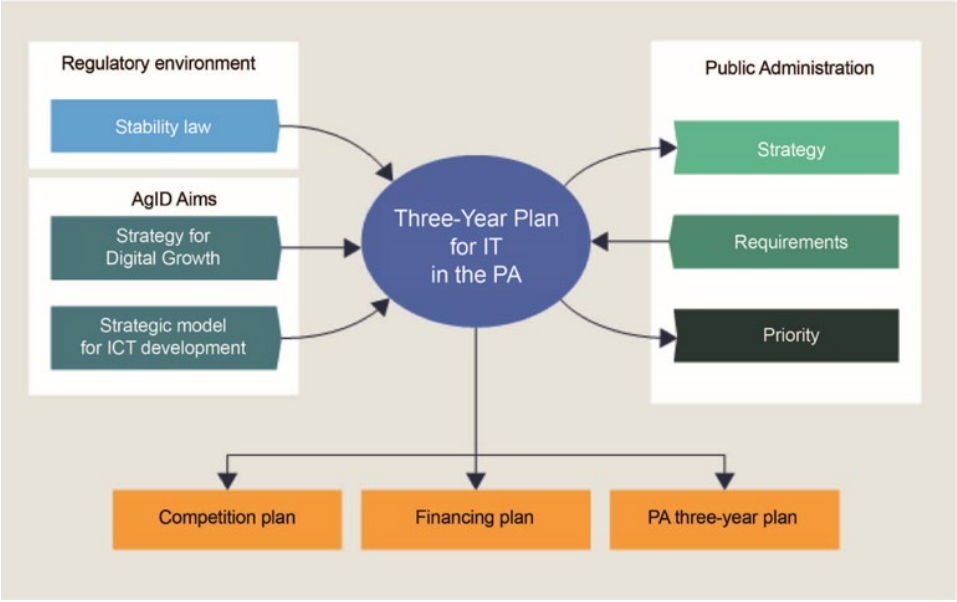

Figure 5 – Input and output of the PAs' three years plan for IT

The city of Florence has been a forerunner in the ICT sector and the ICT "renaissance" of the city has been stated in its "Digital Manifesto": it will give, first of all to the municipal administration and subsequently to all the subjects that provide public and private services in the city, a reference point containing the digital values considered fundamental for the city. On the basis of the Manifesto a campaign to involve the "innovative" subjects in the city will be promoted to formalize as many Protocols for sharing digital citizens' assets (open data, platforms, services).

The city of Florence has been working on the open data since 2011, placing itself among the first Italian cities in the field; even today, the city is among the best level, counting on over 1000

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published data sets. It's not just about opening the information to the public: the available mass of data is a completely new way of promotion and knowledge of the city from every web access.
Nowadays open data represent a way for knowing the city, but also a tool for the promotion of start-ups and SMEs producing innovation, because who realizes an app using public open data gets automatically visibility in the Municipality's Showcase App.
Florence has also started experimentation on open data generated by users.
Open data also optimize the internal communication processes, since the different departments and public utilities can easily access to what they need to do their job: thanks to the Florence Digital governance model, the production of open data is promoted also by other bodies managing public services in the city.
Since 2003, the Municipality of Florence has understood the relevance strategic development of a shared service centre for the metropolitan area aimed at the provision of eGovernment services.
For this purpose, the public company "Common Line" was established in 2006 with the aim of managing and further developing the eGoverment multi-channel platform 055055.it.
Common Line manages a common single platform providing hundreds of online services of eGovernment to more than 30,000 registered users, with more than 400,000 accesses a year to online services, and more than 12 million euro of online payments per year.
Common Line, together with the management of the tourist card system in Florence, is recently becoming a test lab also for smart tourist app for mobile devices, touch-totems, and Digital Signage networks, all designed for re-use and a possible extension a metropolitan level.
The integrated traffic management platform developed in recent years is mainly comprised of two modules:

- Traffic Supervisor: a system for the control and centralised management of traffic that allows to identify the network's current state of traffic and also forecast the future state in the short and long term;
- Info-mobility Platform: a system that is completely integrated with the traffic supervisor that consists of a portal for the disclosure of useful information to the public (calculation of multimodal routes, times, etc.) and allows the end user to program the optimal itinerary in relation to events or delays promptly reported on the street graph. Moreover, the platform lets you calculate the intermodal private/public route so to enhance and favour the use of public transport vehicles with low environmental impact.

Many APPs have been developed in the last years to provide citizens with innovative services: among them there is the public transport app with the e-ticketing service, the taxi booking app (national) with the possibility of selecting e-vehicles, … (http://app.comune.fi.it/app/a0025.html)
The Municipality of Florence has owned for many years its own optical fiber network; as a result, the intranet was designed and built to support the use of broadband in the coming years. The 200 km long FI-NET network has been offered through agreements also to other public bodies to connect their offices scattered around the city.
Recently, the Municipality has decided to implement and offer another very useful communication network, which is the WiFi public network: the "FirenzeWiFi" network was designed with a federated approach, being owned by several public bodies, but using the same authentication and user-tracking mode throughout the network.

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Currently there are already more than 1,400 hotspots spread across the city , where citizens and visitors can access the Internet for up to 2 hours a day, with a daily bandwidth limit and a user-friendly access with a simple click, without login.
Today FirenzeWiFi registers daily an average of 10,000 accesses, an average use of 400 GB and an average use of 40 minutes.
Different EU projects, in cooperation with the University of Florence, are working on data management and resilience management (Resolute, Sii mobility,…)
Regarding public lighting, a pilot test for innovative adaptive systems has been deployed in the Cascine park during STEEP project; most of the municipal infrastructure will be retrofitted in the next years thanks to a national financing scheme (PON METRO), giving the opportunity of scaling up REPLICATE action.

1.3 Bristol

Bristol is one of the eight core cities in England. It is the largest city in the South West region. The City Council's administrative area covers approximately 110km² with an estimated population projected to grow by 26% between 2006 and 2026 to 519,800. Compared to the rest of the region, the population profile of Bristol is relatively young, with more children aged under 16 than people of pensionable age. At an estimated 49,700 (11.9%) Bristol has the largest black and minority ethnic population of all local authorities in the South-west. This population is not evenly distributed; the inner-city wards of Lawrence Hill, Ashley and Easton which are the area of focus of the Replicate project have the highest percentage residents from those groups.

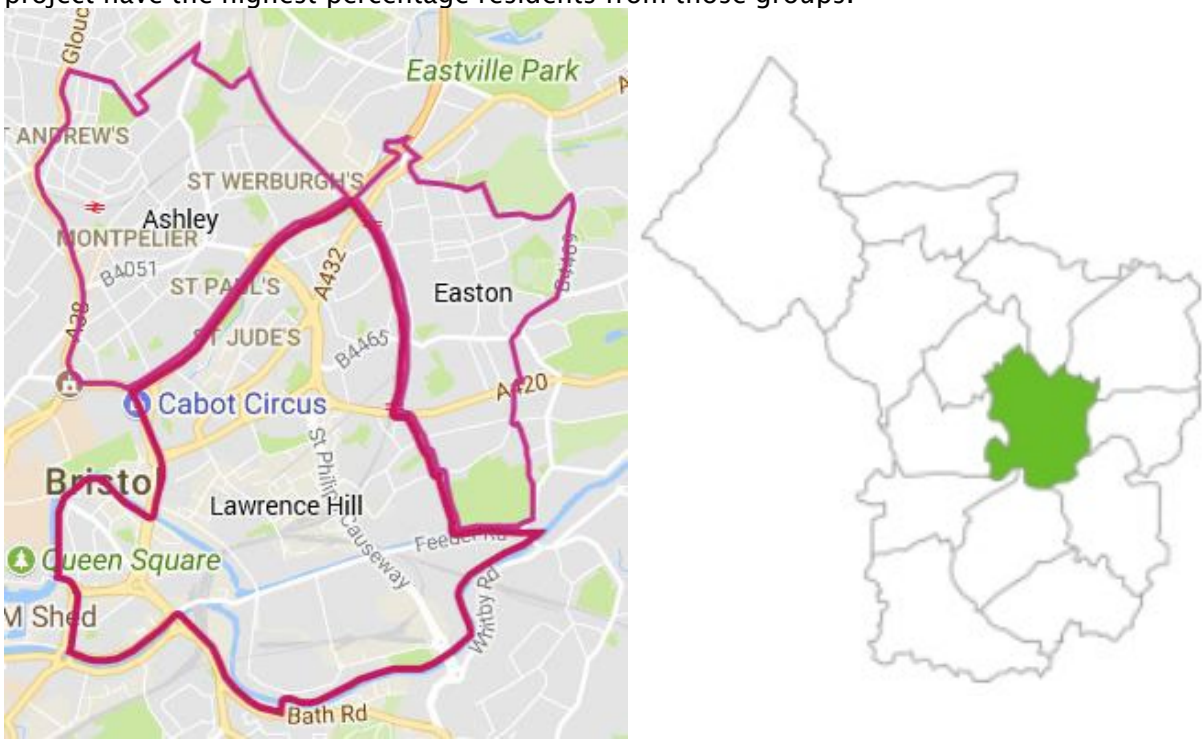

Figure 6 – Replicate pilot area

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There have been many changes to the policy context affecting Bristol as a Smart City in the last three years, but Bristol remains in the vanguard of UK Smart Cities. Whilst there is no room for complacency, tough energy efficiency targets are, to date, being met, and Bristol is currently experiencing some of the largest investments in its transport system in recent times. The flagship ICT project in the city, Bristol is Open, continues its development.
There have also been major changes to sub-regional governance leading to new strategies being developed. Fortunately, these changes have tended to strengthen the focus on cities becoming smarter; so, whilst the framework has indeed 'evolved', those changes are considered to be complementary to Bristol as a Smart City and to support the work REPLICATE is doing.
The biggest contextual change to note is that on 4 May 2017 a new tier of sub-regional government, covering the Bristol City, South Gloucestershire and Bath & North East Somerset areas, was created with the West of England Combined Authority (WECA) coming in to force. WECA is responsible for setting out a strategy for growing the city region economy, and has powers over issues such as housing, transport and skills.

Energy efficiency

At the national level, the Capacity Market (CM) which started in October 2016, was set up as part of the government's Electricity Market Reform policy under the 2013 Energy Act with the aim to ensure the future security of our electricity supply at the lowest cost to consumers. The CM is, broadly, a mechanism to replace old, polluting power stations with newer, lower carbon ones and to encourage smart grid technologies to manage Demand Side Response by providing a payment for reliable sources of capacity.
The CM is the biggest reform in the UK's energy policy in over 20 years, offering a unique opportunity to be a part of the future UK smart grid and with the potential to provide commercially attractive options for businesses. The CM is governed by the Electricity Capacity Regulations 2014 and the CM Rules which describe details on the contents of capacity agreements, obligations of capacity agreement holders including penalties, and technical operation of the Capacity Market.
Commencement of the Capacity Market is part of a transition period in how the UK's electricity is balanced. There are options for businesses wanting to take part in CM demand response as a source of revenues through different auctions.
It is expected that most businesses will engage with CM in the future through aggregators to provide Demand Side Response Services (where consumers' demand changes in response to a price signal). The price signal could be received via smart metering, through introduction of Time-of-Use Tariffs (TOUT), or through utilisation payments to businesses signed up in advance to provide extra capacity. There are two forms of DSR available through the CM:
demand turn-down and demand turn-up: Historically, in the UK most DSR has been demand turn-down but as energy storage solutions become more effective and efficient, demand turn-up becomes more of an option, as will be discussed later in this report.
Bristol is currently considering how it can aggregate electricity demand flexibility in the business sector and in the housing sector, to make the most of business opportunities to provide DSR services and receive revenues in return. Bristol is considering how the capacity and value of demand flexibility

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may vary with increasing integration of smart appliances, electric vehicles, on-site/community renewables and battery storage in the city. Energy demand management systems will be able to turn-up or turn-down supply in response to signals by integrating ICT and physical smart devices connected to the network (the Internet of things or IoT). Replicate will be connecting retrofit and smart homes, district heating, community PV and an energy demand system to integrate with a smart city platform.

Otherwise, energy policy in Bristol continues to be set by the Core Strategy commitment (BCS14) which states that "Proposals for the utilisation, distribution and development of renewable and low carbon sources of energy, including large-scale freestanding installations, will be encouraged. In assessing such proposals, the environmental and economic benefits of the proposed development will be afforded significant weight, alongside considerations of public health and safety and impacts on biodiversity, landscape character, the historic environment and the residential amenity of the surrounding area."[3]

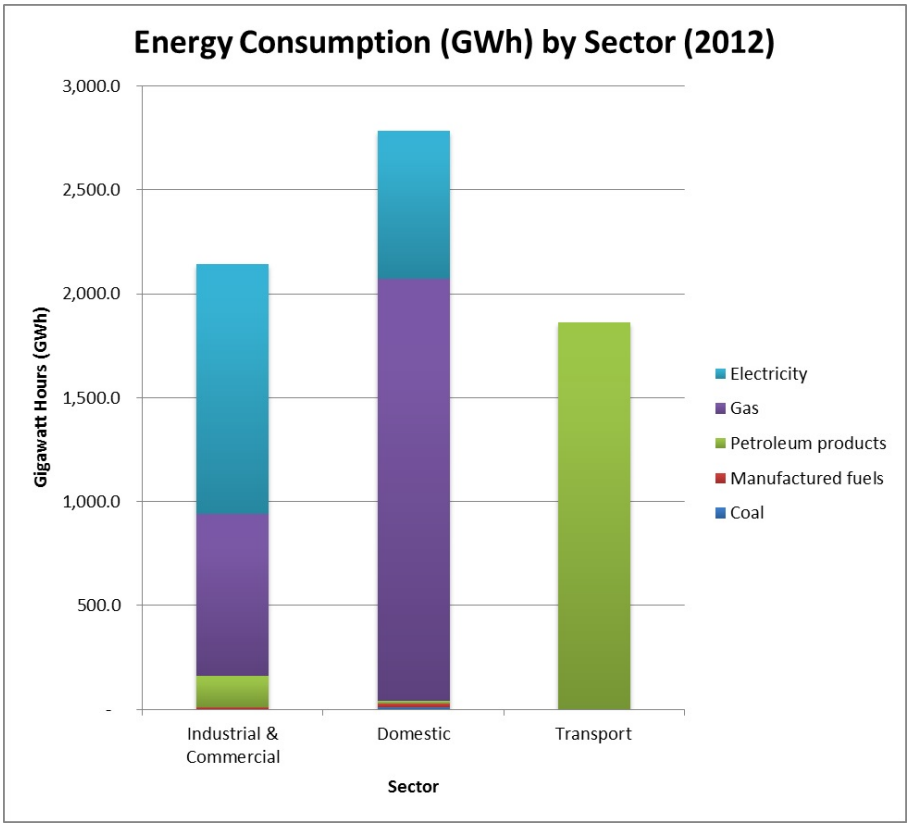

Figure 7 – Bristol energy demand

Based on 2012 data, the annual energy demand of Bristol is around 7,000 GWh. The figure 7 above indicates that 27% of all energy was consumed in the transport sector, 32% in non-domestic, and 41% in the domestic sector. As a City, Bristol uses more gas than electricity, with gas accounting for approximately 40%, and electricity for approximately 28% of all fuel consumed. Gas was the

[3] Bristol Core Strategy, p95 (https://www.bristol.gov.uk/planning-and-building-regulations/local-plan)

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dominant fuel source for the domestic sector accounting for 72% of the all gas consumed, whilst electricity was the dominant fuel source for the non-domestic sector accounting for 63% of all electricity consumed. For transport, approximately 130 thousand tonnes of fuel were consumed in 2013 of which 40% was petrol and 60% diesel[4].

In its cabinet meeting of 3 November 2015 Bristol City Council passed a report titled "Climate and Energy Security Framework" (CESF). In it Bristol was noted as having made good progress in reducing energy use and Carbon Dioxide (CO2) emissions and succeeded in reducing CO2 emissions by 17% and energy use by 18% since 2005. As Bristol is a growing city, its emission savings per person are even greater at 24%. Bristol City Council set parallel targets for its own energy use and CO2 emissions and has succeeded in nearly achieving a 40% reduction in CO2 emissions – 5 years early.

The CESF also translates Bristol's existing 2050 CO2 reduction target of 80% into key milestone targets of 50% reduction by 2025 and 60% by 2035, and associated energy reduction targets. This will help to provide a more tangible long-term pathway towards the substantial decarbonisation of Bristol whilst also aligning with planning horizons for other functions within the city and West of England, which are crucial to achieving the targets. The proposed targets are broadly in line with UK targets but marginally ahead due to the later baseline year.

The approach to developing and implementing this framework follows a number of distinct but iterative stages. These are:

- Reviewing current targets, agreeing the vision, and creating clear long-term targets and objectives;
- Defining and developing our understanding of the energy system;
- Identifying sources and gathering data to quantify our emissions;
- Identifying and assessing the costs and benefits of potential interventions;
- Planning and using our knowledge to inform the application of interventions to reduce emissions;
- Implementing interventions and influencing plans and strategies across other the city to reduce emissions
- Monitoring progress and using our learning to adjust plans to respond to societal, economic and technological change[5].

The importance of green energy is reinforced in Bristol City Council's Corporate Strategy 2018-2023 (Draft for consultation, November 20176) which identifies a "Wellbeing Key Commitment" to "Build resilience, improving our ability to cope with environmental, economic or social 'shocks and stresses' while putting Bristol on course to be run entirely on clean energy by 2050."

[4] Steep Project website: "Bristol's energy use and emissions: How far have we come?" (https://tools.smartsteep.eu/wiki/Bristol%27s_energy_use_and_emissions:_How_far_have_we_come%3F#cite_note-7)
[5] Bristol City Council (2015). Our Resilient Future: A Framework for Climate and Energy Security (https://www.bristol.gov.uk/documents/20182/33423/Our+Resilient+Future+A+Framework+for+Climate+and+Energy+Security/2ee3fe3d-efa5-425a-b271-14dca33517e6), pp1-2.
[6] Bristol City Council (2017). Corporate Strategy: Draft for Consultation (https://www.bristol.gov.uk/council-spending-performance/corporate-strategy-2018-2023-budget-consultation), p22

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Mobility

In October 2017 WECA published its Joint Transport Study in which it set out a Transport Vision that will build on the current investment programme with a continued strong focus on shifting travel behaviour towards sustainable modes and tackling congestion on the road network. It will significantly accelerate investment to transform the ways that people travel in future in the West of England. It will aim to more than double the trips made by cycling and public transport.
It sets a target for no overall increase in the number of trips by car across the sub-region in the context of 105,000 new homes being delivered by 2036.

The Transport Vision focuses on:

- A step change in the number of healthy, low carbon walking and cycling journeys
- Transforming connectivity by public transport
- Managing traffic demand and a more resilient road network
- Effective connectivity at the local, sub-regional, national and international scales.

One of the key components of the Transport Vision is "Technology and Smarter Choices" consisting of behaviour change, effective marketing, use of new technologies (including on-demand information and smart-ticketing) and potentially increased use of Connected & Autonomous Vehicles.
A 'new technology' that was introduced into Bristol in 2017 was dockless public bike sharing. The Chinese company Yobike selected Bristol as its first UK implementation city, introducing hundreds of yellow cycles from May. The bikes can be used for £1 per hour or on a membership basis. They must be parked at designated parking locations identified via the phone app. The scheme operates in the city centre and higher-density suburbs, including the Replicate area.
Bristol City Council is also currently developing a Bristol Transport Plan, which will form a linking strategy between the WECA strategy and specific Bristol local plans for topics such as public transport development, parking management, cycling, walking and air quality management. One of the key ideas for further consideration in this strategy is the development of a light metro, which would probably need underground sections in the city centre.

The largest investment project underway is MetroBus[7], part of a package of transport infrastructure improvements in the West of England which have been designed to help unlock economic growth, tackle poor public transport links in South Bristol, long bus journey times and high car use in the North Fringe of the city and M32 motorway corridor.
Following the investment of an estimated £230million new MetroBus routes are expected to open in 2018. It will have advanced ticketing and information, as well as clean modern vehicles. The new Cabot Circus, Cabot Circus South and Temple Meads stops will provide connections to and from the western part of the REPLICATE area. The journey planner being updated by Replicate will provide

[7] https://travelwest.info/metrobus

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MetroBus information, and the electric vehicles and parking app will all be able to integrate with MetroBus services.

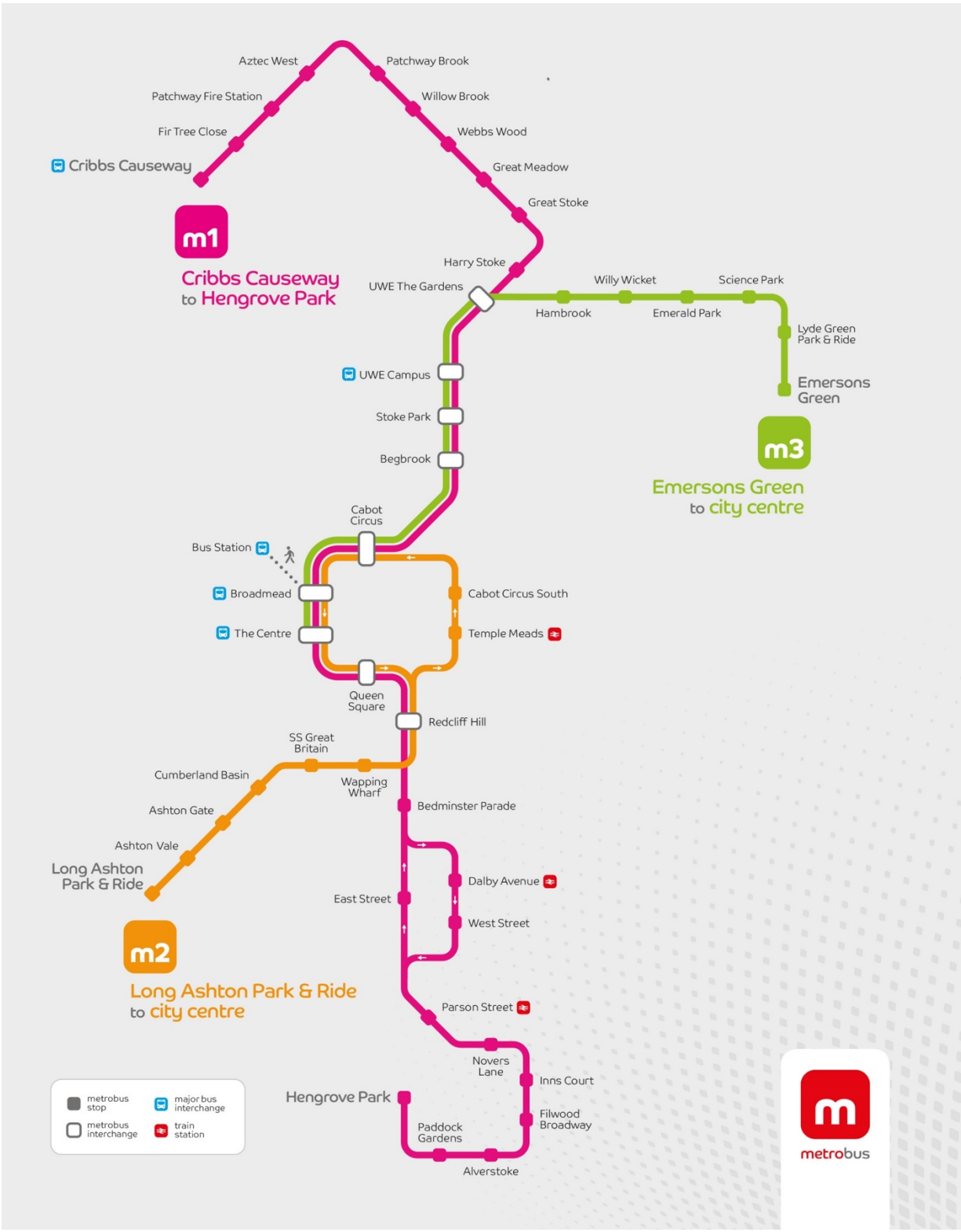

Figure 8 – the metrobus map in Bristol

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The UK Government is actively promoting the take up of plug-in electric vehicles through a range of national grants and infrastructure schemes delivered locally. In 2016 the UK plug-in vehicle fleet was the fourth largest in Europe and more than 137,000 plug-in electric vehicles had been registered in the UK as at December 2017.
Go Ultra Low West is supporting the increased use of ultra-low emission vehicles throughout the West of England. It will:

- Double the existing provision of charge points to 400 in total
- Match fund business charge points and business demonstrator cars
- Provide 4 exemplar demonstration charging hubs
- Provide ULEV car club bays
- Ensure the conversion of 20 % of the council fleet to ULEVs.
- Result in Improved air quality

In its 2017 Air Quality Annual Status Report (ASR) Bristol City Council concluded:
"The priority for Bristol City Council for the coming year is to address the problem of air pollution by developing a programme of work with two main elements:

1. The undertaking of a feasibility study for a Clean Air Action Plan which is likely to include a Clean Air Zone as a key measure. A final business case will be submitted to the Secretary of State at the end of 2018.
2. A communication, awareness raising and engagement programme to increase understanding of the air pollution issue."

Following a successful trial of bio-methane buses, the West of England has secured £4.8million from the Office for Low Emission Vehicles, which is designed to help unlock a £28m investment by First West of England in bio-methane powered buses. Alongside historic investment, the additional buses would mean that over half of First West of England's Bristol fleet would be low emission or low carbon.
The new buses, which could start running by 2019, will help Bristol make progress in reducing harmful air pollution to meet legal limits. The funding will help introduce 110 new gas-powered buses, 30 of which will be introduced for MetroBus services.

ICT

The 2017 draft Corporate Strategy commits to "Make progress towards being the UK's best digitally connected city"[8]. The strategy recognises that for most households and businesses high-quality broadband is now essential utility, in order to secure access to government information, public and commercial services, work and leisure opportunities. However, inequalities in access exist, with

[8] Bristol City Council (2017), Corporate Strategy: Draft for Consultation, p19.

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around 7% of premises in the city are not able to access superfast broadband and limited competition is a problem more generally.

The strategy also specifically mentions smart homes – a key aspect of the Replicate project – as one of the future technologies that will require additional bandwidth and symmetrical upload/ download speeds, rather than the asymmetric services available to most households currently.

The Bristol digital strategy has received high-profile endorsement, as Bristol has overtaken London as the UK's leading "smart city" according to the second UK Smart Cities Index, commissioned by Huawei UK and conducted by Navigant Consulting[9]. The report also highlighted the growing importance of public-private partnerships to foster collaboration and drive smart city initiatives. Of particular note were partnerships with local universities, but businesses and other organisations such as health authorities were also key drivers.

The report is based on evaluations of 20 cities and their strategies, key projects and overall readiness in using digital technology to improve crucial civic services from transport infrastructure to healthcare.
Bristol's move up the rankings is a direct result of it taking significant strides to extend its innovation programmes and more closely integrate those initiatives into city strategy. The Bristol Is Open[10] project provides a large-scale connectivity testbed offering 'beta city experimentation-as-a-service' across a developing infrastructure network.
Facilities include:

- Bristol Data Dome Planetarium, a 98-seat facility which is the UK's only stereo 3D hemispherical screen with 4K resolution, delivering 2.1bn pixels per second
- IoT Mesh, which enables experimentation into smart street solutions such as connected rubbish bins and streetlamps.
- The Wireless Mile (Wi-Fi, 3G, 4G, LTE & 5G experimental technologies)
- Software Defined Network /Network Function Virtualisation, which enables multiple experiments to be carried-out simultaneously across the network.

The backbone fibre network is due to be extended to the north of the city to connect the high-tech industries and the University of the West of England, based in the 'north fringe'

[9] http://news.bristol.gov.uk/bristol_overtakes_london_as_uk_s_smartest_city
[10] https://www.bristolisopen.com/

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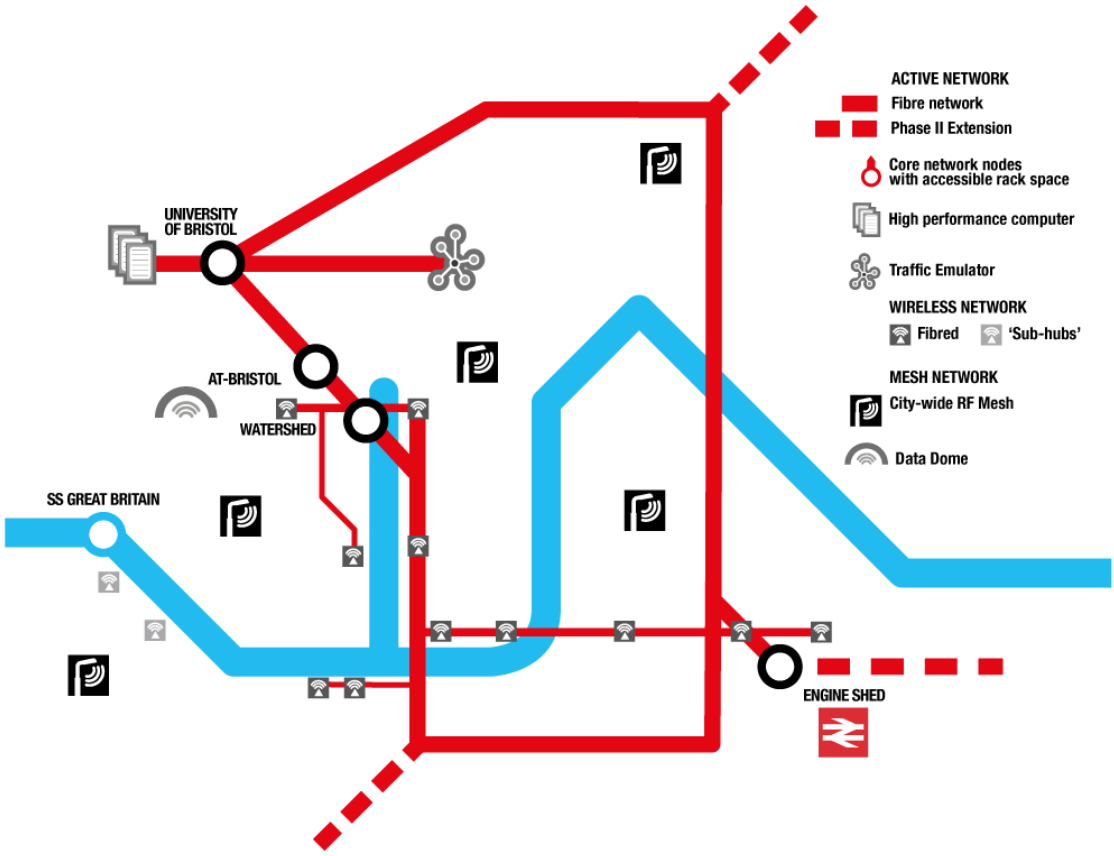

Figure 9 – the fiber network in Bristol

A new City Operations Centre ensures that services are effectively implemented. The centre went live in 2017, combining previously separate emergency control, telehealth and traffic monitoring functions. The new state-of-the-art control room has been designed with significant potential to make more use of the latest ICT technologies and also allows for a variety of organisations to come together to ensure the best coordination of services across the city.

In 2017 Bristol City Council procured a new open data platform (supplier: OpenDataSoft) and API provider (supplier: Urban Things). These new technologies give Bristol the ability to publish and share data easily and efficiently.

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1.4 Energy tariffs and ESCO markets

To better compare the intervention and understand the cross-fertilisation chances of the different measures implemented in the three lighthouses, a short overview on energy prices is reported below

1.4.1 Electricity

The final cost for electricity is made up of several components (energy, grid and taxes) with a different weight in each EU nation as it is shown in the graph below.

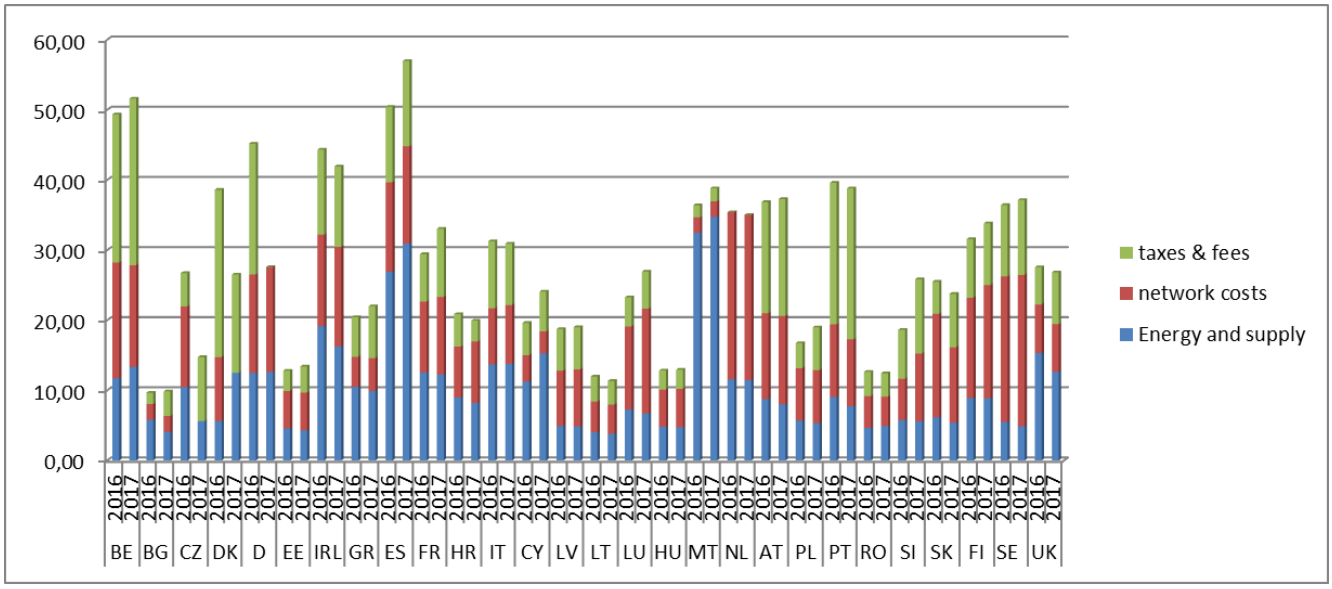

Figure 10 – tariffs composition for domestic users in EU (Source Eurostat)

Hereafter is reported a comparison between the final fees for electricity (c€/kWh) for domestic users in EU:

Country	FINAL TARIFFS FOR ANNUAL CONSUMPTION RANGE (c€/kWh)									
	< 1.000 kWh/year		1.000-2.500 kWh/year		2.500-5.000 kWh/year		5.000-15.000 kWh/year		> 15.000 kWh/year	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
France	28,83	29,57	18,76	19,47	16,98	17,23	15,82	15,87	15,52	15,38
Germany	45,36	47,37	32,8	33,62	29,73	30,48	28,16	28,75	26,81	27,15
Italy	31,57	32,95	21,73	22	23,77	21,11	27,56	21,78	27,54	21,18
UK	26,18	26,42	21,7	20,38	18,91	18,11	17,52	16,34	16,18	15,4
Spain	51,29	57,16	27,31	27,73	22,35	22,37	19,61	19,07	17,18	15,75
UE	**33,35**	**33,94**	**22,6**	**22,75**	**20,53**	**20,45**	**19,4**	**18,98**	**18,46**	**17,85**
Euro Area	**37,06**	**37,66**	**23,96**	**24,3**	**21,94**	**21,89**	**21,1**	**20,71**	**20,25**	**19,54**

Figure 11 EU electricity tariffs for domestic final users in 2017 (source: ARERA – Eurostat)

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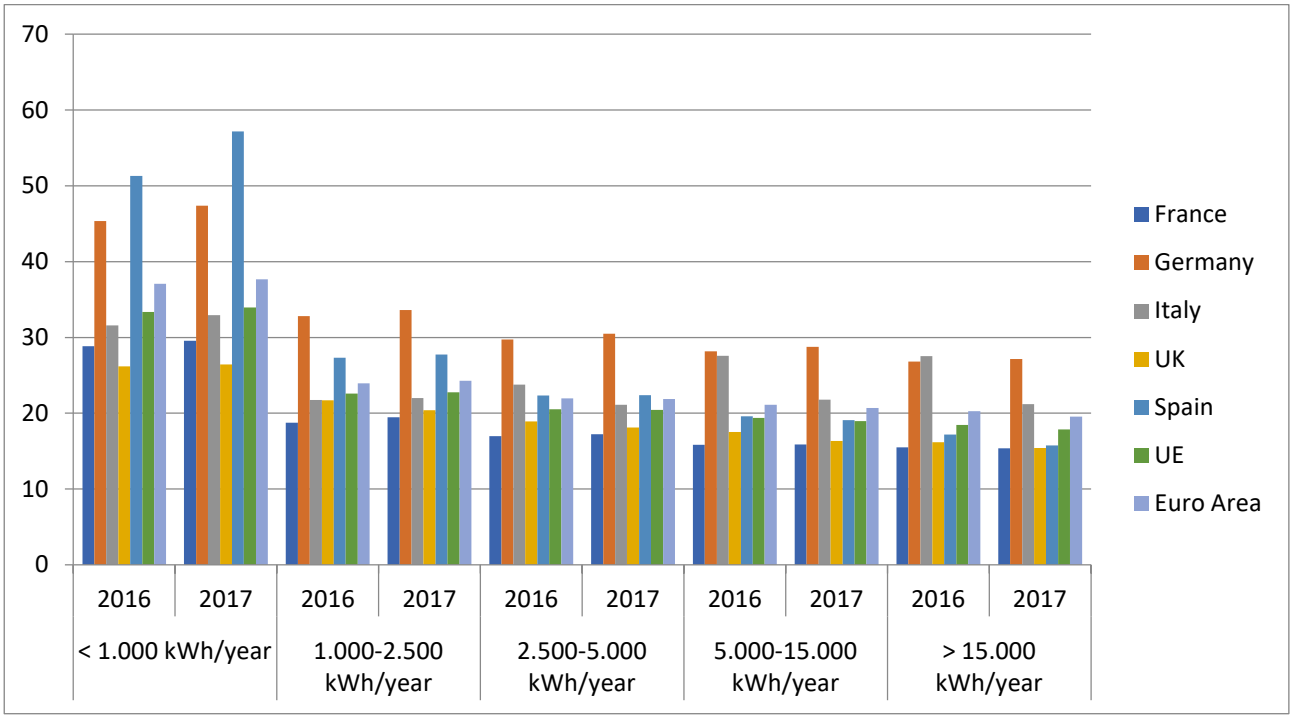

Figure 1 – EU electricity tariffs (comprehensive of taxes and fees) for domestic final users in 2017 and 2016 (source: ARERA – Eurostat)

Country	ENERGY AND SUPPLY TARIFFS FOR ANNUAL CONSUMPTION RANGE (c€/kWh)									
	< 1.000 kWh/year		1.000-2.500 kWh/year		2.500-5.000 kWh/year		5.000-15.000 kWh/year		> 15.000 kWh/year	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
France	22,13	21,74	12,67	13,01	10,97	11,11	9,89	9,97	9,58	9,56
Germany	26,55	27,65	16,2	16,4	13,85	13,86	12,57	12,45	12,14	11,93
Italy	21,95	23,95	14,36	15,72	14,29	13,29	15,42	12,48	14,79	11,29
UK	21,14	19,81	17,52	15,25	15,28	13,44	14,15	12,17	13,07	11,58
Spain	40,33	44,94	21,47	21,81	17,57	17,59	15,42	15	13,51	12,39
UE	**23,79**	**23,1**	**15,15**	**14,66**	**13,13**	**12,52**	**11,97**	**11,17**	**11,26**	**10,42**
Euro Area	**25,85**	**25**	**15,44**	**15,14**	**13,31**	**12,76**	**12,2**	**11,44**	**11,56**	**10,65**

Figure 13 – EU electricity net tariffs for domestic final users in 2017 and 2016 (source: ARERA – Eurostat)

In 2017, the tariffs profile in Spain shows the highest prices for lower consumers with the biggest differential with the euro area (i.e. in the countries that adopt the single currency) in the first consumption class, while the upper classes could benefit from a smaller difference even negative for the last two classes.
In 2017 the tariffs in Spain have been higher than the previous year of about the 3% in general on the energy component.

On the contrary for the Italian domestic consumers, electricity prices in 2017 remained lower than the average prices charged in the euro area for the first three classes of consumption (gross of taxes

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and charges). Analysing the net prices, in 2017 only the first category of consumption has registered a lower tariff than the euro zone one.
For what it concerns the last three categories of consumption, the tariffs per kWh have registered a decrease compared to the 2016, settling respectively on -11%, -21% and -23% in terms of final price, confirming the trend started in 2016.
It should be noted, however, that in 2017 the 95% of Italian customers rank in the first three classes of consumption (that is, consumption up to 5.000 kWh / year) and consume about 90% of the electricity sold in Italy to the domestic sector. It therefore follows that the overwhelming majority of Italian domestic customers in 2017 continued to pay lower than average prices for euro area customers.
As for the intermediate consumption class (i.e. 2500-5000 kWh), in 2017 Italy registered lower tariffs than the euro area average: in fact, Italian prices, taxes included, have decreased by 11,2% in comparison to 2016, while in the euro Area the average price reduction has been of 0,2%. The Italian reduction is the highest among all the European countries. In terms of net values, the differential price, however, remains slightly positive (+ 4%), despite the higher reduction, compared to the previous year, registered in Italy (-7% in Italy against -4% registered in the euro area).
In this case, the United Kingdom is the country that marks the most significant reduction from one year to the next (-12%).
The Italian families with an annual electricity consumption included in this intermediate class of consumption, with a price of 21.11 c€ / kWh, pay 6% less than Spanish ones, but 17% more than the UK ones.

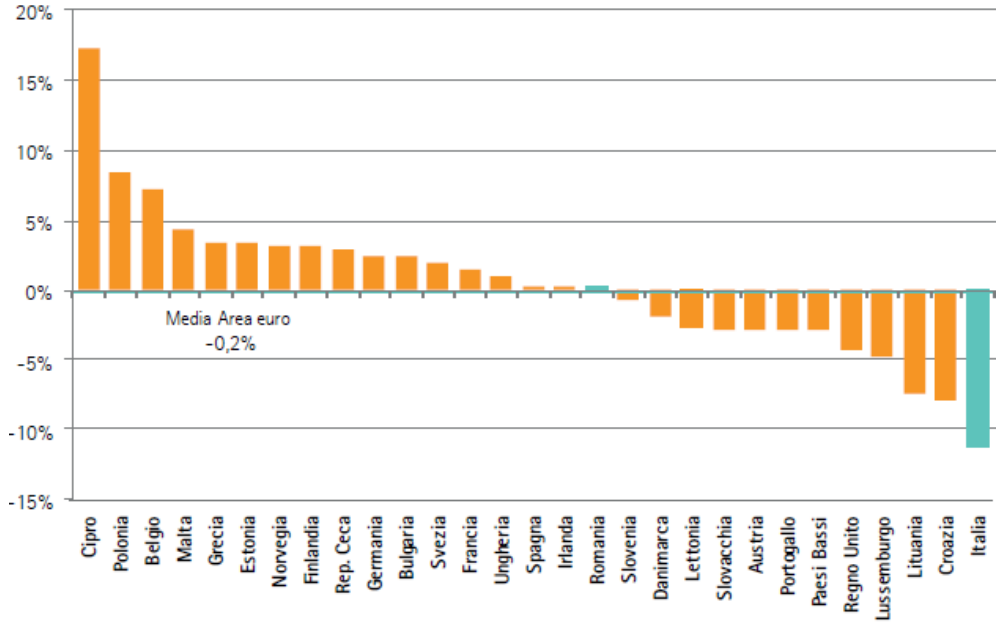

Figure 14 - 2016-2017 percentage variation of final prices for 2,500 and 5,000 kWh annual consumption class (source: ARERA - Eurostat)

It is clear from the graphs and the tables above that UK consumers are paying lower tariffs than the EU average and the Italian and Spanish families. Moreover, in the UK the difference between the

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consumption classes is not so high as in Spain or even in Italy. The decrease in the tariffs from the previous year is up to the 11% on the energy component. Taking into account the final tariffs, only the first consumption category has registered an increase in 2017 (+1%), while for all the other categories the tariffs have decreased.
The tariffs for e-mobility are slightly different: in Italy for example the market in this sector is under fast development and the tariffs (https://www.arera.it/allegati/elettricita/schede/TariffePrezziRicariche_st.pdf) are usually on consumption basis, taking into account also infrastructural costs, with a range for kWh from 0,26 to 0,50€ depending on the access point (private, public, max power,…).
The difference between tariffs in private and public charging has been experienced also in in Norway (Oct.2017, https://wpstatic.idium.no/elbil.no/2016/08/EVS30-Charging-infrastrucure-experiences-in-Norway-paper.pdf): "In Norway, the two national charging operators Fortum Charge & Drive and Grønn Kontakt have a payment model for fast charging where the customers pay per minute of charging, regardless of how many kWh the car receives. Payment for 50 kW fast charging starts at NOK 2,50/minute. This results in a kWh price of roughly NOK 3-5 depending on actual charging speed. At home, BEV users pay around NOK 1 per kWh (all taxes and fees included), making fast charging comparatively more expensive.

1.4.2. Gas

Regarding gas market, the bulk price experienced much more significant decreases than the final market, even considering the prices net of the tax impact.
The average differential for domestic users between 2016 and 2015 tariffs in EU is -5,3% in line with the Italian and Spanish data.
In 2017, natural gas prices for domestic consumers in the euro Area, including fees and taxes, have on average decreased by around 2%.
In Italy instead the gas prices have increased, except for the first class of consumption (<525 m3, mostly for cooking and hot water), for which a reduction has been registered compared to 2016.
However, on average, the Italian domestic gas prices have decreased by 0,02% from 2016 to 2017, while, in the same period, the Spanish ones have increased by 1,96% and the UK ones have registered a -11,81% variation.

Country	FINAL TARIFFS BY CONSUMPTION CLASS (m³)					
	< 525,36		525,36-5.253,60		> 5.253,60	
	2016	2017	2016	2017	2016	2017
France	145,41	147,37	70,12	70,52	58,02	58,26
Germany	111,49	108,55	68,89	64,54	63,31	58,14
Italy	114,95	113,01	83,01	83,44	74,5	75,32
UK	83,92	71,85	55,75	50,16	49,84	44,35
Spain	103,28	105,72	81,16	81	60,66	62,92
UE	**101,89**	**99,14**	**66,53**	**64,29**	**59,39**	**56,32**
euro Area	**116,24**	**115,86**	**74,03**	**72,43**	**65,63**	**63,21**

Figure 15 – EU final gas tariffs for domestic use (source: ARERA – Eurostat)

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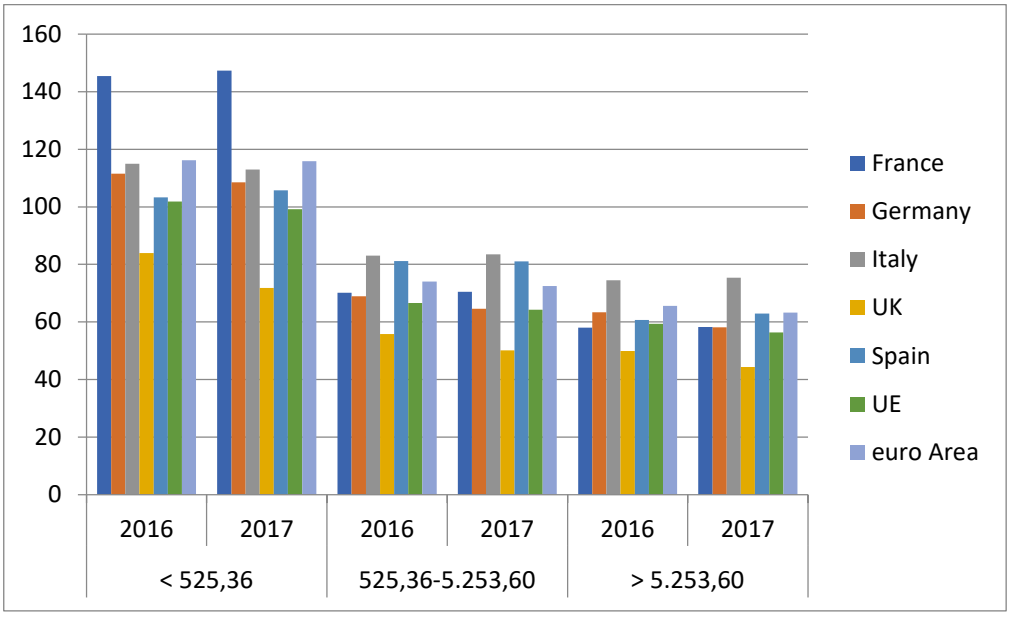

Figure 16 – EU final gas tariffs for domestic use (source: ARERA – Eurostat

Country	NET TARIFFS BY CONSUMPTION CLASS (m³)					
	< 525,36		525,36–5.253,60		> 5.253,60	
	2016	2017	2016	2017	2016	2017
France	116,95	117,81	54,08	52,93	44,41	42,97
Germany	84,82	82,36	51,62	47,96	46,9	42,57
Italy	86,17	84,51	53,03	53,26	42,07	43,02
UK	78,03	65,47	51,84	46,23	46,32	41
Spain	82,88	84,9	64,6	64,47	47,66	49,51
UE	**80,06**	**77,11**	**49,36**	**47,18**	**42,68**	**40,72**
euro Area	**87,41**	**87,01**	**51,28**	**49,85**	**43,34**	**42,34**

Figure 17 – EU net gas tariffs for domestic use (source: ARERA – Eurostat*)*

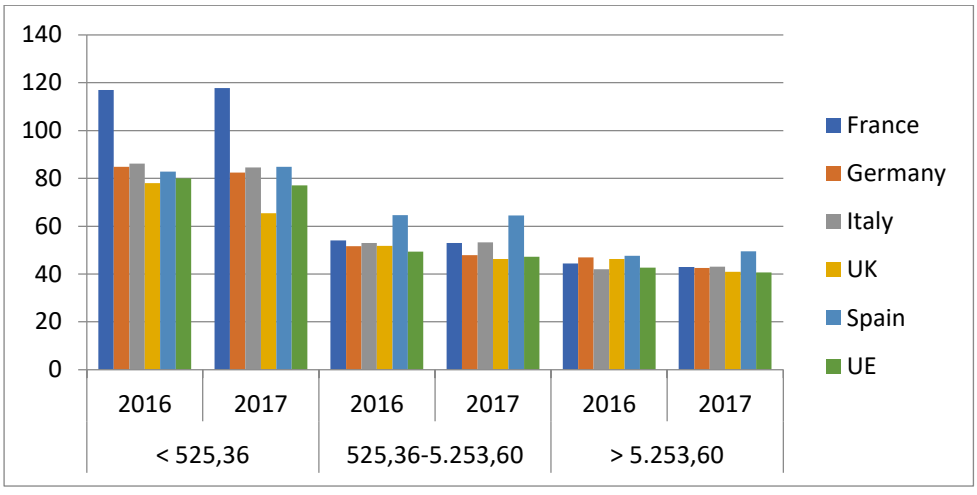

Figure 18 – EU net gas tariffs for domestic use (source: ARERA – Eurostat*)*

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In 2017, natural gas prices including taxes for Italian domestic consumers were significantly higher than the average euro area prices, with the exception of the first class of consumption (<525 m3, mostly for cooking and hot water). As for the pre-tax prices, the differences between Italy and the other EU countries are limited (except for France that register the highest prices).
In the case of Spain, the middle consumption class is the only one above the euro area average, while UK, also for gas tariffs, registers the lower prices.
Analysing the second class of consumption (that in Italy represents the 73% of total domestic gas consumption), Italy has the highest price compared to the other countries mentioned in the tables above.

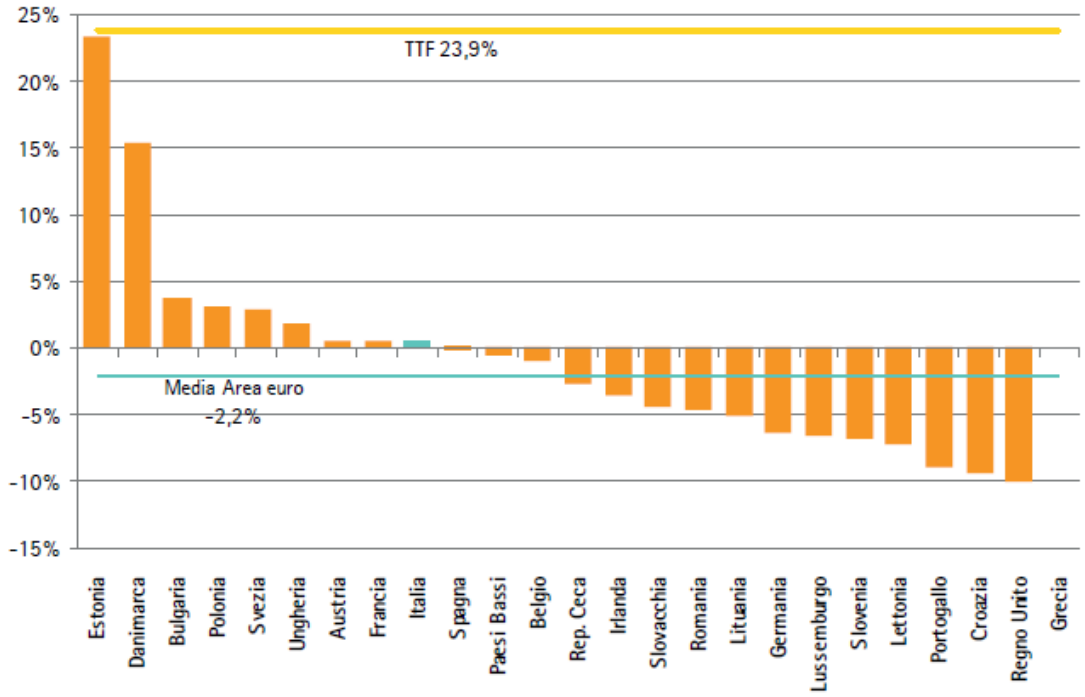

Figure 19 - 2016-2017 percentage variation of final prices for 525,36-5.253,60 m3 annual consumption class (source: ARERA - Eurostat)

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1.4.3. Overview of the ESCo markets

The status of the ESCo market in the three nations of the lighthouses has been summarised in the following table to enable comparisons and assessment of potentials for the replication phase.

	SPAIN	ITALY	UK
ESCo Market status (2015)	small	Well developed	excellent
EPC (Energy Performance Contracting) market status (2016)	growing	stable	good
ESCo market size	About 1 billion	1 billion	400 millions
EPC market size	n.a.	300 millions	100 millions
EPC definition	yes	In law 102/2014/07/04 and standard UNI CEI 11352/2014	Provided in the model contract (developed under RE:FIT) and in the Department of Energy and Climate change's Energy strategy and guidance documentation
Established sectors	• Public lighting mainly • Public buildings (hospitals, schools…), industrial sites, commercial buildings and shopping malls	• Public buildings (hospitals) and street lighting • "servizio calore" contract also for public sector • industrial sites and processes • few residential projects	• public buildings (schools and educational sites) • leisure facilities
Main barriers	• lack of trust • lack of information • financing	• low level of trust in the model • ambiguity about risk allocation (no standard docs) • regulatory instability	• complexity of the concept • for smaller costumers: raising affordable finance and undervaluing EE • split incentives

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Main barriers in public segment	• financial constraints coupled by problems with creditworthiness • ESA 2010 related restrictions	• Timely payment • Low demand	• Lack of capacity and skills
Key drivers	• Strong set of measures for EE • Many EU projects • Definition of standard agreements by Spanish Government	• Supporting schemes • ESCo/EPC definitions, standards, guidelines • Revolving founds	• Government's commitment as part of the UK EE strategy • RE:FIT, CEF, ESSENTIA and ECOVATE projects • EE founds and financing sources
Expected development	Growth is expected, dependent on the changes on legal pressures	Slow growth	Continue in the current growth trend
opportunities	Government support (legal and financial) to give impulse	Removal of external or structural barriers (energy prices, EU predictable legal framework…)	Continue with the public segment programmes, while increase capacities, support facilitators

Table 20 – Summary of the ESCO market in Spain, Italy, UK (developed from data by JRC 2016)

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ANNEX 2

Sommario

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1. The methodology adopted

The project consortium can count on a relevant number of Smart Cities stakeholders experienced in different fields: it was necessary to collate the knowledge of all partners, to validate the relevance of the initiatives selected.

The actions have been shared and the discussion open to any interested partner with the aim of cross fertilising the scale up and replication plans to be developed in the next years. A follow-up activity is already foreseen with followers within the city-to-city learning program at the end of the pilot implementations.

The information exchange is based on the previous Project outputs described in the following paragraphs: the City Model Canvas provided in WP2 (D2.2), the related City Data Canvas developed in WP7 (D7.1), the Value Chain from WP9 (D9.2,9.3) and the monitoring KPIs of WP10.

The analysis of each action starts from the data collected in the City Data Canvas (D7.1), developing the points closely related to the management model and replicability, providing all the info needed to develop the City Model Canvas or similar tools.

The contents analysed are:

- General description (what)
- Value proposition (core value – why)
- Players (stakeholders and users – who)
- Market analysis (framework)
- Impacts & Business model scheme (how)

To complete the analysis and wrap up the lessons learnt, for each action a SWOT & USP (Unique Selling Proposition) analysis have been included.

1.1 The City Model Canvas from WP2

In WP2 (D2.2), the City Model Canvas (CMC) has been introduced as a framework for analysing the business models of Smart Cities.

To begin with, business models usually have four parts. The first and central part is the value proposition: what exactly is the value that the organisation is offering? In the case of cities, the overall value proposition encompasses improved quality of life in an urban environment that is economically prosperous, environmentally responsible and socially inclusive. The second part of the business model includes the elements that are associated with delivering the value to the public. This includes a definition of who are the direct beneficiaries of smart services, where are the potential barriers to delivering that service, and in what form will the services be delivered. The third part of the model includes all elements that are associated with producing that value: these are the resources, activities and partners that will enable the organisation to create a product or service, or in this case, a 'smart service'. The fourth element of the business model relates to 'the bottom line, or the net benefits of the model. For firms, this net profit consists of the 'revenue streams' minus

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the 'cost structure' of the model. In the Smart City Business Model, this element was expanded and labelled as 'the triple bottom line' because it consists of the economic, environmental, and social costs and benefits that the smart city model will bring for the city.

1. Mission achievement: What is the ultimate goal that the city seeks to achieve?

<table>
<tr><td rowspan="2">6. Key partnerships
Who can help the city deliver the proposed value to the beneficiaries? Who can access key resources that the city council does not have?</td><td>7. Key activities
What must the city council do to create and deliver the proposed value?</td><td rowspan="2">2. Value proposition
What specific problems does the proposed service solve or alleviate?</td><td>4. Buy-in & support
Whose buy-in is needed in order to deploy the service (legal, policy, procurement, etc.)?</td><td rowspan="2">3. Beneficiaries
Who will directly benefit from the proposed services?</td></tr>
<tr><td>8. Key infrastructure & key resources
What key resources does the city council have to create and deliver the value?</td><td>5. Deployment
How will the city solve the problems of the Value proposition specifically?</td></tr>
<tr><td colspan="3">9. Budget costs
What costs will the creation and delivery of the proposed services entail?</td><td colspan="2">10. Revenue streams
What sources of revenue for the city do the proposed services provide? What other sources of revenue does the city have?</td></tr>
<tr><td colspan="3">11. Environmental cost
What negative environmental impacts can the proposed services cause?</td><td colspan="2">12. Environmental benefits
What environmental benefits will the proposed services deliver?</td></tr>
<tr><td colspan="3">13. Social costs
What are some of the potential social risks that the proposed service entails? Who is most vulnerable as a result?</td><td colspan="2">14. Social benefits
What social benefits will the proposed services bring about? For whom will these benefits materialise?</td></tr>
</table>

Figure 1 – The City Model Canvas developed in WP2 (D2.2)

The Smart City Business Model introduced in WP2 can be understood as a tool in the rehearsing strategy feedback loop. It is meant to be useful for city council managers to articulate the logic of how they can create and deliver value in a way that meets the objectives of their smart city strategy, and to assess the possible economic, environmental and social impact of these actions. As city managers use the CMC to rehearse different choices and assess their impacts, they will also be able to identify trade-offs between the elements of the triple bottom line and make adjustments before 'enacting' their initiatives.

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1.2 The City Data Canvas from D7.1

In D7.1 ("Peer review methodology") a template for describing the common actions in the three City's pilots has been developed: its aim was to harmonise the information and to have a unique reference for the pilot analysis.

There are not many comprehensive methodologies for analysing a smart city's integrated action from different points of view (technical, environmental, financial, social,…). Addressing this need, the proposed framework identifies the key elements of each smart services, their interaction and the overall effect of the integrated implementation. This tool, named the City data Canvas, inheriting the name form the economic sector models, can be used by lighthouses to describe their actions and the context:

In accordance with WP10 – Monitoring, it has been decided to consider two different levels of analysis: City level (first table of the template) and intervention level (following tables)

In the interventions tables, some standard elements have been suggested but cities were free to add tabs and to provide also files in annex to illustrate relevant aspects.

After a first review of the cross-cutting actions which make the pilots, a common core set of interventions has been agreed with the lighthouses as illustrated in the picture below.

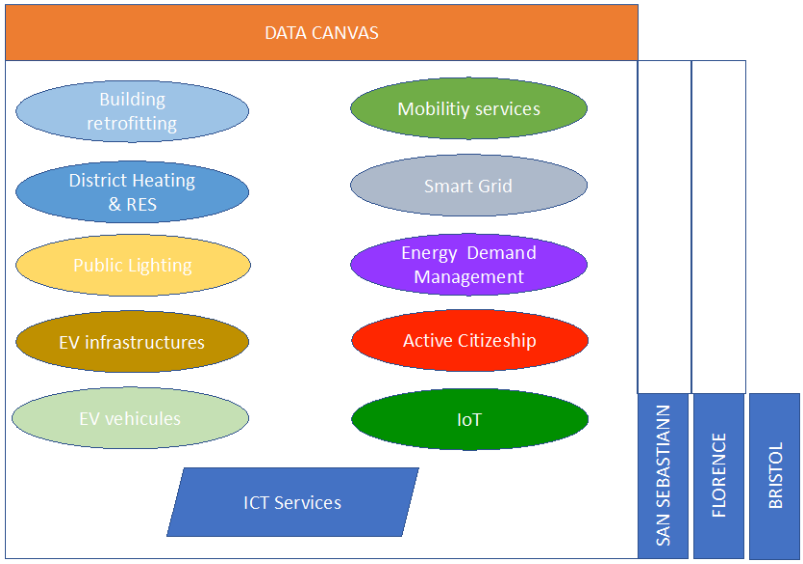

Figure 2 – Common topics suggested for the pilots description

In each table different kind of information have been asked to analyse the action from different points of view. The main sections included in the template are summarized in the following scheme.

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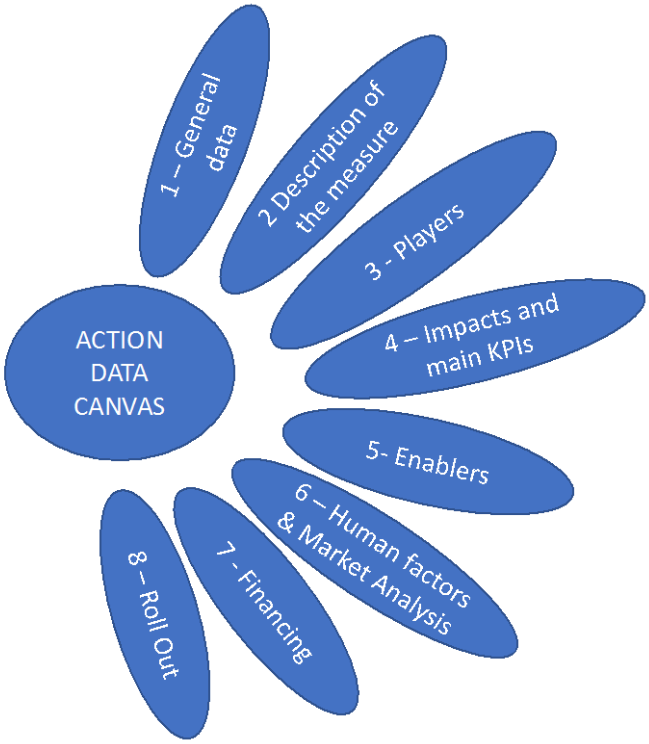

Figure 3 – Data composition for each measure

1.3 VCE and Management Model Schemes

The development of a smart city creates a network of organizations working "together" in a value chain in order to produce products or services (rif. D9.3). Taking inspiration from the sectorial Value Chain models in use in WP9 by Esade, for each action a management model scheme has been developed to illustrate the links and the value chain between stakeholders involved in the pilot to provide the action. A further step has been made, drafting for each measure a possible scale-up management scheme to extend and replicate the action in the next future supporting the replication planning phase.

The flows analysed in our management model schemes consider money transfers, services provision and information/data Exchange

1.4 SWOT & USP analysis

SWOT Analysis is a well-known and useful technique for understanding Strengths and Weaknesses, and for identifying both the Opportunities and the Threats of a process.

Originated by Albert S. Humphrey in the 1960s, the SWOT matrix could be a powerful tool to support strategy making. In this document it will summarise in a glance the analysis of each single measure, providing the basis for the replication plans development.

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The USP is the core value of the action, the unique thing that the measure can offer that competitors can't (make sure that it's something that really matters to potential customers/beneficiaries of the measure). It's the "Competitive Edge" which makes the action attractive for both the promoter and the beneficiaries.

1.5 The monitoring KPIs

The viability and the performance of City Model Canvas (CMC) of cities and Business Model Canvas (BMC) of interventions are the objective of the REPLICATE business models monitoring system (refer to Deliverable 10.7).

The monitoring of business models at the city level (CMC) and at the intervention level (BMC) are interconnected among each other, and so are the KPIs.

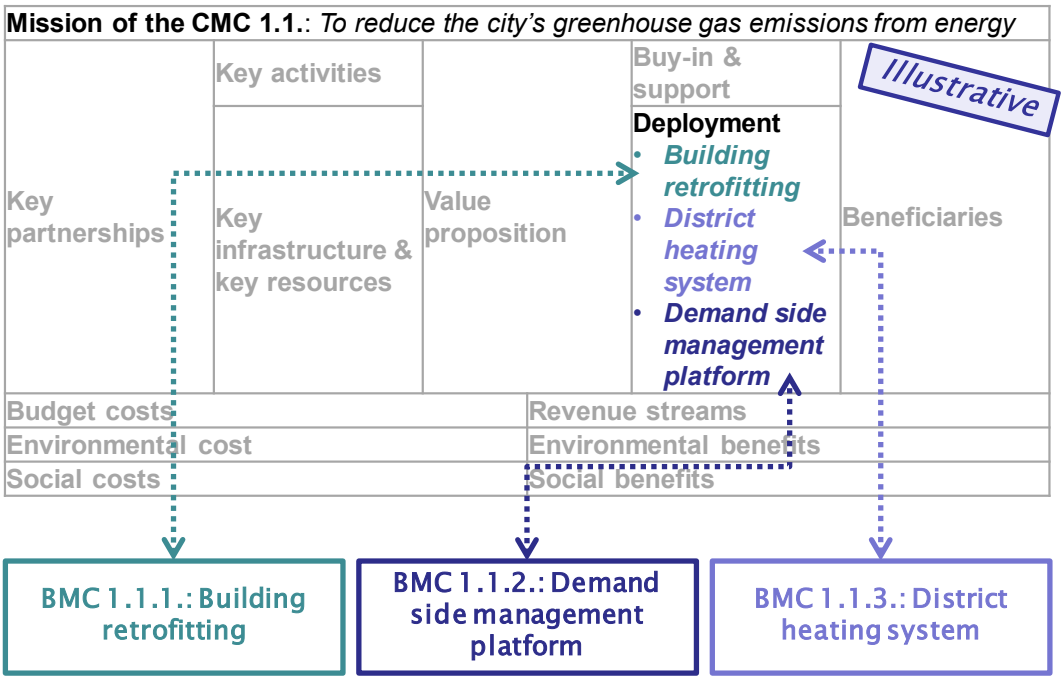

Figure 4 – Relationship between CMCs and BMCs related to energy efficiency (Source: D10.7)

The framework for monitoring business models in REPLICATE follows the following structure:

Figure 5 – Monitoring framework of CMCs and BMCs in REPLICATE

The data required are partially gathered starting with the present deliverable (making use also of the info collected in D7.1 City Data Canvas), and then using surveys (and additional data / information asked within the surveys to complete the monitoring), feeding regularly updated KPIs of business models.

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ANNEX 3

Sommario

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1. INVOLVED PROJECT PARTNERS LIST

The list of the involved project partners and their description, including their role in the pilot action, is provided for each lighthouse consortium in alphabetic order.

1.1 San Sebastian pilot

Fomento San Sebastian (project coordinator): Fomento San Sebastián S.A is a public municipal company dedicated to the promotion and the economic and social development of the city through innovation, the generation and transformation of knowledge, networking, and the promotion and management of projects, all in accordance with criteria of sustainability. Fomento de San Sebastián, has also designed a Smart Plan for the city with an Action Plan for 2016-2020, in which an integral plan for the city's smart strategy is established with the main challenge of establishing a strategic line with shared objectives and to give coherence and coordination to the public action. Fomento San Sebastián is in charge of the coordination of the Replicate project, leading and coordinating all the actions of the project and ensuring a proper execution. In particular, in the pilot of San Sebastian, it is in charge of the coordination of the actions deployed in the city and it is also the leader of the energy implementations. FSS has been developing a municipality WiFi service since 2004 to provide electronic communications services. Fomento San Sebastian is also the responsible for the deployment of the public fibre optic network of the city.

Within the REPLICATE project, Fomento San Sebastian is the owner of the District Heating and is in charge of continuing the implementation of the broadband wireless network to other areas without coverage and to enhance the actual post WiMAX deployment.

San Sebastian City Council (project partner): The municipality of San Sebastian is in charge of the implementations in the pilot of San Sebastian together with Fomento San Sebastian, who acts as the coordinator and manager of all the actions carried out in the city. Several departments of the city council take part in the project (leaded by Fomento de San Sebastian): Mobility department, Town Planning department, Infrastructures and Urban Services department, Etxegintza (Housing department), Environment Department, Public Lighting department and Citizen Participation department.

Commtech (third party): Commissioning company hired by UTE Txomin Enea that is in charge of validating the DH system.

Dbus (project partner): Compañía del Tranvía de San Sebastián is the company managing public urban transport in the city of San Sebastian under the trade name Dbus. The Company was founded

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in 1886. DBUS has implemented a full electric bus line. 26-Amara-Martutene line is offering service with 2 100% electric buses and 2 hybrids, which reduce consumptions and emissions into the atmosphere. DBUS is leading Spanish city in technology systems implementation.

DonostiaTIK- Municipal Computer Center company (third party): DonostiaTIK is the City Computer Center company belonging to the City Council of San Sebastian. DonostiaTIK is in charge of the coordination of the ICT and Infrastructures implementations and has deployed the Smart City Platform. They will do all the works related with the maintenance, integration and hosting of the common platform within the city with the local computers and data from San Sebastian city.

EUROHELP (partner): With a team of more than 200 professionals with extensive experience and high technical qualification, Eurohelp is an IT consulting firm that offers innovative solutions to private companies and the Public Administration. In San Sebastian Pilot, data gathered from Mobility, Energy Efficiency and ICT solutions are to be published in Linked Data formats (RDF), being Eurohelp responsible for both the data processing and transformation, Besides, Eurohelp is developing a Citizen Participation platform to assist municipality managers in decision-making processes. EUSKALTEL (project partner): Euskaltel is a Telecommunications Operator and CATV Operator (CableCo) in Basque Country established in 1995. It is Independent Mobile Operator operating its own network also for Mobile services. In order to do that, Euskaltel has adopted the Full Mobile Virtual Network Operator (MVNO) model, with its own CORE network. It is in charge of providing aggregated data about the mobility of people.

Giroa-Veolia (project partner): Giroa-Veolia is the specialist of energy and environment management services company of Veolia also dedicated to the maintenance, conservation and adaptation of buildings, installations and complexes of different nature, in order to improve their comfort, performance and security. Giroa-Veolia, company with more than 35 years of experience in the market, where it has been a forerunner in the Saving Share and in the Guarantee of Results, (ESCO Company) has created a new conception of job and service, based on a pragmatic approach to the demands of its clients. Giroa-Veolia is the partner in charge of the retrofitting intervention.

IKUSI (project partner): Ikusi is a global leader in the design, implementation and management of electronic systems with a large presence in the Spanish and international markets. IKUSI provides mobility solutions for the management and regulation of public transport, traffic management, road safety, charging for use, integrated fare management and security solutions infrastructure, citizen information systems and value-added services. Within the project framework, Ikusi is in charge of the deployment of the Smart Mobility Platform.

LEYCOLAN (Project partner): Leycolan S.A.L. was founded in 2015 as an engineering company, focused on providing high energy savings in street light infrastructures and converting the existing

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power grid into IP networks. The team comprises of highly qualified engineers, experts in Broadband PLC communication systems, and experts in lighting technology.

Leycolan takes part in San Sebastian Pilot, deploying and implementing the replacement of the street lights into new LED lights and the implementation of a new intelligent system and the remote-control system on an online operation basis.

SISTELEC (project partner): Sistelec is a wholesaler specialised in wireless communications who is in charge of Installation and deployment of high-speed mobile network based on postWIMAX technology. Sistelec has created the transport layer which will increase coverage areas and will include more robust wireless security protocols of the time. The transportation network develops relevant applications to manage all the services received by the high-speed mobile network.

Smartos (third party): Contracted by Fomento San Sebastian for the DH, is in charge of the supervision of all the necessary technical issues, definitions or changes and adjustment on the technical calculations.

UTE Txomin Enea (third part): UTE Txomin Enea is composed by Ferrovial Servicios S.A. and Tecnocontrol Servicios S.A., responsible for the running and maintenance of the DH.

UTE Txomin Berria (third party): in charge of the Pipeline network assembly of the DH reaching the buildings.

1.2 Florence pilot

Municipality of Florence (project partner):

The Municipality of Florence is the lead partner for the Florence pilot and is responsible for project management and coordination. The city is the owner of the Public Lighting network and service as of the Public e-vehicles charging network and service and it is the regulatory body for public mobility.

Casa spa, the social housing company of Florence and its neighbour municipalities, is the building manager and also an ESCo.; they have been in charge of the insulation and storage design.

CNR (project partner): The National Research Council (CNR) is the largest public research institution in Italy. CNR's mission is to perform research in its own Institutes, to promote innovation and competitiveness of the national industrial system, to promote the internationalization of the national

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research system, to provide technologies and solutions to emerging public and private needs, to advice Government and other public bodies, and to contribute to the qualification of human resources. CNR is involved in the Florence pilot, where it participates in activities on electrical mobility and energy efficient buildings for the Florence pilot. It also participates in cross-cutting activities, on the activities related to evaluating the effectiveness of energy efficiency actions. CNR has developed an external *Web Service* that can be accessed by the Energy APP through standardised APIs to construct the *Energy Profile* of dwellings by using very limited qualitative data.

e-distribuzione (project partner): e-distribuzione is a Distribution System Operator (DSO) and a subsidiary of the Enel Group, Italy's largest power company and Europe's second listed utility by installed capacity. With about 32 million consumers and more than 1,100,000 km lines, e-distribuzione is the second largest DSO in Europe. As well as providing power distribution services to its household and business consumers, the company runs R&D activities with the aim to constantly improve supply services to consumers and facilitate new advanced services to the customers in the framework of smart grids developments. Solutions for the integration of renewable energy sources as well as the active participation of customers in the management of the electricity network have been investigated and tested by the company under different national and European projects. E-distribuzione in REPLICATE is involved in the implementation of the Florence's pilot and it is responsible for the pilot's following activities: smart grids; energy demand management (i.e. Smart info), EV fast recharging infrastructures installation and management.

Enel X (project partner): Enel X is part of Enel group and entered the project to develop the public recharging network and its management system in connection with the city platform.

Mathema (project partner): Mathema is a R&D performing ICT company active since 1987 whose main mission is to support very large public and private organisations in the development of world-wide cloud based complex information systems, in the analysis and mining of large data sets, in the development of smart mobile apps. In particular the core activities and competencies span from Very Large database (VLDB) management, Crowd sensed information, Ontology based Data Fusion and Mining, Social Intelligence, Big Data/Open Data analytics, Augmented reality, and Service Gamification.

The specific contribution in this action refers to the app to manage the fast recharging network for taxi drivers (localization, availability, reservation of the stations)

SILFI (third party):

SILFI is an in-house (totally public owned) company of the Municipality of Florence and it is in charge of the public lighting system, the traffic lights and all the smart services of the city including info-mobility

It is enrolled as ESCO at national level and it works also on the Smart City Control Room action.

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SPES Consulting (project partner): SPES is a SME born with the aim to offer interdisciplinary consultancy services in the field of sustainability and innovation. The offered services include strategic planning, studies execution, researches, project solutions evaluation and assistance both in the phases of implementation and management. The company intends to apply and spread, at national level, the methodologies and the innovative instruments of the strategic planning, energy efficiency, sustainable mobility and environmental sustainability that are being developed in the European Union. Thanks to the diversified experience of its staff, SPES Consulting is able to offer a wide range of services with flexibility and competence.

SPES, above the technical support to the municipality of Florence in its pilot, aims to support cross cutting activities among lighthouses and to develop replication plans.

SPES has been involved for the last five years in the planning procedures of sustainable measures and in the evaluation of the impacts in Florence city. SPES main tasks on behalf of Florence are:

- evaluate the compatibility of the realisation of the project's objectives.
- support the selection of the technologies and solutions evaluating replicability potential and impacts.
- support the local consortium management.
- support the updating of the planning framework and stakeholders' involvement (System thinking, Maratona ascolto,…).
- support in the business plans definition.
- monitoring and EMS implementation.

Moreover, SPES, in close contact with the lighthouses and the other project leaders, will:

- promote the experience exchange among international partners.
- assess the technologies, approaches and business plans of the various measures adopted in the lighthouses.
- develop, together with the lighthouses, replication plans.

Telecom (project partner): The Telecom Italia Group is a major Italian enterprise and a key European strategic ICT player. Driven by technological innovation and a commitment to service excellence, Group companies operate in fixed-line and mobile telecommunications, Internet & Media, Information Technologies. Most of the R&D activities of the Group are performed inside the Innovation Department. The work carried out by the Innovation Department is the outcome of a strategic partnership with the main manufacturers of telecommunications equipment and systems, and with centres of excellence in research at the most highly qualified national and international academic institutions. Telecom Italia in REPLICATE has to provide the IoT Connectivity Platform currently at standard ETSI M2M and specifications for the following smart city services: smart waste, smart bench and smart green.

Thales (project partner):

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Thales Italia spa (THALIT) is the Italian branch of the French Group Thales and it provides technological solutions designed for several markets (Civil security, mobility and terrestrial transports, air navigation systems, protection and surveillance of critical infrastructures, airports, defence, etc.). Thales Italia is strongly oriented to innovation and to keep many and useful cooperation agreements with highly qualified universities and Research Centres in Italy, in addition to cooperation with international research centres trough structures and agreements organized at Thales Group level, worldwide.

Thales collaborates with the Municipality of Florence (Comune di Firenze) to implement the pilot by supporting the design of ICT solutions, video supervision, system integration aspects and the deployment of Smart City Control Room.

UNIFI (project partner):

The University of Florence is acting on the project with two departments: DINFO, Department of Information Engineering with its DISIT lab and research group, providing an infrastructure for cloud and distributed computing, and DIEF, Department of Industrial Engineering, involved with a research group that is historically based on the field of energy systems. DINFO is actively involved in the Florence pilot for Local IT Systems integrated with ICT Smart City Platform concept and ontology, Data Management, digital services development.

1.3 Bristol pilot

Bristol City Council (project partner): Bristol City Council is the lead partner for the Bristol pilot and is responsible for project management and coordination. It also leads on the Smart Homes and manages the retrofit and district heating interventions.

Bristol will deploy a number of smart integrated energy, mobility and ICT solutions in the neighbourhoods of Ashley, Easton and Lawrence Hill. The Bristol pilot will explore how technology could help tackle inequalities. REPLICATE offers an opportunity for people in Bristol to test "tomorrow's technology today", learning about and becoming familiar with new technologies that will become increasingly commonplace. The project will contribute towards Bristol's ambition to be carbon neutral and run entirely on clean energy by 2050.

Bristol is Open – BiO (project partner): Bristol Is Open (BIO) is a joint venture between the University of Bristol and Bristol City Council. It was initially funded by the local, national and European governments. BIO is an R&D test bed for experimentation around connectivity and IoT and Smart City solutions at a city scale. Bristol Is Open (BiO) is involved in the Bristol Pilot and is responsible for helping the project's technology to connect through the smart city platform and work together.

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Bristol is Open are involved in different tasks of the REPLICATE project such as:

The integration of the demonstration IT systems with ICT Smart City Platform. During this task, the demonstrated IT systems in Bristol will be integrated with the ICT Smart City Platform in a controlled environment. This will involve a large number of actions, such as:

- Network/computing resources; through optical fibre links (the core) and wireless connections (access points/network).
- Sensors and actuators through wireless solutions provided on the platform.
- Defining the interfaces for enabling existing or enhancing customer premises IoT connectivity.
- Active input into the creation of a set of software defined networking tools, development of the core Network Operating System (NetOS™) for network control and virtualization, prototype future demonstration (by UoB and Zeetta) of the Smart City Platform (FIWARE and NetOS) and integration with different ICT services.

They will also work together with other project partners to (for example):

- Feed requirements to inform creation of different sets of tools for the Software Defined Control.
- Enable Integration of the NetOS with a demonstrator FIWARE platform using well-defined FIWARE standards.
- Investigate different approaches for the integration of FIWARE in physical or virtual infrastructures.
- Capturing requirements and developing solutions or making changes to BIO to enable connections into BIO.
- Provide a capability to capture and host experimental data for agreed project partners.

Co-wheels (project partner): Co-wheels is the only independently-owned national car club, providing low emission, hybrid and electric cars on a pay-as-you-go basis for organisations and communities across the UK. Co-wheels now deliver car clubs in over 60 locations across the UK. They have a diverse range of operations, from city centres to villages. Some of their cars are used by local authorities and universities as pool cars for staff, whilst others focus entirely on being shared cars for local residents.

Co-wheels are involved in the Bristol Pilot and are responsible for deploying e-bikes and EV cars in a car club.

EV car club: electric cars – Renault Zoes – which have been deployed in the Ashley, Easton and Lawrence Hill area as part of the Co-wheels car club and accessible to the public, tourists and businesses / organisations.

E-bikes: e-bikes have been deployed in the Ashley, Easton and Lawrence Hill area as part of the Co-wheels car club; primarily designed to be available for voluntary healthcare sector organisations to facilitate journeys made during the working day, it is envisaged that this could evolve to become a

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public facing bike share scheme. The bikes are power assisted which means it will make it easier for people who may not usually cycle to get involved.

Esoterix Systems Ltd (project partner) who is in charge of operating the service. Esoterix is a Bristol (UK) based technology company creating the next generation of demand responsive software for transport providers. The vision is a first/last-mile service which takes people from where they are to where they want to go at a price which is 'everyday affordable'.

Esoterix combines the latest technological capabilities with engineering expertise to enable better access for all to work, healthcare and leisure facilities; better efficiency of road networks (less congestion), and, in doing so reduce carbon emissions.

Esoterix is involved in the Bristol Pilot as responsible for deployment of the electric taxi-bus.

Knowle West Media Centre (project partner): KWMC supports people to make positive changes in their lives and communities, using technology and the arts to come up with creative solutions to problems and explore innovative ways of doing things. The arts organisation and charity has been based in South Bristol since 1996 and offers skills training and employment for young people, an award-winning digital manufacturing space, and a diverse programme of creative projects exploring issues from energy to health.

KWMC is involved in the Bristol Pilot and are responsible for supporting Bristol partners to work with community organisations, volunteers and local residents within the REPLICATE Bristol pilot areas.

KWMC is also leading the activities of Bristol's 'Created by us' work strand, which will use their methodology 'The Bristol Approach to Citizen Sensing' to support residents to use appropriate digital technologies to tackle other issues within their area, such as damp homes and air quality.

Other partners involved in The Bristol Approach include universities and Ideas for Change; the University of Bristol and University of the West of England are assisting by contributing their experiences in the public understanding of science and through providing independent evaluation of the engagement process.

NEC (project partner): NEC Laboratories Europe focuses on software-oriented research and development of technologies to enable advanced solutions for society. In particular, innovative communication architectures and systems are developed that apply the software defined network paradigm to next generation fixed and mobile networks. Strong security technologies that provide data privacy and dependability are indispensable ingredients of future ICT solutions. Data acquisition and analytics technologies enable innovative solutions in the areas of smart transport, smart energy and sensor-enabled smart world solutions.

NEC is involved in the Bristol Pilot and is in charge of the Energy Management System – Holistic monitoring and analysis of demand and supply. This task will provide a management system for monitoring for consumers and producers, as well as control of the energy demand for selected use cases. This will include all energy resources made available in the Bristol pilot, e.g. the households

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smart whitegoods or the electric storage, electric vehicles' charging needs, intelligent lighting of districts, and the PV installed (monitoring energy production only) on public and community buildings (if any) during the project. The core work is focussing on the development of energy balancing algorithms to enable a demand-side-management (DSM) participation trial.

Integrating the control logic, the Bristol Pilot community power cluster's energy management is implemented and deployed for different business models. It will be evaluated for potential integration into the smart city operation centre or energy control room solutions, enabling customer assurance and satisfaction.

Route Monkey (project partner): Route Monkey is one of the UK's leading players in the optimisation of assets including vehicles, goods, people and energy. Its powerful algorithms can help organisations to cut costs and emissions, while improving productivity.

Route Monkey is a specialist developer of algorithms and is involved in the Bristol Pilot. It is responsible for adding functionality to the TravelWest journey planner. REPLICATE will provide flexible transport options and air quality improvements through integrated use of electric vehicles and electric bikes. Route Monkey will be supporting the project through enhancements to the Travel West journey planning app to help residents make best use of both traditional and new multi-modal mobility options within the city.

Sustainable Travel Solutions (STS): Sustainable Transport business being used to provide the support package for the bikes and leasing of bikes when and where necessary (servicing, maintenance etc).

University of Bristol – UoB (project partner): UoB is a leading research-intensive UK university, which was ranked among the top 50 universities in the world in the QS World University rankings 2016.

As part of the Bristol Pilot, the various University of Bristol teams (UoB-HPN, UoB-ITS, UoB-EFS), are mainly in charge of the development of digital technology and the deployment of sensors, e.g. air quality monitors and e-bike trackers (HPN, ITS), as well as contributing to citizen engagement research (EFS). UoB HPN and ITS had an integral part in the ICT systems demonstration and the ICT Smart City Platform (SCP) development (HPN) based on the FIWARE framework. They are also involved in the development of the demand side response trial with REPLICATE's smart homes. Citizen engagement tasks included researching community engagement and citizen perceptions (EFS). The ICT tasks involve a large number of actions that range from the deployment of the infrastructure to the demonstration/integration of the SCP with different ICT services and use-cases, such as citizen-led air quality monitoring. UoB-HPN worked on different approaches regarding the integration of the BiO Infrastructure and FIWARE. In particular, this consisted of:

- FIWARE installation in the physical network;
- FIWARE on a network slice; and
- FIWARE distributed over several slices.

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University of West England – UWE (project partner): UWE Bristol is a University Alliance university with a common mission to make the difference to cities and regions. They use their experience of providing high quality teaching and research with real world impact to shape higher education and research policy for the benefit of students, business and civic partners. They innovate together, learn from each other and support every member to transform lives and deliver growth.

UWE is contributing the Bristol Pilot, within which it is undertaking planning, coordinating and analysis tasks towards effective monitoring and evaluation of the implementations. UWE Bristol is also contributing to the cross-cutting analyses to support scale-up and replication.

UWE is preparing evaluation plans for each demonstration considering both quantitative indicators as well as qualitative information necessary to understand the effects of the implementations. The demonstrations include energy and mobility initiatives as well as ICT applications in the mobility sector. Once established, each plan will be followed with the collection of data, back-end recording systems, and specific investigations (surveys of users, interviews with stakeholders). In addition, UWE will assist in the analysis of the city experiences with a view to assessing their practicality and cost-effectiveness for replication elsewhere, as well as the development of a business-model road map for delivery.

Zeetta (project partner): Zeetta Networks transforms your network into an interactive programmable platform for better control, improved efficiency, enhanced performance and better cost controls of your existing infrastructure. Zeetta's vision is to allow enterprises, cities and network operators to scale up the capabilities of their network and satisfy the demand for data without escalating CAPEX and OPEX costs. Put simply, to make the most out of their network capability through use of our NetOS® software. Zeetta, part of the Bristol Pilot, is involved in developing ICT Smart City Platform and integrating REPLICATE ICT Systems.

Zeetta Networks will be working on ICT and infrastructure actions with some partners to:

- Integrate the demonstration IT systems with the ICT Smart City Platform concept.
- Creation of a set of software defined networking tools.
- Development of the core Network Operating System (NetOS™) for network control and virtualization. Understand the Network Operating System (NetOS) as a component for the Smart City Platform. It could provide different network slices for different users and purposes on demand (granting Infrastructure as a Service (IaaS)).
- Integration of the Network Operating System and FIWARE.
- Prototype demonstration of the Smart City Platform (FIWARE and NetOS) and integration with different ICT services.

ZEETTA will also actively input into the following actions:

- Different approaches regarding the integration of BIO Infrastructure and FIWARE.
- Contribute to the prototype demonstration of the Smart City Platform (FIWARE and NetOS)
- ICT services and their integration with the Smart City Platform.