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°

REPLICATE PROJECT

REnaissance of PLaces with Innovative Citizenship And Technology

Project no. 691735

H2020-SCC-2015 Smart Cities and Communities

Innovation Action (IA)

D4.10 Florence pilot action publishable report

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1. 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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2. EXECUTIVE SUMMARY

The "publishable report" aims to summarise the activity completed in the Florence pilot and to monitor achievements.
In the first four years of the project, from February 2016 to January 2020, the pilot action has been designed and almost implemented. A comprehensive set of measures involving energy efficiency in the Piagge area, electric mobility for taxi fleet and public recharging network, Smart lighting and Smart City platform has been deployed supported by the on-going activity on citizens' engagement that has been started long ago by the Administration for inclusive and participated decision-making processes.
Actions, for a total investment of about 8 million euro co-financed by the EU, have been analysed in detail from the technical as well as from the business model point of view in other project documents (WP2, 7, 9).
The present work aims at disseminating in an innovative way the actions to a wide, and not only technical, public.
It has been decided to exploit the expertise of the local consortium and to develop an APP where to store and update video and materials about each of the measures implemented.
This modality will allow the city of Florence to offer to any interested user an inside overlook of the pilot action with videos in the field and direct contributions of all partners explaining their innovations. Moreover, in the next period, it will be possible to add further contents with the last actions to be finalised and upcoming monitoring data.
The web-APP has been tested during the site visit of the project consortium in October 2019 and contents have been made available also in English to reach a wider public.

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3. INTRODUCTION

3.1 Relation to Other Project Documents

The definition of the work plan of the REPLICATE project is essential for achieving an effective innovation management system.
The District Management Plan delivered in WP1 (D1.5 Florence District management Plan) describes the guiding principles and the organisational structure of the whole pilot action in Florence, illustrating in detail the links and synergies among the different measures implemented and sectors involved in order to achieve impact and market objectives.
In this specific case the energy efficiency action in the pilot of Florence is closely related to the mobility action, whose progress is regularly monitored with dedicated deliverables, as well as with the ICT platform and apps development which are illustrated in specific deliverables submitted at the end of the implementation phase.
All the actions have been analysed in detail in cross cutting WPs; in this framework other public documents have been published with detailed analysis of technical solutions and management models in use (D7.3 and 7.5 Report on technical solutions v2 and Report on management models v2).

3.2 Reference documents

This document is based in the following projects level documents:

Ref.	Title	Description
REPLICATE Grant Agreement signed 240713.pdf	Grant Agreement	Grant Agreement no. 691735
DoA REPLICATE (691735)	REPLICATE Annex 1 – DoA to the GA	Description of the Action
REPLICATE Consortium agreement signed December 2015 (7th December version)	Consortium Agreement	REPLICATE project – Consortium Agreement
REPLICATE Project Management Plan	D1.1 Project Management Plan (v.1) (29/04/2016)	REPLICATE Project Management Plan
REPLICATE District Management Plans	D1.4 District Management Plan San Sebastian D1.5 District Management Plan Florence	REPLICATE District Management Plans

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	D1.6 District Management Plan Bristol	
REPLICATE Communication Plan	D11.1 Communication Plan	REPLICATE Communication Plan
REPLICATE Florence first year report	D.4.1 Pilot action progress report year 1 (ex D.41 e D4.18) & D4.3 Pilot action progress report year 2 & D4.5 Pilot action progress report year 3	REPLICATE Florence first, second and third implementation years reports
REPLICATE Pilot action measures advancement sheets	D4.2 & D4.4 Pilot action measures advanced sheets	REPLICATE Pilot action measures advancement sheets
Replicate Cross cutting analysis	D7.2 & 7.3 Reports on technical solutions	Technical analysis of the actions implemented in the three pilots
REPLICATE Cross cutting analysis	D7.4 & 7.5 Reports on management models	Management models analysis of the actions implemented in the three pilots

Table 1 reference documents

Where there are contradictions, the documents listed above supersede this plan. The Grant Agreement is the contract with the European Commission so takes precedence over all other documents.

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3.3 Abbreviations list

GA	Grant Agreement
CA	Consortium Agreement
DoA	Annex I-Description of the Action
EC	European Commission
H2020	Horizon 2020
LV/MV	Low/Medium Voltage
PC	Project Coordinator
PL	Pilot Leader
PMP	Project Management Plan
SCCR	Smart City Control Room
TC	Technical Coordinator
HP	Heat pump
CHP	Combined Heat and Power
WP	Work Package
WPL	Work Package Leader

Table 2 Abbreviations list

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4. DELIVERABLE DESCRIPTION

The aim of this deliverable is to illustrate the state of the art of the pilot measures, disseminating first results and lessons learnt, and the design and implementation process of the APP developed to explain and provide updates about the REPLICATE pilot action in Florence after the implementation phase.
The webAPP can be found at http://replicate.mathema.com

Picture 1: REPLICATE group in Florence

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Picture 2: the webAPP home page

All the aspects finalised in these 4 years belonging to the REPLICATE actions in Florence are included in the APP described under the present document which covers:

- Section 5: The evolution of the Smart City Pilot Action in Florence
- Section 6: The local policies framework
- Section 7: The management structure
- Section 8: The (web)APP, its technical development, contents and test phase
- Section 9: Impacts, innovation and replication potential of the actions
- Section 10: Lessons learnt
- Section 11: Conclusions

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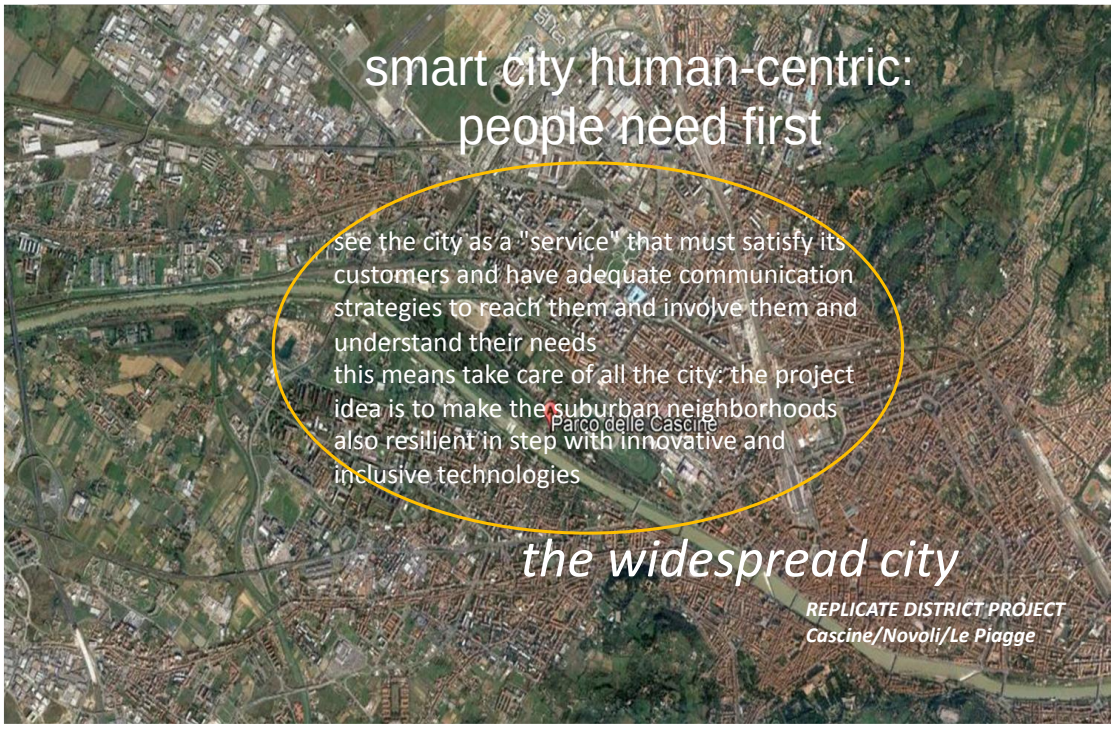
5. THE EVOLUTION OF THE SMART CITY PILOT ACTION IN FLORENCE

The aim of the pilot action was to realize an innovative, smart and integrated vision in a city district putting the Smart City Plan into action for a following replication and scale up at metropolitan level.
At the beginning of the project the pilot action has been described in a video cartoon to support communication and engagement of local stakeholders (available athttps://www.youtube.com/watch?v=RlWlXO2IsIg).

Picture 3: Florence pilot video home page

The pilot area in Florence involves the Cascine park, Novoli quarter and Le Piagge, in the north-west side of the city
The district has been selected because is hosting a mix of uses (industrial settlements dismissed and tertiary activities) including a big residential settlement (5000 m2 constructed area/6000 buildings), the presence of the biggest park of the city and the relevance for the mobility sector (city's entrance, airport, stations, highway, tramlines under construction, bike paths,…).
The main target of the action was to satisfy through technologies and new approaches, people's needs in terms of wellbeing, sustainability and quality of life.

OBJECTIVES



Picture 4: Florence pilot philosophy

The actions, insisting in the same district in a synergic way, are related to:

- Energy efficiency and renewable energy integration
- Electric mobility
- ICT platform and smart lighting

ENERGY

- ✓ Retrofitting and district heating: social housing, 300 dwellings with 700 people, 20.000 m^2. The main objective of the intervention is the exemplar transformation of two residential buildings, tackling energy poverty, implementing shell insulation and the disposal of old existing individual heating systems with a high-performance micro DHS producing energy with high RES exploitation through an innovative solar thermal seasonal storage. Target: saving consumption 50% and energy bills for tenants 10%.
- ✓ Smart grid: functionalities on L/MV network on 2 primary and 60 secondary substations The aim is to create a resilient network system by reducing outages and increasing the quality of service together with the resilience of the grid, enabling advanced functionalities and new value added services for the citizens and the PA Target: 25.000 citizens involved, - 3100 t CO_2 /year.
- ✓ Smart info: device to monitor real time electricity consumption. Residential

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apartments/families in the pilot area of Florence will be equipped with Smart Info, to increase customer awareness providing user-friendly info. A supporting app, including heating consumption and mobility behaviours, with gaming to reward the energy heroes is foreseen. Target: 600 families involved.

MOBILITY

- ✓ e-mobility: promote the EV The aim is to improve the public recharging network in the pilot area and make the taxi service more efficient (full electric taxi vehicles and very fast recharge) to decrease the impact of mobility and to promote e-vehicles also in the private sector; facilitations for taxi owners are already in place (reserved fast recharging stations, app to book the recharge and see real time info about the public stations, agreements with vehicles providers for special conditions, reduced license fees, prioritization of the e-service). Target: 100 e-taxi, 6 very fast recharge for taxi drivers, recharging public stations, - 250 t CO2 /year
- ✓ advanced mobility service: new services to enhance sustainable mobility and to reduce traffic. The aim is to offer a comprehensive information system to control mobility for the PA, advanced mobility services to citizens, an ad hoc system for taxi fleets. Target: improve and promote sustainable public mobility.

ICT & INFRASTRUCTURE

- ✓ Smart lighting: refurbishing with led lights and empowering adding services the public lighting infrastructure. The action consists in the furniture of led bulbs with technical equipment for value-added services (refurbishment of the network), luminance digital sensors, self-diagnostics and maintenance management in order to reduce the emissions and light pollution and enable the deployment of a smart light system (with sensors, WiFi, light video surveillance on board). Target: 1000 led lights, value-added services, - 3500 t CO2 /year.
- ✓ ICT: city-wide dashboard regarding Smart City measurements. The aim is to achieve a responsive smart city platform (Florence control room) to manage the city in real time, enabling the remote control by the city decision-makers, and to improve the digital basket for citizens with new apps and open data. Data management, big data and open data, local services management and digital services are at the basis of the development of the structure. Target: comprehensive Smart City Platform, wide digital basket for citizens in use from 2019.
- ✓ IOT and capillary network: smart IoT devices and the supporting infrastructure tested in urban environment. The aim is to develop a sensible city able to make use of smart and intelligent technologies: smart irrigations, smart benches, smart waste and TiM CityLink are the first internet of things applications tested in the pilot area. Target: to develop three new IoT services and the related capillary network able to interface with the city platform.

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In the first 4 years of the project, the different pilot actions have been deployed, tested and revised -if necessary- according to the targets and upcoming developments.
The scaling up and replicability has been analysed and for some actions the extension is already on going (public lighting, smart waste) or planned (e-mobility, ICT services).
The objective is to continue with the validation of a comprehensive and sustainable City Business Model to be replicated in other districts, at metropolitan level and in other similar cities.
The actual status of the actions is described in the following table.

ENERGY EFFICIENCY "PIAGGE" BUILDING

Picture 5: The Piagge works

- Retrofitting works on going (almost finished)
- Contribution for retrofitting received (Piano Periferie)
- DH (phase 2) and solar storage (phase 3) revised designed verified and approved (also by "services conference")
- Phase 2 tendered and assigned
- Phase 3 tendered
- National contribution demand for phase 2 and 3 on going (uncommon technology)
- Information meetings with stakeholders
- First monitoring results

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LESSONS LEARNT

- Legal framework can influence timing (and economic feasibility) of implementations: the schedule of such projects has to comply with public procurement timing and that should be taken into account also in the definition of the incentives income supporting the realization
- Works have different costs in each nation/location and have to be tailored to the specific context
- A site with less boundaries could result cheaper allowing the construction of new volumes (not underground) both for the storage and the technical rooms.
- A dynamic simulation could be a very useful support to the design phase in order to select the proper size of the storage, optimizing RES coverage and costs.
- Capacity building is needed for designers and plant managers as far as there are no national examples already in place.

REPLICABILITY

All actions will be included in the SECAP under development (April 2020):

- Retrofitting high replicability
- Small DH systems high replicability
- Solar TES replicable in different conditions

SMART GRID AND DEMAND SIDE PLATFORM

Picture 6: The smart grid and its test on newspapers

HV/MV substations:

- upgrading of the peripheral devices completed
- wiring with optical fiber – completed
- installation of protections on MV lines completed

MV/LV substations:

- installation of smart devices for advanced automation – completed
- Monitoring on going.
- Fault test carried out positively

Smart info+ kit distribution on going

- Agreements re-defined (new partner) and in place

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•Agreements with consumers distributed/signed
Info and distribution campaigns on going

LESSONS LEARNT

- the cost is the main barrier for the implementation, but if the action is included in a planning tool as enabler (for RES, e-mobility, users awareness, active demand management…) it could be easily deployed.
- The technology is improving faster and faster and this aspect must be taken into account while designing the extensions (from the proposal phase to the implementation an update of the technology foreseen has been needed).
- more information for users and service providers (active demand managers, prosumers…) could enhance and accelerate the exploitation of the new opportunities offered by the updated grid

REPLICABILITY
E-distribuzione is in the process of implementing replications in other locations, at urban level with the possibility of extension at national level.

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E-MOBILITY (E-TAXI FLEET WITH DEDICATED FAST INFRASTRUCTURE, PUBLIC CHARGING NETWORK) AND ADVANCED SERVICES FOR CITIZENS

Picture 7: The fast recharge for e-taxi fleet, the public infrastructure and the SUMP

- 70 new e-licences activated
- 4 fast stations in use for taxis and two more fast recharging stations installed
- Locations for new public stations defined in the district: 13 public stations installed, others to be completed by new partner Enel X and connected to EMM
- Study about the impact of the e-mobility on the grid completed by CNR
- EMM further adaptations completed: new legal framework with new interoperability model (CPO-MSP) tested with different providers
- App for taxi drivers in use after the test phase
- Services for vulnerable people active

LESSONS LEARNT

- For the recharging stations installation, fast and public, the collection of all the competent bodies opinions/authorisations has taken more time than expected, because of the bindings of Florence's cultural heritage and also of the new national rules on public tendering.
- The electric vehicles technology and the recharging procedure need training before the daily use.
- Some exchanging protocols between the fast recharging station and the different car models have to be tuned to work properly.
- There is a need of surveillance for the recharging infrastructure in some areas due to vandalism problems and to avoid unwanted parking.
- The interoperability is an important issue (legal framework) and energy tariffs for e-mobility are very different in the market and should be analysed in detail to find the best option for the different users.
-

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REPLICABILITY

- The PUMS – metropolitan city sustainable mobility plan (WP7) includes the extension of all the measures within 2030 with impacts and costs

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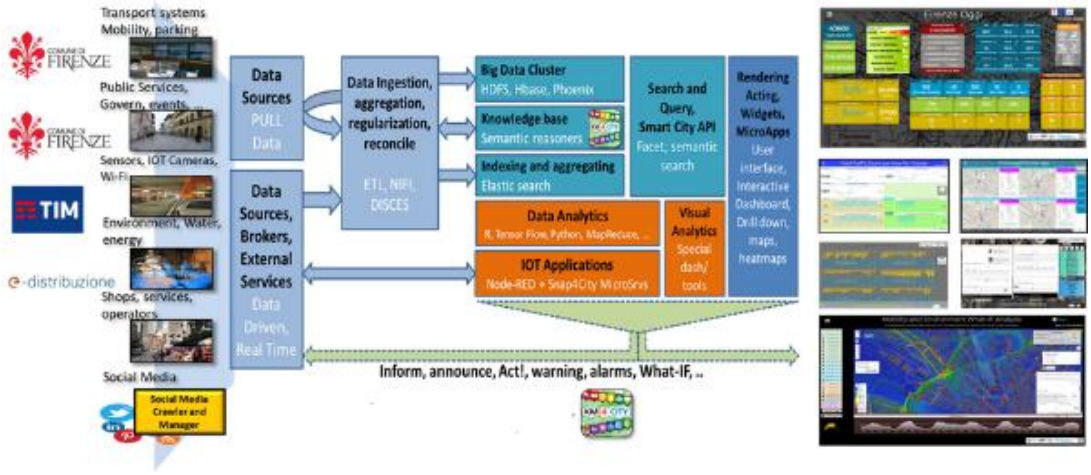
SMART CITY PLATFORM AND LOCAL SERVICES MANAGEMENT



Picture 8: The Florence ICT platform architecture and dashboards

- Platform requirement and specification updated
- Assessment of the available data sources with definition of metadata, first test of real-time exchange protocols and visualisation modalities
- Replicate platform finalized and connected to subsystems (Traffic supervisor, Telecom OneM2M platform for IoT sub-systems, EMM, EMS, 2 Replicate APPs…)
- ORION Fi-Ware Context Broker integration as a parallel data collection option (Smart Irrigation IoT deployment).
- Foreseen data sources integrated with property rights and data ownership analysis (data licensing and agreement); new data sources included in the extension phase
- Dashboard for decision makers has been prototyped
- Municipal personnel trained
- Services deployed in the Replicate platform
- Cyber security test and risk assessment analysis carried out by Thales

LESSONS LEARNT

- Open source approach is a key for scalability and lock-in avoidance even in the Smart City context
- the commitment of the City is fundamental: REPLICATE allowed the City to go beyond the existing Open Data database, to experience a smart city complex and dynamic infrastructure and a real Big Data initiative, not just from a technical perspective, but also with cultural new approach from top decision makers to the technicians managing the PA & public services, to the citizens

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- The daily management of city resources is usually performed by a set of separate city operators and in most cases also delegated to in-house companies. Independent control rooms may be a positive issue to be reactive and solve micro-problems autonomously but, in presence of relevant disasters the distributed solution is not efficient and effective as it should do for the lack of concertation and synchronization of knowledge and actions.
- It is a continuous process that needs to be daily monitored and evolved: issues in data sources ingestion interfaces, source-sub-systems continuously evolving, new IoT subsystems appear in the city to be integrated
- It was necessary to provide tailored dashboards for different user roles and a specific training: the final indicators, provisions and suggestions calculated by complex data processes must be easily understood by the final user of the data representations considering his specific competences.
- Cyber Security's complete investigations could be considered invasive for the systems owners which can hinder cooperation.

REPLICABILITY

- Extension of the data sources and new dashboards developed by municipal personnel
- roll out phase with the physical realisation of the SCCR is on-going

IoT


Picture 9: The Smart Bench, Smart irrigation and Tim CityLink in Florence

- First CityLink smart call-box by TIM and further deployments (4 in total)
- Alia 9 smart bin prototypes in Santa Maria Novella connected to platform
- Smart bench in Museo Novecento
- Design and tender of other smart benches in Cascine Park
- Continuous development of subsystems for monitoring smart city services

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- Realisation of IoT Smart Irrigation for the two gardens "Ex officine Galileo" and Leopolda station and first data acquisition

LESSONS LEARNT

- 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
- As done in Firenze every new object in the city that becomes "smart" shall be integrated into the IoT Platform and the smart city control room to guarantee and maintain the "city holystic view"

REPLICABILITY

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. In the replication phase the smart devices will be required to dialogue directly with the Smart City Control Room through the open API developed.

In particular:

- Advanced new platform for smart waste under deployment city-wide by Alia starting from trials done in REPLICATE. Data under integration from the new platform into the REPLICATE BigData platform (new intelligent solar connected bins by Alia)
- Further gardens/parks with smart irrigation (possible inclusion in SECAP)
- The Smart bench shows a big replication potential in urban areas and private spaces. It can collect data (presences, environmental data …) and provide connection and contents (audio & web).
- TIM City Link introduced by Telecom in the project is providing innovative services and info and it can be easily replicated in other urban areas.

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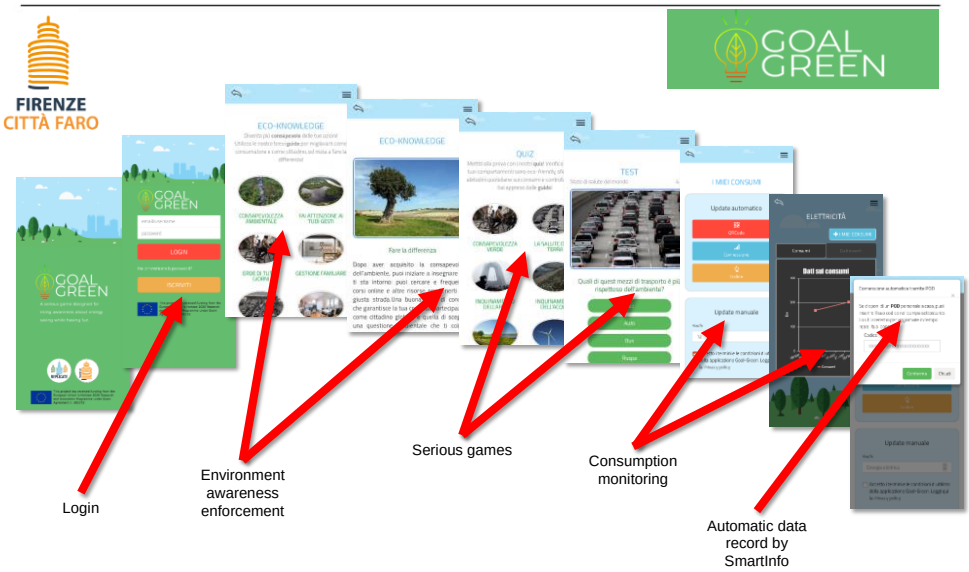
DIGITAL SERVICES (APPs)



Picture 10: The Goal Green App

- Apps tested with different mobile devices
- Apps have been hardened through performing a penetration test and producing a mitigation plan.
- Cyber security audit has been addressed in order to verify the compliance of Apps with GDPR EU regulation. Both activities have been leaded by Thales
- Energy App with educational target (10-12-y) added to improve awareness on responsible use of resources also for schools
- CNR has developed an external Web Service that can be accessed by the Energy APP through standardised APIs to construct the Energy Signature of dwellings by using very limited qualitative data. Specifically, the Energy Signature Web Service can compute three different types of Energy Signatures: The Design Energy Signature (DES), (6 variable geometric and morphological characteristics), the Historical Energy Signature (HES), able to identify any anomalies on the energy behavior, the Real Energy Signature (RES). The user is now able to record regularly the energy consumption and to compare them with a "standard" based upon an algorithm developed by CNR. These consumptions can be recorded manually but there is also an option to allow automatic recording via smart-metering devices present at home.

LESSONS LEARNT

- Gaming could involve a wider range of population keeping them interested in the program.

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- Main obstacles for energy apps: data uploading, constant contents updating for educationals, reliability of uploaded data, GDPR

REPLICABILITY

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". From the economic perspective this kind of apps are intended for being used as complementary to environmental programs in local governments (municipalities, regions, etc.)

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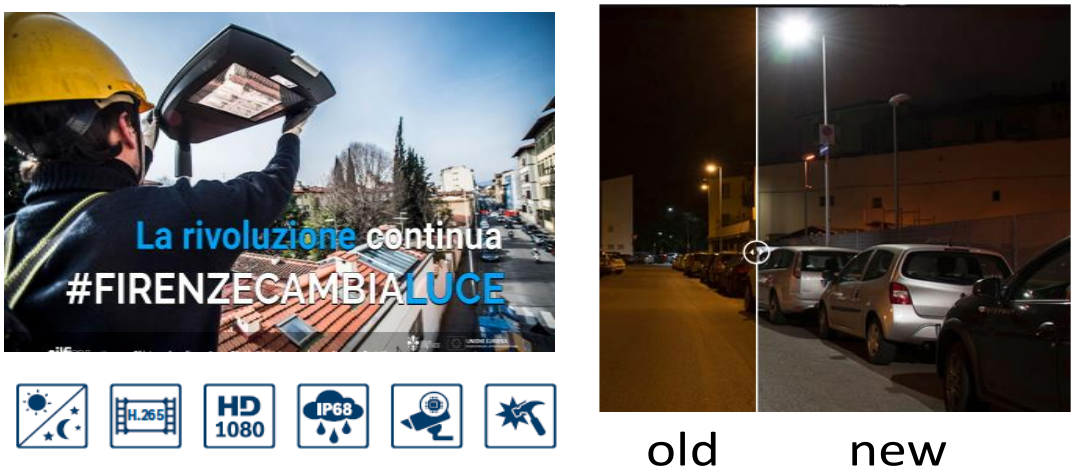
SMART LIGHTING



Picture 11: Florence Smart lighting in practice

- Refurbishement of 1000 lumposts completed (which 286 only changing the bulbs and 695 with a complete refurbishment of the network)
- 4 LTZ smart gates deployed at Cascine Park, with LED, traffic control, wifi and anemometer
- In pedestrian areas (parks) the adaptive lighting has been adopted in 70 lighting spots
- 30 cameras have been placed.
- monitoring started as well as roll out

LESSONS LEARNT

- The national legal framework and the local peculiar situation (cultural heritage) have deeply influenced the realization schedule; these different boundary conditions ought to be taken into account in the replication plans
- Regarding sensors and video cameras maintenance is a crucial issue. They should allow remote diagnosis and intervention.

REPLICABILITY

The action is being extended to other districts thanks to the PON Metro integrated project: more than 30.000 led will be placed

The total consumption of the public lighting system is already reporting benefits from the roll out of the pilot test: considering the extension of the pilot to other districts the saving is reaching 6,5 GWh/y and 3.170 t CO_2

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6. The local policies framework

Picture 12: the evolution of local sustainable policies and commitments in Florence

With the Smart City Plan, the Municipality of Florence has started to implement measures or support 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 supporting the enhancement of sustainable mobility and affecting at the same time the use of biomasses and biofuels. Florence policies regarding electric mobility, started some years ago and defined in the electric mobility action plan, 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 sustainable urban development strategy like the Multi-fund National Operational Programme Metropolitan Cities 2014-2020 (PON METRO), the suburbs program (available also in many other big cities and useful for the replication) or the SUMP and other EU projects about resilience and new technologies.

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Other national subsidies are available also for private players (namely "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.

6.1 Energy efficiency

The municipal Structural Plan, approved in 2010, and its regulation plan endorsed 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 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.

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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 should have been reached.

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.

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

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6.2 Mobility

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 per 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.

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 have been built (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 to manage traffic lights and the creation of a modern traffic management centre,

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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, 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 years, 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.

6.3 ICT

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 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.

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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.
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.

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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.

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7. THE MANAGEMENT STRUCTURE

7.1 Local consortium

The local partnership has been built on the basis of existing collaboration on different previous projects that have been capitalised and also based on partners' skills and availability in supporting the municipality in this ambitious and innovative test.

Picture 13: the Italian consortium

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.

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Casa spa (third party): 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 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.

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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.

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/TIM (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

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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):
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.

7.2 Pilot management structure

In Florence, the Municipality is playing the leader role at pilot level and in each subsector (energy, ICT, mobility, monitoring) with the technical supervision of SPES.

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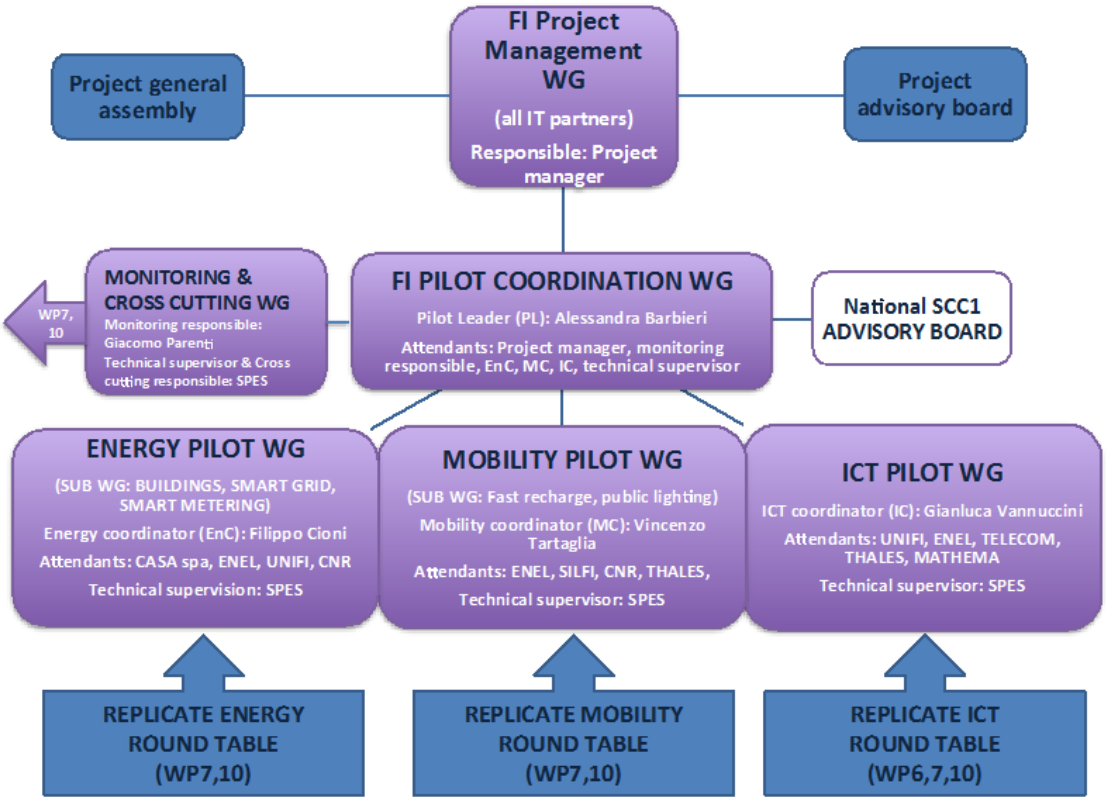

Picture 14: Management structure in Florence

To better manage the project and according to the district management plan, a specific structure with periodic meetings has been set up since the beginning and monitored event thank to the quality annual report (WP1)

This structure is essential for breaking silos in the integrated pilot action implementation, ensuring the exploitation of synergies and the quality of the results.
At national level, a further Advisory Board has been created assembling representatives from the Italian cities participating in other SCC1 projects or UI actions. This group is aimed at enhancing a deeper exchange among smart cities at a national level that are facing the same challenges under the same legal framework, coordinating their communication activities and the dissemination of the results and the replicability of the smart actions.

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8. The (web)APP

In order to have a more efficient way to present the outcomes of the project, that are – by their nature – widespread on a large area and more important to have a permanent way to access a description of the installation and their evolution over time we decided to develop an app conceived as a companion for the site visit held in Florence on 30th October 2019.
The SiteVisit app has been designed and developed by Mathema – following the indication of the Municipality of Florence – and is accessible at the following link
http://replicate.mathema.com/map.html

The app shows the geo-referentiated installations, also for giving an idea of their geographical dislocation.
Each location has an "information pill" (a video explanation and/or a graphical presentation) explaining the proposed solution (see Chapter 8.2).

8.1 The APP technichal development

The SiteVisit (web)App was created using the NodeJS framework for scaffolding, deployment and server-side management of the application, while on the client side, the interfaces were created using the HTML and JQuery languages. The connection between NodeJS server and client is implemented through RESTful API calls. The information showed into the program are geo-referenced upon the real position of the various site where the Replicate project had an installation

The design and development of the portal took place following the principles of ease of access and replicability of the project. The decision to follow these principles led to the adoption of solutions, both in the technical field and in the choice of interfaces.

- Ease of access
  The portal was designed to be fully responsive and therefore can be used both via desktop and via mobile device (smartphone and tablet) without losing access to content.
  It was preferred to avoid creating the portal only as a mobile app (therefore to be installed on mobile devices): this decision made it possible to avoid a series of problems, such as that of compatibility with the different versions of OS present on the devices, which could affect on the distribution of the portal. The choice of a web portal therefore allows access to all devices equipped with a web browser, regardless of their OS.

- Replicability
  In order to ensure the best possible replicability of the portal, to adapt and use it in other contexts with the minimum effort we:

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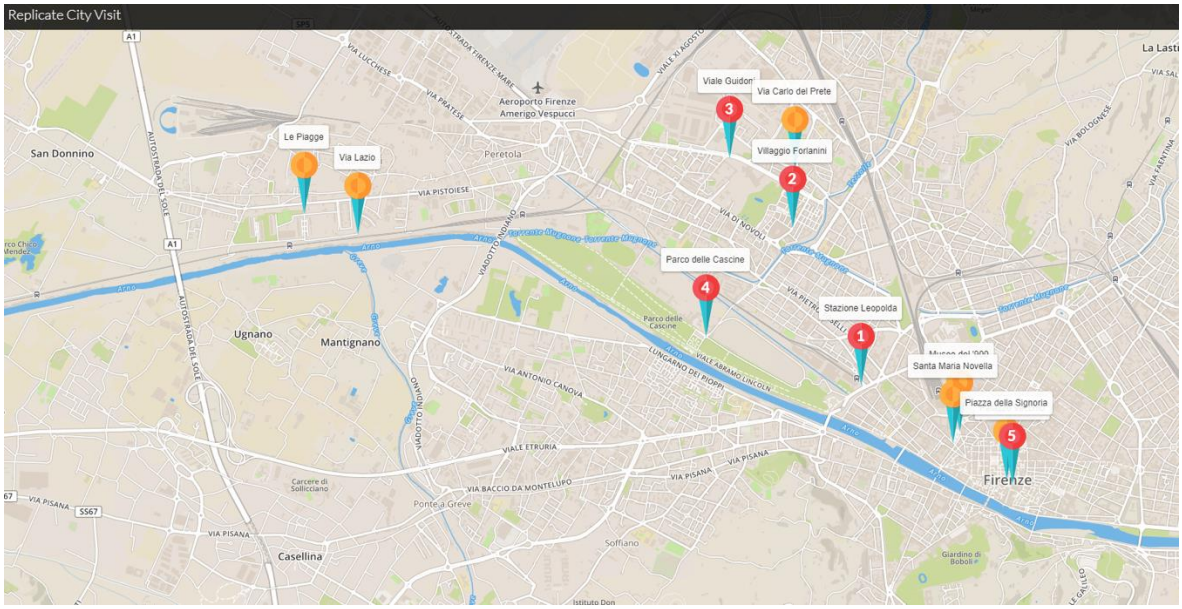
- editable graphics: the graphic components that best identify the project (name, logo, color, etc.) can be changed quickly without impacting the entire portal layout
- access to content: the links to the contents shown in the portal (geographical positions, videos, photos, texts) are obtained by reading an encoded JSON file, without going through other superstructures (such as relational databases)

It is worth to stress that this App, named "SiteVisit" and originally not foreseen, has been conceived for a wider adoption in other projects or cities to represent the state of art and real time development of a plan/action/activity/strategy.

8.2 The contents

The SiteVisit App open and is based on a geo-referentiated view of the installations spread around Florence municipality.



Picture 15: SiteVisit App Home Page

By clicking on each location/site a popup appears with an "information pill" that is a short description and/or a video/graphic presentation of the installation.
For instance, clicking on the yellow tab "Via Lazio" a windows pop-up with a description of the analysis of the recharging column system development and a video presentation.
These contents have been agreed with the Municipality of Florence, provided by each involved partner and then integrated in the app.

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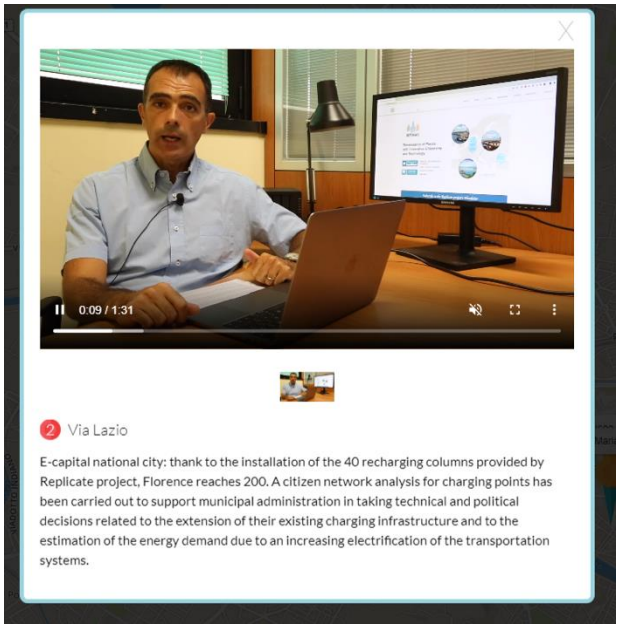
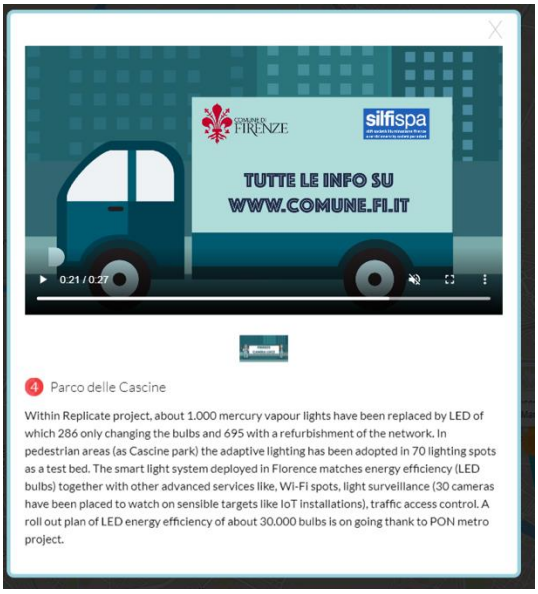


Picture 16: "Via Lazio" video presentation

Clicking e.g on the "Parco delle Cascine" an infographic appears to launch a video in pillar



Picture 17: "Parco delle Cascine" Infographic

8.3 The test during the project consortium site visit

The program of the site visit has been distributed to the participant partners with a clear indication on how the app could be reached (via web link or QR code).

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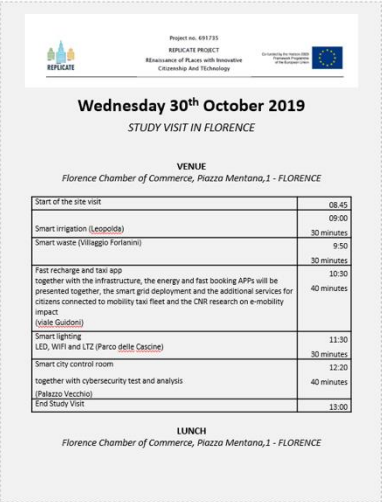

Wednesday 30th October 2019

STUDY VISIT IN FLORENCE

VENUE

Florence Chamber of Commerce, Piazza Mentana,1 - FLORENCE

Start of the site visit	08.45
Smart irrigation (Leopolda)	09:00 30 minutes
Smart waste (Villaggio Forlanini)	9:50 30 minutes
Fast recharge and taxi app together with the infrastructure, the energy and fast booking APPs will be presented together, the smart grid deployment and the additional services for citizens connected to mobility taxi fleet and the CNR research on e-mobility impact (Viale Guidoni)	10:30 40 minutes
Smart lighting LED, WiFi and LTZ (Parco delle Cascine)	11:30 30 minutes
Smart city control room together with cybersecurity test and analysis (Palazzo Vecchio)	12:20 40 minutes
End Study Visit	13:00

LUNCH

Florence Chamber of Commerce, Piazza Mentana,1 - FLORENCE

Picture 18: Program of the site visit and link to the app

Then each participant could access the access by his/her mobile device. It has been decided to release the app as a web-app since the roaming free-of-charge possibility in Europe made possible to have access to the internet also abroad and, moreover, the Comune di Firenze makes available, in many places of the city territory a free wi-fi.

The app has been widely used, during the visit, and highly appreciated, in this sense the test has to be considered fully positive.

Colours reported in the APP, red and yellow, refer to the consortium visit in October 2019 (in red the places included in the project tour).

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9. IMPACTS, INNOVATION AND REPLICATION POTENTIAL

COMMUNICATION SOLUTIONS

- **APP**: Thanks to the development of a WEBAPP, an easy opportunity to describe what has been done and what's going on is a perfect tool to achieve as many people as possible and, at the same time, ensuring that information can be updated and content expanded as a part of developments.

INNOVATIVE SOLUTIONS

- **SMART GRID SOLUTION**: Thanks to the development of a new advanced automation, for the automatic detection and isolation of a fault in the grid (SFS –Smart Fault Selection) it is possible to reconfigure the grid in a faster way, improving service quality and reducing energy outages, based on logic coordination between protection systems, in order to optimise the time equivalent of an electrical fault extinction and consequently reduce the equivalent customer moment. Those are the results obtained, SAIFI (System Average Interruption Frequency Index) 20,04 minutes and SAIFI +MAIFI (Momentary Average Interruption Frequency Index), 1,41 times. The full development of such a system will be done through an appropriated integration and evolution of network protection and control systems. The SFS technology relies on the availability of a short-latency communication carrier in conjunction with a series of high-performance devices. In such a way, it is possible to enhance the maximum current selectivity performance by increasing the number of fault's selection levels as well as allowing a drastic reduction in terms of number of customers affected by the outage, adopting a faster and completely automatic restoration of the remaining network. In detail, when a short circuit happens, the fault passage indicator and measurement devices, upstream the fault, activate themselves and with a machine-to-machine communication and by 'goose (Generic Object-Oriented Substation Event)' message (using IEC 61850 standard protocol) communicate with other devices for reconfigure the grid to supply the maximum number of costumers.

- **NEW GOVERNANCE MODELS**: 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, Fire Brigades, 118 Rescue Agency, and the Municipality (win-win solution).

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- **IoT**: The Smart bench model tested is performing well and it shows a big replication potential in urban areas and private spaces. It can collect data (presences, environmental data, …) and provide connection and contents (audio & web). Also the smart waste solution tested can optimise the service quality for any waste management company. The TIM-link introduced by Telecom in the project is providing innovative services and info and it can be easily replicated in other urban areas.

- **Smart lighting**: The Smart lighting system integrates several other services spread in the district (video cameras, LTZ, WIfi hotspots, sensors, …) optimising the use of the infrastructure. This first experience can be translated in other urban areas with the same control needs.

- **E-TAXI MODEL**: The e-taxi measure with the municipality driving the transition to an e-fleet through new licences, a dedicated fast infrastructure, innovative services (booking APP), facilitations (cheap e-licence, agreements with e-vehicles producers, e-service priority) is proving good results: the model test could be easily extended at metropolitan level and to other large private fleets (as foreseen in the national plan PNIRE).

SOCIAL IMPACTS

- **IMPROVEMENT OF URBAN MOBILITY:** Recharging stops are faster and, due also to the new tramlines and sharing options, people can choose faster ways to reach their final destination; there are also good social impacts due to the availability of new services for vulnerable people (i.e. disabled, women, etc)

- **BUILDINGS RETROFITTING:** The Piagge social housing retrofitting on going to impact on the life quality of tenants with better comfort conditions, lower energy bills and an improved aspect of the urban area. The energy efficiency actions are also accompanied by an awareness rising campaign involving all the tenants and technical partners (e-distribuzione, Casa spa, UNIFI, Mathema, …)

ENVIRONMENTAL IMPACTS

- **PIAGGE**: During last period the consumption has decreased of about 17% due to the insulation works (-617 MWht) and the emissions reduction due to the energy savings is 104 t CO_2/y.

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- **SMART GRID**: in March 2019, e-distribuzione organized a real fault test along the MV feeder "Pavonieri", one of the 18 feeders involved in the project. The outage involved only 326 customers thanks to the new protection and automation infrastructure, instead of 2.547 and the fault was isolated in 474ms on a forecast of one second for this kind of new technology. 2018 index monitoring results obtained:
  - SAIDI[1]: 17,85 min/customer (20,04 in 2017, -10,93%)
  - SAIFI[2] + MAIFI[3]: 1,20 times/customer (1,41 in 2017, -17,5%)
  - Environmental protection, better support for the diffusion of renewable energies and electric mobility, contributing to the reduction of CO2 emissions

- **E-MOBILITY**: The cumulated energy saving since the beginning of the project is 1.639 MWh for taxi fleet with more than 9.162 recharges. The public network in 2018 has caused a saving of 1.025 MWh/y. The cumulated savings since project start are 1.723 MWh.
  A consequent total reduction of 17,4 t $C0_2$/y has been obtained from the fast recharging infrastructure following the methodology and the emission factors in use in the DOA, while the full e-taxi action is providing a reduction of 109 t $C0_2$/y. The cumulated savings from the project start are of 205t.
  Public recharging network registered a reduction of 180 t/y with a cumulated result of 322,5 t.
  It has to be noticed that with actual emission factors, at the basis of the electric mobility strategy, the values are much higher.

- **SMART WATERING**: Water and energy savings are under evaluation as well as increased efficiency of the waste management service. It has been estimated a saving of 30% in water irrigation per year

- **APP GO GREEN:** it has been reported an average impact of 3% in energy consumption for behavioural changes

- **SMART LIGHTING:** The pilot action system has reached a reduction of 268 MWh/y in 2018 with a partial deployment. The cumulated reduction registered is already of 505 MWh at august 2019. The reduction is 130 t CO2/y, the cumulated reduction at August 2019 since the beginning of the project is 244 t CO_2

REPLICATION POTENTIAL

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- **SMART GRID:** The smart grid is the key to develop further smart services: the cost is the main barrier for the implementation, but if the action is included in a planning tool as enabler (for RES, e-mobility, users awareness, active demand management …) it could be easily deployed. The technology is quickly evolving and improving, and this must be taken into account while designing the extensions (from the proposal phase to the implementation an update of the technology foreseen has been needed). The optimal scale for next implementations is at least urban scale, but it can be extended at national level; more information for users and service providers (active demand managers, prosumers ...) could enhance and accelerate the exploitation of the new opportunities offered by the updated grid.

- **SMART LIGHTING:** Public lighting is the backbone of the city and can easily support other services reducing land use and costs. In case of other municipalities, for example in the metropolitan area but also outside, the scheme could be replicated with an in-house Company or an ESCO.

- **E_TAXI**: The test could be easily extended at metropolitan level and to other large private fleets (as foreseen in the national plan PNIRE) or replicated on the main highways (Enel EVA+ project). A green taxi is catchy for smart users, urban friendly (no noise and pollution) and it is cheaper for the owner while the fast recharging infrastructure is important to satisfy the needs of the drivers who are also using their own recharging points during out of service periods. The replication model will see e-distribuzione as DSO/grid manager and another player as recharging network manager. 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 infrastructure costs or the additional services like the APP and the communication/promotion.

- **IOT**: 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. In the replication phase the smart devices will be required to dialog directly with the Smart City Control Room through the open API developed.

- **CYBER SECURITY:** GDPR and Cyber security Analysis results about Florence Pilot Smart Systems allow us to highlight potential vulnerabilities and risks and define a remediation plan for the current architectures. In this way is possible to define a procedure for rectifying faults through the creation of necessary security patches for software updates or the installation of new security software. All the solutions found have to be the basic starting point for the design of the new smart cities of the future. In these cases, the implementation of new systems in new cities will

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adopt a Cyber Secured by design approach, putting in place the solutions already studied and applied in Florence: Software will be designed from the beginning to be secure and Risk Analysis, Security Audit and Vulnerability Assessment become monitoring and inspection measures, in order to avoid critical security bugs.

In the framework of D7.5 Report on management models v2, the management models including revenues and costs analysis have been provided for Public lighting, IoT and e-taxi fast recharge infrastructure and fleet

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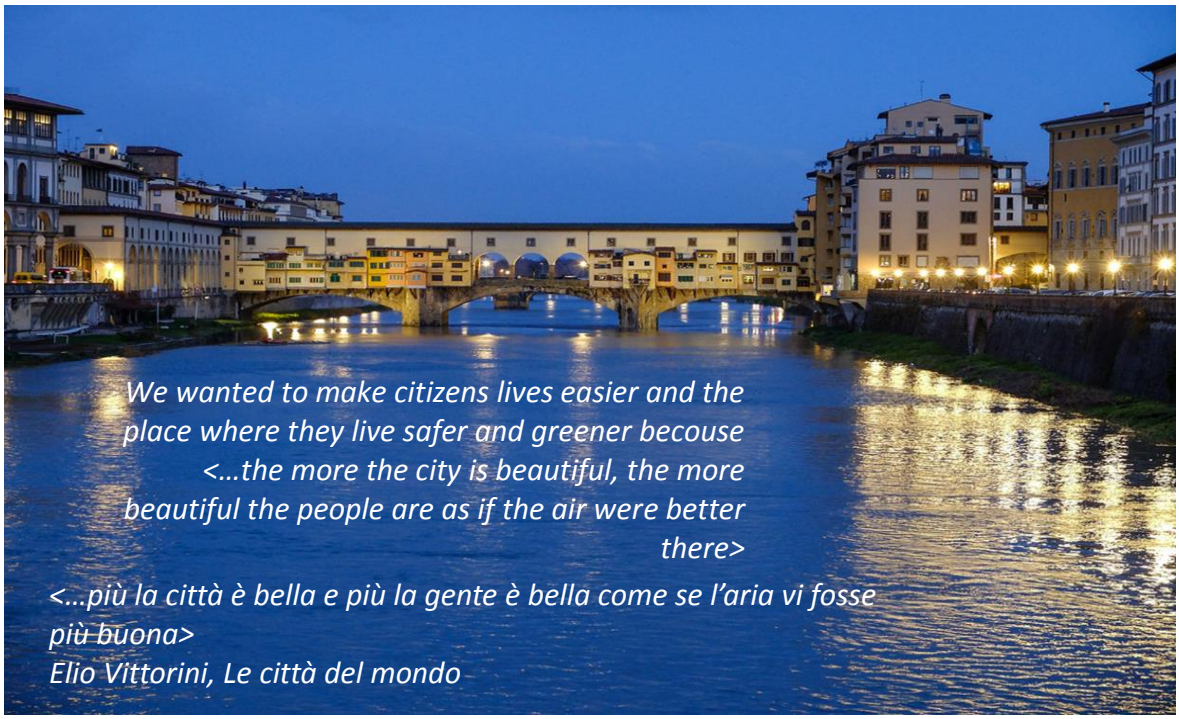
10. LESSONS LEARNT



Picture 19: Florence, Ponte Vecchio view

The lessons from Florence experience are that the schedule of such projects has to comply with public procurement timing and that should be taken into account also in the definition of the incentives income supporting the realisation; another lesson is that some works have different costs in each nation/location and have to be tailored to the specific context.

One of the main problems regarded the investments availability: to publish the tenders the municipality has to make the total investment available since the beginning of the procedures; moreover the expenditure have to be reported in line with the national/regional average cost even if the contractual one at the end of the tender is with no doubt lower. Separating complex (and expensive) projects could make it easier spreading investments and cash flows

Hereafter further specific hints beside those already reported in the previous paragraphs for the single actions:

- The energy tariffs for e-mobility are very different in the market and should be analysed in detail to find the best option for the different users.
- Regarding IoT and Capillary Networks maintenance is a crucial issue. The Sensors deployed have to be maintained providing remote maintenance as much as possible. Each Sensor depending in the complexity shall be reachable both in VPN or directly using a public IP address. This will allow remote diagnosis and intervention. In case of very simple sensors it is mandatory to foresee a remote "OFF command" and "ON

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command" able to cut off power in such a way that the sensor can be shut down and restarted.

- It should be highlighted that the Smart City Platform and the ICT related activities in REPLICATE are not achieving impacts by themselves, but they are the enablers for the other single actions in the different fields (energy management and smart metering in buildings and public lighting, e-mobility manager, traffic control, IoT, environmental monitoring, …). For more details about city platform, please see D4.6 ICT Pilot Architecture. The Smart city control room should support city management and stakeholder engagement with its predictive capacity that sees in the passage from laboratory to reality its main challenge.
- Cyber Security's activities assume complete investigations of the systems in object, for which vulnerabilities and weaknesses are highlighted. This process could be considered invasive for the investigated systems owners which can hinder cooperation. The hope is that thanks to Project on Smart City of future, like Replicate, the third millennium technological themes like Cyber Security can become better know so that society can be ready to face the IT security challenges of the coming years.
- The city and its territory: the national legal framework and the local peculiar situation (cultural heritage) have deeply influenced the realisation schedule; these different boundary conditions ought to be taken into account in the replication plans
- Technology development: innovation allows an easier access to services, a better use of the city and a higher quality of life and it has to be followed even if it evolves faster and faster. Technology implementation in a city should be aimed at providing useful services and not just for testing innovation – this is what "smart" means for Florence. The final aim of any innovative implementation should be always clear and monitored to obtain good performances impacting on citizens' quality of life.
- Citizens participation, supported by the availability of enabling systems like the Apps or the smart benches and the communication panels, is a transversal basic condition for a city like Florence that considers the direct exchange and the interaction with its citizens the real answer beside any ICT supporting tool

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11. CONCLUSIONS

Florence pilot action is made of many different measures that during these years have been implemented facing different destiny because of the evolving framework: minor changes and small deviations have been included, in both negative and positive sense, to fulfil the upcoming needs taking into account the regulatory and market evolution.

Several actions have followed the schedule being improved in their technical aspects (fast recharging network, smart grid, e-taxi…) and are providing the first monitoring data to assess the impacts. Other implementations have just been finalised (APPs, ICT platform, buildings retrofitting…), while in the case of District Heating a delay has been requested due to the complexity of this innovative action and of its administrative procedure.

The status of the implementations as well as the first results of the monitoring will be regularly updated in the APP (at http://replicate.mathema.com), a liveable tool that help us in providing news, data and information on the project area

Many valuable lessons have been learnt and results analysed, together with the transversal WPs, from the technical and business point of view to support the replication.