Deliverable due date: M36 – November 2019

D6.7 TECHNO-ECONOMIC ANALYSIS OF EACH INTERVENTION PER FOLLOWER CITY

WP6 , TASK 6.2

Transition of EU cities towards a new concept of Smart Life and Economy

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Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30th November 2021 (60 Months)
Deliverable	D6.7 Techno-economic analysis of each intervention per follower city
Diss. Level	PU
Status	Working Verified by other WPs **Final version**
Due date	30/11/2019
Work Package	WP6
Lead beneficiary	Tecnalia Research & Innovation
Contributing beneficiary(ies)	CAR, BYD, RIJ, PAL, NBK
Task description	Task 6.2: The working methodology of Task 1.4 will be replicated with follower cities in order to evaluate impacts in follower cities (BYD, RIJ, PAL) from the social, economy and environmental field to understand the interaction of the different interventions as a system. Subtask 6.2.3. Techno-economic analysis of the suggested interventions. The whole value-chain for each project will help to deliver more specific results about the impacts in these cities and their regions. The more disaggregated the value-chain can be characterized the more accuracy can be provided when measuring indirect and induced effects at economy and social level. This subtask will allow to characterize the value-chain of the interventions selected for more accuracy when measuring indirect and induced effects at economy and social level.

Date	Version	Author	Comment
29/01/2019	0.1	Eneko Arrizabalaga (TEC)	Initial structure and content
25/09/2019	0.2	Eneko Arrizabalaga (TEC) Carla Rodriguez (CAR)	Intermediate version including the data from the city of Palencia
09/10/2019	0.3	Eneko Arrizabalaga (TEC) Carla Rodriguez (CAR) Aurélien Henon (NBK)	Intermediate version including the data from the cities of Palencia and Bydgoszcz
22/10/2019	0.4	Eneko Arrizabalaga (TEC) Carla Rodriguez (CAR) Aurélien Henon (NBK) Contributions from the cities of Bydgoszcz, Rijeka and Palencia	Intermediate version including the data from the cities of Palencia and Bydgoszcz and Rijeka

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15/11/2019	0.5	Eneko Arrizabalaga (TEC) Carla Rodriguez (CAR) Aurélien Henon (NBK) Contributions from the cities of Bydgoszcz, Rijeka and Palencia	Advanced version sent to internal review
25/11/2019	0.6	Eneko Arrizabalaga (TEC) Carla Rodriguez (CAR) Aurélien Henon (NBK) Contributions from the cities of Bydgoszcz, Rijeka and Palencia, Contributions of the internal reviewers (ESA)	Final version

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Abbreviations and Acronyms

Acronym	Description
BaU	Business as Usual
CAPEX	CAPital EXpenditures
DH	District Heating
DHW	Domestic hot water
EV	Electric vehicles
GDP	Gross Domestic Product
GIS	Geography Markup Language
GPRS	General Packet Radio Service
GVA	Gross value added
IO	Input Output
LED	Light-Emitting Diode
OPEX	Operating expense
O&M	Operation and Maintenance
PV	Photovoltaic
RES	Renewable energy source
VA	Value Added
WP	Work Package
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy

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1. Executive Summary

The main objective of mySMARTLife project is the demonstration of the Innovative Transformation Strategy concept through piloting different actions, considering advanced technologies, towards the global transformation of the urban life in the cities. The methodology that will be applied in the three Lighthouse cities will foster the replication of the foreseen actions, at different levels, in the follower cities and the smart city network that will be created during the project lifetime.

As a global vision, mySMARTLife will follow the next approach:

Figure 1: Global vision of the mySMARTLife Project.

This Urban Transformation Strategy aims to respond in a holistic and integrated way to the transformation process, overcoming the existing technical and non-technical barriers. During this process the technical support to the different phases is a critical issue. In this regard, the application of existing methods and tools, as well as the development and the adaptation of new methods is essential to provide the needed criteria for the prioritization of measures that will guide this transformation.

In this framework, the deliverable D6.7 aims to describe the methodology defined for the supply chain analysis of interventions that is replicated in follower cities, which is the base to develop technoeconomic analysis of these interventions. The technoeconomic analysis will gather the information necessary of the interventions to evaluate the direct, indirect and induced socioeconomic effects associated to the implementation of interventions in the three follower cities of the project based on the Input Output methodology.

This first step of the definition of the supply chain associated to each intervention will represent the main input for the impact assessment study. More precisely, this first step will generate the “shock” that will represent the increase of the endogenous demand in each city/region due to the deployment of the interventions of mySMARTLife project.

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The simplified methodology proposed in this deliverable considers the cost breakdown of the main cost components of interventions, as well as an analysis of the local capabilities to produce and/or distribute the components that take part in the supply chain of each intervention. Finally, the type of stakeholder (public, private, etc.) who take part in each of the phases of the supply chain are also evaluated and considered in for the analysis.

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2. Introduction

2.1 Purpose and target group

This deliverable is allocated within Task 6.2, which is related to evaluating impacts in cities from the social, economy and environmental field to understand the interaction of the different interventions as a system. The Advanced Integrated Urban Planning is divided in four stages, corresponding with the nine deliverables of the task:

- **Deliverable 6.5:** This deliverable is related to the subtask 6.2.1 and is focused on the description of 3D models for each follower city which includes the energy assessment of the area selected by each city. This is a key step that can be scaled-up to cover a larger area of the city so that it can serve to evaluated aspects that can feed to the different scenarios that will be evaluated for the cities in the subtask 6.2.2.
- **Deliverable 6.6:** This deliverable is related to the subtask 6.2.2 which is focused on the energy scenario development at city scale. The outcome of described in the Deliverable 6.5 will be used for the definition of scenarios.
- **Deliverable 1.14:** This deliverable is related to the subtask 1.4.3 which is focused on the techno-economic assessment of the interventions that will be implemented in the lighthouse cities. The outputs described in this deliverable (focused on the lighthouse cities) will serve as a starting point for the replication plan for the four follower cities.
- **Deliverables 6.8, 6.9 and 6.10:** These deliverables are focused on the definition of the replication plans of the follower cities. The outputs described in this deliverable combined with a wider socioeconomic impact analysis will contribute to the generation of the replication plans.
- **Deliverables 6.1, 6.2 and 6.3:** These deliverables are focused on the Baseline assessment & PESTEL Analysis of follower cities and Initial Replication Plan. The output of these deliverables helps to identify the interventions that can be replicated in each follower cities as well as to identify the main aspects that will influence in this replication. This serves as input for the selection of interventions to be included in a more detailed socioeconomic analysis.

The present deliverable is structured as follows:

Chapter 3: shows the overall methodological approach to the Advanced Integrated Urban Planning in mySMARTLife project, describing the relation between the different phases of the assessment for the lighthouse cities and the relation with the replication in the follower cities.

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Chapter 4: Introduces the supply chain analysis of interventions for the socioeconomic impact assessment and describes the summary of the methodology proposed in the project.

Chapter 5: This chapter is focused on the supply chain analysis of the three follower cities, which includes the main results of the data gathering process and the analysis for each of the phases of the methodology proposed.

Chapter 6: Describes de main conclusions obtained from the work carried out in the subtask 6.2.3.

Chapter 7: Shows the references of the literature consulted to develop the work.

2.2 Contributions of partners

The following table depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
TEC	Overall methodological development and general redaction of the deliverable
CAR	General review of the content of the deliverable and participation on the general strategy of the subtask. Support offered to cities during the data gathering process. Contributions in the redaction of the deliverable.
NBK	General review of the content of the deliverable and participation on the general strategy of the subtask. Support offered to cities during the data gathering process. Contributions in the redaction of the deliverable.
PAL	Contribution (data provision) to the chapter 5
RIJ	Contribution (data provision) to the chapter 5
BYD	Contribution (data provision) to the chapter 5
ESA	Overall review of the deliverable
ARM	Overall review of the deliverable

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2.3 Relation to other activities in the project

The following table depicts the main relationship of this deliverable to other activities (or deliverables) developed within the mySMARTLife project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the Project

Deliverable Number	Contributions
D1.14	This deliverable provides the techno-economic analysis of each intervention per lighthouse city which follow the same methodology described in this deliverable
D6.1, D6.2, D6.3	These deliverables are focused on the Baseline assessment & PESTEL Analysis of follower cities and Initial Replication Plan and provide an overview of the interventions to be evaluated in the supply chain analysis.
D6.5	This deliverable is focused on the description of 3D models for each follower city which includes the energy assessment of the area selected by each city in which the interventions evaluated in this deliverable could be implemented.
D6.6	This deliverable is focused on the energy scenario development at city scale in which the interventions evaluated in this deliverable are characterized in terms of the energy consumption and replication potential.
D6.8, D6.9, D6.10	These deliverables are focused on the definition of the replication plans of the follower cities, in which the results of the socioeconomic analysis developed based in the data gathered and described in this deliverable will be used as prioritization criteria

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3. Overall methodological approach to the Advanced Integrated Urban Planning in mySMARTLife project

This section aims to provide a general overview of the overall methodological and modelling approach of the Advanced Integrated Urban Planning of mySMARTLife project. The figure below shows how each of the phases of the methodology corresponds with the different subtasks of the Task 6.2 of the project and how each subtask contributes to the rest with their corresponding outcomes.

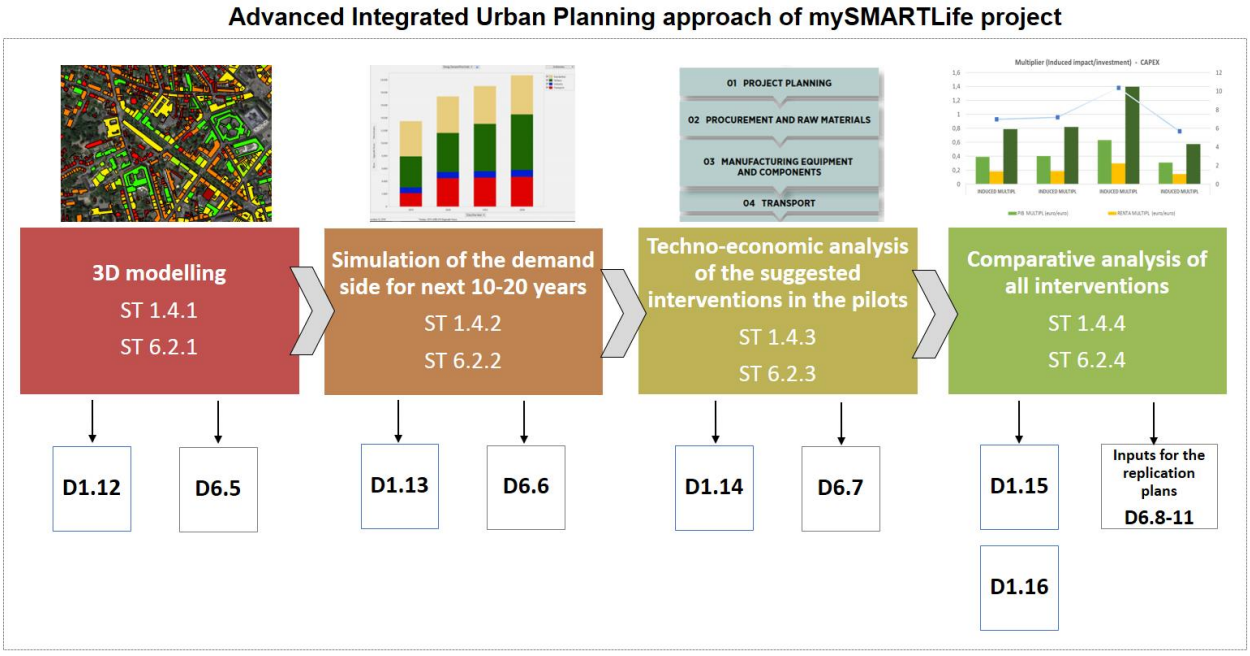

Figure 2: Methodological approach of the Advanced Integrated Urban Planning in mySMARTLife project.

The methodology is composed by four main phases that correspond with the main subtasks showed in the figure above. It can be seen, that the entire process is applied to both the lighthouse and to the follower cities of the project. The analysis is first applied to lighthouse cities (in WP1) and with the experience gained and with the lessons learnt, it is applied in a second step to the follower cities of the project (in the subtasks specified within the WP6).

The **first phase** is focused on the **3D modelling and energy demand analysis** of the three follower cities. The 3D modelling is applied at city scale to prepare the data available in the city in the way that is required for the energy modelling of the building stock. In this phase the area selected in each city is evaluated through an energy model. The energy modelling evaluates the energy demand of the building stock considering several characteristics that are specific for each building. The results of the modelling

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provide the hourly energy demands (heating, cooling, DHW) and the hourly electricity consumption (lighting, equipment, etc.) individually for each building but also in an aggregated way according to a classification depending on the construction period and use of the buildings. The procedure is carried out in a way that the model is calibrated so that it can be used for other areas of the city or for the entire city. The visual representation of the results allows a quick understanding of the energy needs of the city but also an initial idea of the refurbishment potential or the potential for the implementation of renewable energy technologies such as the solar thermal and the solar photovoltaic systems. This is a bottom-up modelling approach that provides some specific results that are useful for the scenario definition in the following phase of the methodology which follows a top-down approach to the city energy modelling. The main outputs of this phase are the deliverables D1.12 and D6.5.

The **second phase** of the modelling methodology is focused on **simulating the energy demand for the next 10-20 years for the city**. In this case the entire city is evaluated including not only the built environment but also the rest of the sectors of the city such as the industry and mobility. In this case other types of modelling tools are required to define the energy matrix of the city (Sankey diagram) for the base year. Then, the evolution of several characteristics (such as the evolution of the socioeconomic characteristics of the city, population, GDP, etc.) are evaluated for each city, establishing the interrelation between these parameters and the future energy needs of the city. This will allow to generate the Business as Usual (BaU) scenario for the city, which defines the expected evolution of the energy demands/consumptions of the different sectors of the city, as well as the required local energy generation or the energy import needs in the following years. This BaU scenario is the base for future evaluations of the expected impact of alternative efficient scenarios that can be proposed for the cities. As explained before, the potential results of the modelling in the first phase can serve to define some aspects of these alternative scenarios. The main outputs of this phase are the deliverables D1.13 and D6.6.

The **third phase** is focused on the **technoeconomic analysis of the suggested interventions in the pilots**. In this case a supply chain analysis is carried out for the interventions that can be implemented in the pilots, evaluating the disaggregation of the cost components that compose the intervention, as well as the existing capabilities at city/regional scale for the manufacturing or distribution of each component. Besides, an analysis of the socioeconomic structure of each city and its corresponding region is carried out in order to define the sectoral disaggregation that is required for the supply chain analysis. The result of this phase will be the specific “shocks” that will serve as an input for the macroeconomic modelling that is carried out in the last phase of the methodology. Each intervention will be represented as a specific increase of the production of the corresponding subsectors in the region. The main outputs of this phase are the deliverables D1.14 and D6.7.

Finally, the **fourth phase** is focused on the **comparative analysis of all the interventions based on the impact assessment results**. In this phase the impact assessment of each intervention is carried out based on the results of the previous phases. On the one hand, the shocks created in the third phase are

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used to evaluate the potential impact associated to each intervention to generate a direct, indirect and induced effect in the development of several socioeconomic characteristics of the cities/regions such as the increase of the GDP, VA or the employment. This information can also be combined with the results of the phases one and two which will provide an idea of the deployment potential of each type of intervention in the cities which will affect the final impact. Finally, this socioeconomic analysis for each intervention is combined with the expected energy and environmental impact analysis which will provide extra criteria that will be useful for the prioritization of the technologies. Hereunder, a multicriteria methodology will be used to compare the different interventions for each city based on the expected impacts. The main outputs of this phase are the deliverables D1.15 and D1.6.

In the case of the follower cities, a similar process is carried out to get a better understanding of the potential impact that the future implementation of actions can have in each follower city. This, as well as all the intermediate results obtained for the follower cities will be important inputs for the replication plans (D6.8-11).

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4. Supply chain analysis of interventions for the socioeconomic impact assessment

4.1 Overall methodological approach to the supply chain analysis of interventions for the socioeconomic impact assessment

This section provides a summary of the methodological approach and the steps that need to be followed for the supply chain analysis of interventions (to generate the endogenous shock that represents the intervention) according to the methodology proposed in mySMARTLife project. **Figure 3** shows the four main steps of the method. Besides, the fourth step is further described including the main sub-phases which are included in it.

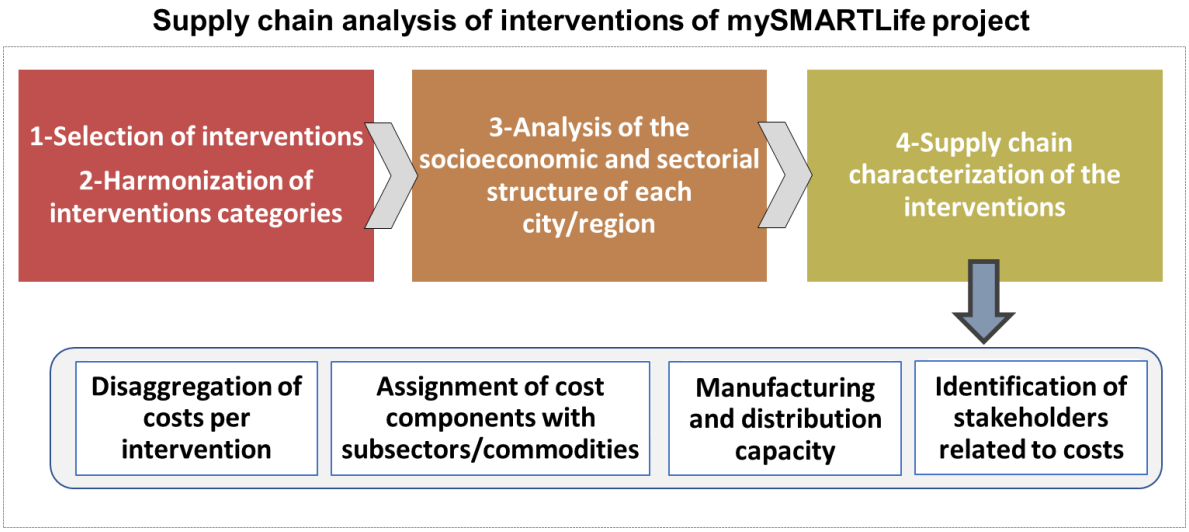

Figure 3: Methodological approach of the Advanced Integrated Urban Planning in mySMARTLife project.

Each of these steps are further explained in the following paragraphs.

Phase 1- Selection of interventions:

In this step each city must select the group of interventions that will be included in the techno-economic analysis. The selection of interventions will be specific in each city according to the criteria that are described in the following section.

Phase 2- Harmonization of interventions categories:

Once each city has selected the group of interventions that will be included in the analysis, in this step various intervention categories will be defined in order to harmonize as much as possible the analysis

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between the different cities. The main idea is to group each type of interventions under a common epigraph which will help to stablish a common approach for the evaluation of similar interventions. This step is further described in the following section.

Phase 3- Analysis of the socioeconomic and sectorial structure of each city/region:

This step will provide a better understanding about the main socioeconomic characteristics of the city evaluated. However, the socioeconomic impact assessment will be based on the use of the extended Input-Output tables which in most of the cases are only available at a national scale (which must be adapted to the regional level). Therefore, for this socioeconomic analysis two scales will be considered, the city and the regional scales.

Special attention needs to be paid to the sectoral structure of both the city and the region, focused on the disaggregation of aspects such as the total Value Added, the production and the employment in the different subsectors. This is an aspect that will be relevant and will influence the way in which the disaggregation of cost per intervention will be carried out.

Phase 4- Supply chain characterization of the interventions:

This step is focused on the detailed characterization of the supply chain of each intervention and can be divided in the following four sub-phases:

- **Sub-phase 4.1. Disaggregation of costs per intervention**

  The first step is the disaggregation of the total cost of each intervention in the different cost components that compound it. The first disaggregation will consist in the distinction of the main phases of the supply chain: project planning, procurement and raw materials, manufacturing equipment and components, transport, installation, operation and maintenance and decommissioning.

  In the practice, it is observed that in most of the cases some of these cost components are difficult to obtain such as the cost of the decommissioning. Besides, some of these cost components are provided combined such as the cost of the procurement of the row material and/or the manufacturing. Here, it is relevant to understand that depending of the aim of the project different level of disaggregation will be needed.

  In this case, the most limiting aspect for the level of detail of the results will be the disaggregation level of the Input Output tables at national level combined with the level of disaggregation of the socioeconomic data at regional level. This means that although a higher level of detail could be obtained in the supply chain analysis stage, this would be lost when this information is introduced as an increase of the endogenous demand in the adapted IO tables.

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- **Sub-phase 4.2. Assignment of each cost component with the corresponding subsector or commodity**

This sub-phase is focused on finding a correspondence between each of the cost components of the supply chain analysis of each intervention with one of the subsectors or commodities of the IO table of the corresponding city/region.

- **Sub-phase 4.3. Evaluation of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) in each city**

This sub-phase is focused on evaluating and reflecting in the supply chain analysis whether the city and the region evaluated has the capacity in terms of existing companies or institutions that can respond to an increase of the need of the cost components (services, commodities, manufacturing of products, distribution of products, etc.).

The main aim is to get a better understanding of the dependency (in terms of imports of commodities, etc.) of each city for implementing every intervention.

- **Sub-phase 4.4. Identification of the main stakeholder related to each cost component**

Finally, this sub-phase aims to understand who the main actor is associated to each cost component of every intervention. This will allow to understand whether the investments are made by citizens, private companies or public bodies among others. This is an aspect that can affect the total impact associated to each intervention.

This is the summary of the process developed previously in WP1 for the lighthouse cities of the project. In this case, the same method is used for the analysis of the follower cities. It needs to be remarked that in the case of the follower cities the ex-ante impact assessment results obtained are useful for identifying the specific interventions that could be prioritized according to the specific criteria of each city.

Since the method applied in this case was developed in detail in WP1, the detailed description of the methodology can be consulted in the deliverable D1.14 Techno-economic analysis of each intervention per pilot.

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5. Supply chain analysis of the three Follower cities

5.1 Case of Palencia

5.1.1 Phase I Selection of interventions

In order to get a better understanding of the impact that the replication interventions being implemented in lighthouse cities would have in Palencia, a selection of interventions has been made to carry out the techno-economic analysis and thus study its viability and benefits for the city. The interventions have been selected under the following criteria: represent a relevant investment, are relevant to the city from a strategic point of view, have a high replication potential within the city or have some singularity.

Based on all these criteria and in relation with the actions selected for the replication plan, the city of Palencia has pre-selected the following interventions:

- **District Heating with biomass in public and private buildings**

The action consists of the replacement of the existing oil boiler of three municipal buildings by a District Heating system using biomass. In addition to the public buildings, it is expected to extend the network once is in service towards two more public buildings and private residential buildings. The DH includes a biomass boiler plant combined with a thermal solar plant and an absorption refrigeration system.

- **Electric Vehicles for municipal services fleet**

The action consists in the implementation of EV in the municipality of Palencia for municipal fleet. For the analysis it has been considered 11 electric vehicles for municipal services fleet: 7 e-vans to replace municipal services vehicles and 4 motorcycles for the Local Police.

- **Smart Citizen Platform for all municipal services**

The action develops a new channel for compilation and dissemination of municipal information, allowing citizen participation and collaboration with the local administration through open consultations. A specific app will allow citizens to communicate suggestions, claims and incidents geo-reference in the municipal GIS; as well as conducting direct surveys of citizenship.

- **Energy Monitoring of public buildings**

The action consists of the realization of energy audits and of the implementation of energy monitoring meters in three public buildings of Palencia to obtain valuable information regarding the needs of the buildings in order to reduce the energy demand and/or cover it with renewable energies.

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5.1.2 Phase II Harmonization of intervention categories

With the aim of homogenizing as much as possible the techno-economic analysis the interventions mentioned above could be classified in the following intervention categories defined in previous tasks of the project for both the lighthouse and follower cities:

- **Mobility interventions**
    - Electric vehicles
    - Charging infrastructure
    - Etc.
- **Energy efficiency for buildings:** Includes all interventions related to the improvement of the efficiency of the systems integrated in the buildings as well as the interventions related to the improvement of the characteristics of the building envelope.
    - Improvement of the characteristics of the building envelope
    - Smart meters and control
    - Efficient energy generation technologies
    - Etc.
- **Public lighting**
- **Renewable energy technologies**
    - Solar:
        - Solar thermal
        - Solar photovoltaic
        - Solar hybrid technologies
    - Wind:
        - Large wind turbines
        - Micro-turbines
    - Etc.

According to the intervention categories described above, the interventions pre-selected in the follower cities can be classified as it is showed in the table below.

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Table 3: Categorization of interventions into intervention categories for the example described.

Intervention to be replicated	Intervention category	Specific intervention related to it from the lighthouse pilots
DISTRICT HEATING with biomass in public and private buildings	**District Heating** (CITY INFRASTRUCTURES)	**HAM action 13:** District Heating with a share or renewable hydrogen
ELECTRIC VEHICLES for municipal services fleet	**Electro-mobility** (MOBILITY)	**HAM action 22:** Electrification of public vehicle fleet
SMART CITIZEN PLATFORM for all municipal services	**ICT for citizen engagement** (NON-TECHNICAL ACTIONS)	**NAN action 39:** Engagement Portal for citizens
ENERGY MONITORING of public buildings	**Smart metering & management** (URBAN PLATFORM AND ICT DEVELOPMENTS)	**NAN action 47:** Energy data monitoring of public buildings

5.1.3 Phase III Analysis of the socioeconomic and sectoral structure for the disaggregation of the supply chain

From the experience of the analysis carried out for the lighthouse cities, it can be concluded that the decision adopted of using standardize data from the IO tables is a good approach. Therefore, following the same approach, the public available IO tables of the World Input-Output Database (WIOD) [15] are used also for the follower cities.

The classification of sectors and commodities has therefore been prepared according to the NACE codes described in the table below.

Table 4: Classification of commodities in WIOD database based on the CPA Statistical Classification of Products by Activity.

CODE	Commodity
CPA_A01	Products of agriculture, hunting and related services
CPA_A02	Products of forestry, logging and related services
CPA_A03	Fish and other fishing products; aquaculture products; support services to fishing
CPA_B	Mining and quarrying
CPA_C10-C12	Food products, beverages and tobacco products
CPA_C13-C15	Textiles, wearing apparel and leather products
CPA_C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
CPA_C17	Paper and paper products
CPA_C18	Printing and recording services
CPA_C19	Coke and refined petroleum products
CPA_C20	Chemicals and chemical products
CPA_C21	Basic pharmaceutical products and pharmaceutical preparations
CPA_C22	Rubber and plastics products
CPA_C23	Other non-metallic mineral products
CPA_C24	Basic metals
CPA_C25	Fabricated metal products, except machinery and equipment
CPA_C26	Computer, electronic and optical products
CPA_C27	Electrical equipment
CPA_C28	Machinery and equipment n.e.c.
CPA_C29	Motor vehicles, trailers and semi-trailers
CPA_C30	Other transport equipment
CPA_C31_C32	Furniture; other manufactured goods
CPA_C33	Repair and installation services of machinery and equipment
CPA_D35	Electricity, gas, steam and air-conditioning

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CPA_E36	Natural water; water treatment and supply services
CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation
CPA_F	Constructions and construction works
CPA_G45	Wholesale and retail trade and repair services of motor vehicles and motorcycles
CPA_G46	Wholesale trade services, except of motor vehicles and motorcycles
CPA_G47	Retail trade services, except of motor vehicles and motorcycles
CPA_H49	Land transport services and transport services via pipelines
CPA_H50	Water transport services
CPA_H51	Air transport services
CPA_H52	Warehousing and support services for transportation
CPA_H53	Postal and courier services
CPA_I	Accommodation and food services
CPA_J58	Publishing services
CPA_J59_J60	Motion picture, video and television programme production services, sound recording and music
CPA_J61	Telecommunications services
CPA_J62_J63	Computer programming, consultancy and related services; information services
CPA_K64	Financial services, except insurance and pension funding
CPA_K65	Insurance, reinsurance and pension funding services, except compulsory social security
CPA_K66	Services auxiliary to financial services and insurance services
CPA_L68	Real estate services
CPA_M69_M70	Legal and accounting services; services of head offices; management consulting services
CPA_M71	Architectural and engineering services; technical testing and analysis services
CPA_M72	Scientific research and development services
CPA_M73	Advertising and market research services
CPA_M74_M75	Other professional, scientific and technical services; veterinary services
CPA_N77	Rental and leasing services
CPA_N78	Employment services
CPA_N79	Travel agency, tour operator and other reservation services and related services
CPA_N80-N82	Security and investigation services; services to buildings and landscape; office administrative, office
CPA_O84	Public administration and defense services; compulsory social security services
CPA_P85	Education services
CPA_Q86	Human health services
CPA_Q87_Q88	Social work services
CPA_R90-R92	Creative, arts and entertainment services; library, archive, museum and other cultural services;
CPA_R93	Sporting services and amusement and recreation services
CPA_S94	Services furnished by membership organizations
CPA_S95	Repair services of computers and personal and household goods
CPA_S96	Other personal services
CPA_T	Services of households as employers; undifferentiated goods and services produced by households
CPA_U	Services provided by extraterritorial organizations and bodies

5.1.4 Phase VI Supply chain characterization of the interventions

All the interventions that are being evaluated in the current study are characterized in detail in this section, under the four steps that follow.

5.1.4.1 Step I Disaggregation of costs per intervention

This step is the first approach to the disaggregation of the costs of each intervention.The interventions have been assigned a lifetime according to the type of actuation and the interests of the city related with their strategies and plans. This project lifetime should be considered when studying the costs of the interventions. The costs of all the components are evaluated in the framework of that lifetime, so there are some components that will not need to be replaced during that period, others that do not have an assigned lifetime because they

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take place once in the whole intervention, and others that will need to be replaced, when their useful life is less than the lifetime of the project.

- **Intervention 1: "District Heating with biomass in public and private buildings"**

The costs analysed in the table below for the first intervention take into account the installation of the District Heating network for two municipal buildings: Local Police building and Miguel de Unamuno Social Centre and Library. The distribution of the network consists of a network for heat supply and another for heat return.

Table 5: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 1.

Project / intervention lifetime: 50 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Design and planning cost	2.573,67	€	-	2.573,67 €
Construction costs	42.271,42	€	50	42.271,42 €
Infrastructures and connection cost	4.904,71	€	50	4.904,71 €
Electricity installation cost	8.065,63	€	50	8.065,63 €
Installation of equipment cost	8.273,98	€	50	8.273,98 €
Equipment cost: Biomass storage and feeding system	13.197,45	€	30	26.394,90 €
Equipment cost: Thermal equipment	64.045,30	€	30	128.090,60 €
Equipment cost: Fumes output	7.788,35	€	30	15.576,70 €
Equipment cost: Distribution network	31.300,43	€	50	31.300,43 €
Waste management cost	543,75	€	-	543,75 €
Safety and Health cost	6.171,00	€	-	6.171,00 €
Quality control cost	1.815,00	€	-	1.815,00 €
Grid electricity price	5.447,42	€/year	50	272.371,00 €
Operation & Maintenance cost (materials/consumables)	498,40	€/year	50	24.920,00 €
Operation & Maintenance cost (labor)	4.488,42	€/year	50	224.421,00 €
Biomass fuel cost	26.822,07	€/year	50	1.341.103,50 €
Tax (Fee per year)	3.332,69	€/year	50	166.634,50 €
Insurance costs (Fee per year)	2.788,59	€/year	50	139.429,50 €
End of life costs	1.138,57	€	-	1.138,57 €

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- **Intervention 2: "Electric Vehicles for municipal services fleet"**

This intervention is analysed in the figure below, detailing the costs of the acquisition and operation of a single electric vehicle (van) during 20 years of lifetime. In addition, the costs of installing the internal charging point (slow-charge 16A) related to the recharging of the mentioned e-van have also been taken into account.

Table 6: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 2.

Project / intervention lifetime: 20 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
E-vehicle cost (without the battery cost)	27.877,98	€	20	195.145,86 €
Battery cost	5.529,00	€	10	77.406,00 €
E-vehicle charger cost	780,00	€	20	5.460,00 €
Grid connection works	720,00	€	-	5.040,00 €
Taxes	0,00	€	-	- €
Grid electricity price	604,50	€/year	20	84.630,00 €
Operation & Maintenance cost (materials/consumables)	239,00	€/year	20	33.460,00 €
Operation & Maintenance cost (labor)	240,00	€/year	20	33.600,00 €
Tax (Fee per year)	37,90	€/year	20	5.306,00 €
Insurance costs (Fee per year)	322,00	€/year	20	45.080,00 €
Scrap value of vehicle	150,00	€	-	1.050,00 €
Battery recycling cost	400,00	€	-	2.800,00 €

- **Intervention 3: "Smart Citizen Platform for all municipal services"**

The figure below correspond to the costs of the development and implementation of the complete digital platform within the DigiPal project.

Table 7: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 3.

Project / intervention lifetime: 20 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Analysis and first design of citizen participation tools and open data portal cost	16.940,00	€	-	16.940,00 €
Design of the citizen participation tool and data portal cost	20.207,00	€	-	20.207,00 €
Software solution development for citizen participation tool and open data portal cost	29.766,00	€	-	29.766,00 €
Software solutions implementation cost	4.719,00	€	-	4.719,00 €

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GIS and IDE georeferencing services integration cost	5.082,00	€	-	5.082,00 €
Content generation linked to citizen participation (surveys, suggestions, etc.) and open data costs	11.495,00	€	-	11.495,00 €
Operation & Maintenance costs (e.g. license)	968,00	€/year	20	19.360,00 €
Technical Support Services (technical assistance, training courses)	1.210,00	€/year	20	24.200,00 €
End of life costs	130,00	€	-	130,00 €

- **Intervention 4: "Energy Monitoring of public buildings"**

Table 8: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 4.

Project / intervention lifetime: 20 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Analysis of the status of pilot buildings and first approach for implementation of measures cost	4.598,00	€	-	4.598,00 €
Water meter cost	5.929,00	€	20	5.929,00 €
Gas meter cost	6.171,00	€	20	6.171,00 €
Electric meter costs	9.559,00	€	20	9.559,00 €
Thermal energy meter costs	9.317,00	€	20	9.317,00 €
Temperature and humidity sensors cost	2.783,00	€	10	5.566,00 €
Data concentrators with Ethernet connexon cost	2.178,00	€	20	2.178,00 €
Development and implementation of Energy Efficient software cost	14.036,00	€	-	14.036,00 €
Installation of sensors cost	18.876,00	€	30	18.876,00 €
Configuration of monitoring devices cost	3.872,00	€	-	3.872,00 €
Monitoring and maintenance of energy efficiency APP cost	7.381,00	€/year	20	147.620,00 €
Periodic reports on energy efficiency	4.356,00	€/year	20	87.120,00 €
Technical Support Services (technical assistance, training courses)	2.178,00	€/year	20	43.560,00 €
Grid electricity price	48,96	€/year	20	979,20 €
Operation & Maintenance cost (materials/consumables)	968,00	€/year	20	19.360,00 €
Operation & Maintenance cost (labor)	1.210,00	€/year	20	24.200,00 €
End of life costs	70,00	€	-	70,00 €

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For this intervention it is considered the cost of monitoring three municipal buildings: Multipurpose Centre EFIDES, Local Police Building and Public Services Centre Mariano Timón. The costs have not been disaggregated per building as they are part of the same intervention within DigiPal project that is carried out jointly in all three at the same time.

5.1.4.2 Step II Assignment of each cost component with the corresponding subsector or commodity

In this step the correspondence between the different components of the interventions and the commodity is established per each intervention, using the IO tables based on the CPA Statistical Classification of Products by Activity.

- **Intervention 1: "District Heating with biomass in public and private buildings"**

Table 9: Assignment of the cost component with the corresponding subsector or commodity for the intervention 1.

Component	CODE	Commodity
Design and planning	CPA_M71	Architectural and engineering services; technical testing and analysis services
Construction	CPA_F42	Constructions and construction works for civil engineering
Infrastructures and connection	CPA_C33	Repair and installation services of machinery and equipment
Electricity installation	CPA_C33	Repair and installation services of machinery and equipment
Installation of equipment	CPA_C33	Repair and installation services of machinery and equipment
Equipment: Biomass storage and feeding system	CPA_C28	Machinery and equipment n.e.c.
Equipment: Thermal equipment	CPA_C28	Machinery and equipment n.e.c.
Equipment: Fumes output	CPA_C28	Machinery and equipment n.e.c.
Equipment: Distribution network	CPA_C28	Machinery and equipment n.e.c.
Waste management	CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
Safety and Health	CPA_Q88	Social work services without accommodation
Quality control	CPA_M74	Other professional, scientific and technical services
Grid electricity price	CPA_D35	Electricity, gas, steam and air-conditioning
Operation & Maintenance (materials/consumables)	CPA_C27	Electrical equipment
Operation & Maintenance (labor)	CPA_C33	Repair and installation services of machinery and equipment
Biomass fuel	CPA_C16	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials
Tax (Fee per year)	CPA_K64	Financial services, except insurance and pension funding
Insurance costs (Fee per year)	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory and social security
End of life	CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services

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- **Intervention 2: "Electric Vehicles for municipal services fleet"**

Table 10: Assignment of the cost component with the corresponding subsector or commodity for the intervention 2.

Component	CODE	Commodity
E-vehicle (without the battery)	CPA_C29	Motor vehicles, trailers and semi-trailers
Battery	CPA_C27	Electrical equipment
E-vehicle charger	CPA_C27	Electrical equipment
Grid connection works	CPA_C33	Repair and installation services of machinery and equipment
Taxes	CPA_K64	Financial services, except insurance and pension funding
Grid electricity price	CPA_D35	Electricity, gas, steam and air-conditioning
Operation & Maintenance (materials/consumables)	CPA_C27	Electrical equipment
Operation & Maintenance (labor)	CPA_C33	Repair and installation services of machinery and equipment
Tax (Fee per year)	CPA_K64	Financial services, except insurance and pension funding
Insurance costs (Fee per year)	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory and social security
Scrap value of vehicle	CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
Battery recycling	CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services

- **Intervention 3: "Smart Citizen Platform for all municipal services"**

Table 11: Assignment of the cost component with the corresponding subsector or commodity for the intervention 3.

Component	CODE	Commodity
Analysis and first design of citizen participation tools and open data portal	CPA_J62_J63	Computer programming, consultancy and related services; information services
Design of the citizen participation tool and data portal	CPA_J62_J63	Computer programming, consultancy and related services; information services
Software solution development for citizen participation tool and open data portal	CPA_J62_J63	Computer programming, consultancy and related services; information services
Software solutions implementation	CPA_J62_J63	Computer programming, consultancy and related services; information services
GIS and IDE georeferencing services integration	CPA_J62_J63	Computer programming, consultancy and related services; information services
Content generation linked to citizen participation (surveys, suggestions, etc.) and open data	CPA_J62_J63	Computer programming, consultancy and related services; information services
Operation & Maintenance (e.g. license)	CPA_C26	Computer, electronic and optical products

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Technical Support Services (technical assistance, training courses)	CPA_J62_J63	Computer programming, consultancy and related services; information services
End of life	CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services

- **Intervention 4: "Energy Monitoring of public buildings"**

Table 12: Assignment of the cost component with the corresponding subsector or commodity for the intervention 4.

Component	CODE	Commodity
Analysis of the status of pilot buildings and first approach for implementation of measures	CPA_J62_J63	Computer programming, consultancy and related services; information services
Water meter	CPA_C26	Computer, electronic and optical products
Gas meter	CPA_C26	Computer, electronic and optical products
Electric meter	CPA_C26	Computer, electronic and optical products
Thermal energy meter	CPA_C26	Computer, electronic and optical products
Temperature and humidity sensors	CPA_C26	Computer, electronic and optical products
Data concentrators with Ethernet connexon	CPA_C26	Computer, electronic and optical products
Development and implementation of Energy Efficient software	CPA_J62_J63	Computer programming, consultancy and related services; information services
Installation of sensors	CPA_C33	Repair and installation services of machinery and equipment
Configuration of monitoring devices	CPA_J62_J63	Computer programming, consultancy and related services; information services
Monitoring and maintenance of energy efficiency APP	CPA_J62_J63	Computer programming, consultancy and related services; information services
Periodic reports on energy efficiency	CPA_J62_J63	Computer programming, consultancy and related services; information services
Technical Support Services (technical assistance, training courses)	CPA_J62_J63	Computer programming, consultancy and related services; information services
Grid electricity price	CPA_D35	Electricity, gas, steam and air-conditioning
Operation & Maintenance (materials/consumables)	CPA_C27	Electrical equipment
Operation & Maintenance (labor)	CPA_C33	Repair and installation services of machinery and equipment
End of life	CPA_E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services

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5.1.4.3 Step III Evaluation of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) in each city

This step aims to understand if the investment made to implement each action benefits the city (locally or regionally), depending on whether there is in the city or region the capacity to respond to the need for the different components of the interventions.

- **Intervention 1: "District Heating with biomass in public and private buildings"**

Table 13: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 1.

Cost breakdown	Local (city level)		Regional level	
	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Design and planning cost	YES	YES	YES	YES
Construction costs	YES	YES	YES	YES
Infrastructures and connection cost	YES	YES	YES	YES
Electricity installation cost	YES	YES	YES	YES
Installation of equipment cost	YES	YES	YES	YES
Equipment cost: Biomass storage and feeding system	NO	YES	NO	YES
Equipment cost: Thermal equipment	NO	YES	NO	YES
Equipment cost: Fumes output	NO	YES	YES	YES
Equipment cost: Distribution network	NO	YES	YES	YES
Waste management cost	YES	YES	YES	YES
Safety and Health cost	NO	YES	NO	YES
Quality control cost	YES	YES	YES	YES
Grid electricity price	NO	YES	NO	YES
Operation & Maintenance cost (materials/consumables)	YES	YES	YES	YES
Operation & Maintenance cost (labor)	YES	YES	YES	YES
Biomass fuel cost	NO	NO	YES	YES
Tax (Fee per year)	NO	NO	NO	NO
Insurance costs (Fee per year)	NO	NO	NO	NO
End of life costs	YES	YES	YES	YES

As it is shown in the table above, numerous companies have been identified for both local and regional production. At local level, some have been identified as *Dimension Ingeniería* for design and planning, *Teiser* for construction, *Electricidad de Lamo S.L.* for both infrastructures and connection and electricity installation,

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Enerpal for the installation of equipments and equipments cost as biomass storage and feeding system, thermal equipment and distribution network. For the fumes output equipment, *DrHumo soluciones* has been identified. *Castro S.L.* has been identified for the waste management, *Extinnox* for safety and health, and *Teicon Ingeniería* for quality control. Within the operation phase, *IGE2* Energía has been identified for the grid electricity, and *Mantenor Muiños* for both O&M (materials and labour). The last one identified locally is for the end of life, *Gerepal Alipio*.

Although several companies have also been identified at regional level for the same components or services as at local level, the new one that needs to be mentioned is the biomass fuel supplier, *Biomasa Herrero*.

- **Intervention 2: "Electric Vehicles for municipal services fleet"**

Table 14: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 2.

Cost breakdown	Local (city level)		Regional level	
	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
E-vehicle cost (without the battery cost)	NO	YES	YES	YES
Battery cost	NO	YES	NO	YES
E-vehicle charger cost	NO	YES	NO	YES
Grid connection works	YES	YES	YES	YES
Taxes				
Grid electricity price	NO	YES	NO	YES
Operation & Maintenance cost (materials/consumables)	NO	YES	NO	YES
Operation & Maintenance cost (labor)	YES	YES	YES	YES
Tax (Fee per year)				
Insurance costs (Fee per year)	NO	YES	YES	YES
Scrap value of vehicle	YES	YES	YES	YES
Battery recycling cost	YES	YES	YES	YES

The specific companies for those components that have been identified as having local production and distribution are *Vicuto S.A.* for both vehicle and battery, as well as the operation and maintenance (both materials and labor). *EasyCharger* has been identified for the charger and grid connection works, *IGE2 Energía* for the grid electricity, *Mapfre familiar* for insurance, *Cat Monzon S.L.* for the scrap vehile and Chatelac for recycling the battery.

The companies identified at regional level are multiples as well, but they are not mentioned sice local (city level) companies have been found to be used in the first instance for all the components.

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- **Intervention 3: "Smart Citizen Platform for all municipal services"**

Table 15: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 3.

Cost breakdown	Local (city level)		Regional level	
	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Analysis and first design of citizen participation tools and open data portal cost	NO	NO	NO	NO
Design of the citizen participation tool and data portal cost	NO	NO	NO	NO
Software solution development for citizen participation tool and open data portal cost	NO	NO	NO	NO
Software solutions implementation cost	NO	NO	NO	NO
GIS and IDE georeferencing services integration cost	NO	NO	NO	NO
Content generation linked to citizen participation (surveys, suggestions, etc.) and open data costs	NO	NO	NO	NO
Operation & Maintenance costs (e.g. license)	NO	NO	NO	NO
Technical Support Services (technical assistance, training courses)	NO	NO	NO	NO
End of life costs	YES	YES	YES	YES

For this intervention, no local or regional production or distribution companies have been identified. Only *Induraees S.L.* for the end of life management at local level.

- **Intervention 4: "Energy Monitoring of public buildings"**

Table 16: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 4.

Cost breakdown	Local (city level)		Regional level	
	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	Local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Analysis of the status of pilot buildings and first approach for implementation of measures cost	YES	YES	YES	YES
Water meter cost	NO	YES	NO	YES
Gas meter cost	NO	YES	NO	YES
Electric meter costs	NO	YES	NO	YES

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Thermal energy meter costs	NO	YES	NO	YES
Temperature and humidity sensors cost	NO	YES	NO	YES
Data concentrators with Ethernet connexon cost	NO	YES	NO	YES
Development and implementation of Energy Efficient software cost	YES	YES	YES	YES
Installation of sensors cost	YES	YES	YES	YES
Configuration of monitoring devices cost	YES	YES	YES	YES
Monitoring and maintenance of energy efficiency APP cost	NO	NO	YES	YES
Periodic reports on energy efficiency	NO	NO	YES	YES
Technical Support Services (technical assistance, training courses)	NO	NO	YES	YES
Grid electricity price	YES	YES	YES	YES
Operation & Maintenance cost (materials/consumables)	NO	NO	YES	YES
Operation & Maintenance cost (labor)	NO	NO	YES	YES
End of life costs	YES	YES	YES	YES

For this intervention, several companies have been identified for the local production and distribution of the different components, such as *Dimensión Ingeniería* for the first analysis and approach of the buildings, *Elektra* for the water meter, *Mantenor Muiños* for the gas meter and thermal energy meter, *Electricidad de Lamo* for the electric meter, temperature and humidity sensors data concentrators, development of the software, installation of sensors and the configuration of monitoring devices. Regarding the operation phase, *IGE2 Energía* has been identified for the grid electricity and *Chatelac* for the end of life management.

As in the others interventions, multiple companies have been identified at regional level for all components, but here only those for which no local equivalent company has been found are mentioned: *Ingernova*, for monitoring and maintenance of energy efficiency APP, for periodic reports on energy efficiency, for the technical support services, as well as for both O&M costs (materials and labor).

5.1.4.4 Step IV Identification of the main stakeholder related to each cost component

This last step focuses on the actors that make the investment of the different components of each action by defining the percentage of their contribution from the total cost of the investment in each component.

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- **Intervention 1: "District Heating with biomass in public buildings"**

Table 17: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 1.

		Who makes the payment?				
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
Design and planning cost	2.573,67	€	50 %	50 %	0 %	0 %
Construction costs	42.271,42	€	50 %	50 %	0 %	0 %
Infrastructures and connection cost	4.904,71	€	50 %	50 %	0 %	0 %
Electricity installation cost	8.065,63	€	50 %	50 %	0 %	0 %
Installation of equipment cost	8.273,98	€	50 %	50 %	0 %	0 %
Equipment cost: Biomass storage and feeding system	13.197,45	€	50 %	50 %	0 %	0 %
Equipment cost: Thermal equipment	64.045,30	€	50 %	50 %	0 %	0 %
Equipment cost: Fumes output	7.788,35	€	50 %	50 %	0 %	0 %
Equipment cost: Distribution network	31.300,43	€	50 %	50 %	0 %	0 %
Waste management cost	543,75	€	50 %	50 %	0 %	0 %
Safety and Health cost	6.171,00	€	50 %	50 %	0 %	0 %
Quality control cost	1.815,00	€	50 %	50 %	0 %	0 %
Grid electricity price	5.447,42	€/year	0 %	100 %	0 %	0 %
Operation & Maintenance cost (materials/consumables)	498,40	€/year	0 %	100 %	0 %	0 %
Operation & Maintenance cost (labor)	4.488,42	€/year	0 %	100 %	0 %	0 %
Biomass fuel cost	26.822,07	€/year	0 %	100 %	0 %	0 %
Tax (Fee per year)	3.332,69	€/year	0 %	100 %	0 %	0 %
Insurance costs (Fee per year)	2.788,59	€/year	0 %	100 %	0 %	0 %
End of life costs	1.138,57	€	0 %	100 %	0 %	0 %

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- **Intervention 2: "Electric Vehicles for municipal services fleet"**

Table 18: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 2.

			Who makes the payment?			
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
E-vehicle cost (without the battery cost)	27.877,98	€	19 %	81 %	0 %	0 %
Battery cost	5.529,00	€	19 %	81 %	0 %	0 %
E-vehicle charger cost	780,00	€	50 %	50 %	0 %	0 %
Grid connection works	720,00	€	0 %	100 %	0 %	0 %
Taxes	0,00	€	0 %	100 %	0 %	0 %
Grid electricity price	604,50	€/year	0 %	100 %	0 %	0 %
Operation & Maintenance cost (materials/consumables)	239,00	€/year	0 %	100 %	0 %	0 %
Operation & Maintenance cost (labor)	240,00	€/year	0 %	100 %	0 %	0 %
Tax (Fee per year)	37,90	€/year	0 %	100 %	0 %	0 %
Insurance costs (Fee per year)	322,00	€/year	0 %	100 %	0 %	0 %
Scrap value of vehicle	150,00	€	0 %	100 %	0 %	0 %
Battery recycling cost	400,00	€	0 %	100 %	0 %	0 %

- **Intervention 3: "Smart Citizen Platform for all municipal services"**

Table 19: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 3.

			Who makes the payment?			
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
Analysis and first design of citizen participation tools and open data portal cost	16.940,00	€	50 %	50 %	0 %	0 %
Design of the citizen participation tool and data portal cost	20.207,00	€	50 %	50 %	0 %	0 %
Software solution development for citizen participation tool and open data portal cost	29.766,00	€	50 %	50 %	0 %	0 %
Software solutions implementation cost	4.719,00	€	50 %	50 %	0 %	0 %
GIS and IDE georeferencing services integration cost	5.082,00	€	50 %	50 %	0 %	0 %

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Content generation linked to citizen participation (surveys, suggestions, etc.) and open data costs	11.495,00	€	50 %	50 %	0 %	0 %
Operation & Maintenance costs (e.g. license)	968,00	€/year	0 %	100 %	0 %	0 %
Technical Support Services (technical assistance, training courses)	1.210,00	€/year	0 %	100 %	0 %	0 %
End of life costs	130,00	€	0 %	100 %	0 %	0 %

- **Intervention 4: "Energy Monitoring of public buildings"**

Table 20: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 4.

			Who makes the payment?			
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
Analysis of the status of pilot buildings and first approach for implementation of measures cost	4.598,00	€	50 %	50 %	0 %	0 %
Water meter cost	5.929,00	€	50 %	50 %	0 %	0 %
Gas meter cost	6.171,00	€	50 %	50 %	0 %	0 %
Electric meter costs	9.559,00	€	50 %	50 %	0 %	0 %
Thermal energy meter costs	9.317,00	€	50 %	50 %	0 %	0 %
Temperature and humidity sensors cost	2.783,00	€	50 %	50 %	0 %	0 %
Data concentrators with Ethernet connexon cost	2.178,00	€	50 %	50 %	0 %	0 %
Development and implementation of Energy Efficient software cost	14.036,00	€	50 %	50 %	0 %	0 %
Installation of sensors cost	18.876,00	€	50 %	50 %	0 %	0 %
Configuration of monitoring devices cost	3.872,00	€	50 %	50 %	0 %	0 %
Monitoring and maintenance of energy efficiency APP cost	7.381,00	€/year	50 %	50 %	0 %	0 %
Periodic reports on energy efficiency	4.356,00	€/year	50 %	50 %	0 %	0 %
Technical Support Services (technical assistance, training courses)	2.178,00	€/year	50 %	50 %	0 %	0 %
Grid electricity price	48,96	€/year	0 %	100 %	0 %	0 %
Operation & Maintenance cost (materials/consumables)	968,00	€/year	0 %	100 %	0 %	0 %
Operation & Maintenance cost (labor)	1.210,00	€/year	0 %	100 %	0 %	0 %
End of life costs	70,00	€	0 %	100 %	0 %	0 %

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.2 Case of Rijeka

5.2.1 Phase I Selection of interventions

A selection of interventions has also been made in the case of Rijeka in order to carry out the techno-economic analysis. These actions have been selected according the following criteria: relevance according the political context, the environmental and economic issues, the technical feasibility, the social awareness and the potential acceptance. The potential replication and deployment at larger scale (regional, national) are also considered.

Based on the criteria defined, the city of Rijeka has pre-selected the interventions that are listed below:

- Smart Public Lightning

The smart lighting system presumes the possibility of remote control and management (lighting/turning off/strength regulation) of every particular lamp in the system. For the Rijeka public lighting system, it would mean replacing all existing lamps (app.15.500) with new LED lamps which have the above-mentioned possibilities. The available technologies of the smart public lighting systems mostly use wireless GPRS technology.

- Smart metering and smart data management

40 smart meters will be installed in public buildings by year 2021 (including the public buildings under retrofitting actions – 17); and final number is estimated to be 150 with the data to be processed and stored in Rijeka Data center.

The monitoring of energy resources is an important issue in order to provide insight into consumption dynamics (importance for the city in terms of maintenance and planning); further promotion of the savings and the reduction of the emissions; and the deployed system allows upgrades.

- RES integration – PV panels: energy storage and sharing

This smart-action aim to implement an energy sharing concept joining neighboring buildings in sharing electricity generated by PV panels.

At the same time due to the obstacles at the national level, based on the mySMARTLife findings and interventions in the Lighthouse cities, City of Rijeka will actively promote importance of this action.

5.2.2 Phase II Harmonization of interventions categories

According to the intervention categories described above, the interventions pre-selected in the follower cities can be classified (according to the existing classification of the interventions of lighthouse cities) as it is showed in the table below.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 21: Categorization of interventions into intervention categories for the example described.

Intervention to be replicated	Intervention category	Specific intervention related to it from lighthouse pilots
Smart public lighting	Public lighting	NAN: Smart Lighting
Smart metering & smart data management	Smart meters and control	NAN (47): Energy data monitoring of public buildings
RES integration, PV panels, energy storage and sharing	Solar photovoltaic	HEL: Solar power plants

5.2.3 Phase III Analysis of the socioeconomic and sectoral structure for the disaggregation of the supply chain

As mentioned in the case of Palencia, the public available IO tables of the World Input-Output Database (WIOD) [15] are used also for the follower cities and the classification of sectors and commodities has therefore been prepared according to the NACE codes described previously.

5.2.4 Phase VI Supply chain characterization of the interventions

All the interventions that are being evaluated in the current study for Rijeka are characterized in detail in this section, under the four following steps:.

5.2.4.1 Step I Disaggregation of costs per intervention

As mentioned in the case of Palencia, this step focuses on the disaggregation of the costs of each intervention. The disaggregation takes into account the main components that conform the intervention.

- **Intervention 1: Smart public lighting**

The costs for the first intervention, analyzed in the table below, considers a combined approach, that is, maintenance and modification of individual luminaires. Cost for the management and maintenance means costs for the whole system of public lightning.

Table 22: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 1.

Project / intervention lifetime: 15 years			
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)
High pressure sodium lamp 70W	6	€/unit	7
High pressure sodium lamp 150W	7	€/unit	7
250W high pressure sodium lamp	8	€/unit	7
Electromagnetic preamp for 70W sodium	7	€/unit	8
Electromagnetic preamp for a 150W sodium	11	€/unit	8

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Electromagnetic preamp for sodium bulb	13	€/unit	8
70-400 W sodium lamp bulb	3	€/unit	7
FRA Fuse 6-10 A	3	€/unit	7
Circuit breaker 10 A, 230 V, AC, 1P	2	€/unit	7
Road lamp with 70W high-pressure sodium	167	€/unit	25
Road lamp with 150W high-pressure sodium	208	€/unit	25
Park lamp with 70W high-pressure sodium	257	€/unit	25
Park lamp with 150W high-pressure sodium	257	€/unit	25
Road LED lamp, 83 W, with multi-stage light	382	€/unit	25
Park LED lamp, 53 Watt	472	€/unit	25
10 kV overvoltage protection for LED lamp	10	€/unit	7
LED flashlight preamp	52	€/unit	8
Management and maintenance of the public	500.000	€/year	1

- **Intervention 2: Smart metering & smart data management**

The costs for the second intervention, analyzed in the table below, takes into account measuring device with one central unit, which measures energy consumption (electricity, gas, water ...) in one facility.

Table 23: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 2.

Project / intervention lifetime: 10 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
central unit WMG type	2 362	€/Unit	10	3 .000,00 €
active antenna type 868 AAO	715	€/Unit	5	1 .400,00 €
wireless M-Bus PulseReader	250	€/3Unit	5	2 .000,00 €
wireless M-Bus PulseRepeater	551	€/3Unit	5	1 .000,00 €
Zener batery	350	€/Unit	5	1 .000,00 €
assembly and installation	2000	€/Unit	10	2 .000,00 €
parameterization, testing and commissioning	1000	€/Unit	10	1 .000,00 €
system maintenance and control	13500	€ per year		
database - management	10000	€ per year		

- **Intervention 3: RES integration, PV panels, energy storage and sharing**

The costs for the third intervention, analyzed in the table below, are based on 126m2 PV, which means 78 modules of approximate size 1.64mx0.99m. Since the costs are based on actual data of PVa already installed, the cost of total lifetime is increased by maintenance costs only.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 24: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 3

Project / intervention lifetime: 15 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Supply, setup and connection: SOLVIS SV60-225 PHOTOVOLTAIC MODULE; 225W peak power	17.500	€/117 Units	Guarantee of 80% of rated power: 25 years	17.500
Supply, setup and connection: Photovoltaic exchanger	2.600	€/3 Units	10	2.600
Supply, setup and connection: Cable RADOX Solar	2.000	€/950m	10	2.000
Production and installation of measuring cabinet	600	€/Unit	10	600
supporting substructure of photovoltaic modules for flat roof	1.100	€/180m2	10	600
cable channels PK100	2.300	€/260m	10	2.300
Installation and commissioning	3.000	€/Unit		3.000
Maintenance (cleaning)	1.500	€/year	1	30.000

5.2.4.2 Step II Assignment of each cost component with the corresponding subsector or commodity

For the actions presented in this section most of the costs correspond to electrical equipment and the related repair and installation services.

- **Intervention 1: Smart public lighting**

Table 25: Assignment of the cost component with the corresponding subsector or commodity for the intervention 1.

Component	CODE	Commodity
High pressure sodium	CPA_C27	Electrical equipment
High pressure sodium	CPA_C27	Electrical equipment
250W high pressure	CPA_C27	Electrical equipment
Electromagnetic preamp	CPA_C27	Electrical equipment
Electromagnetic preamp	CPA_C27	Electrical equipment
Electromagnetic preamp	CPA_C27	Electrical equipment
70-400 W sodium lamp	CPA_C27	Electrical equipment
FRA Fuse 6-10 A	CPA_C27	Electrical equipment
Circuit breaker 10 A,	CPA_C27	Electrical equipment
Road lamp with 70W Road lamp with 150W	CPA_C27 CPA_C27	Electrical equipment Electrical equipment
Park lamp with 70W	CPA_C27	Electrical equipment
Park lamp with 150W	CPA_C27	Electrical equipment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Road LED lamp, 83 W,	CPA_C27	Electrical equipment
Park LED lamp, 53 Watt	CPA_C27	Electrical equipment
10 kV overvoltage	CPA_C27	Electrical equipment
LED flashlight preamp	CPA_C27	Electrical equipment
management and	CPA_C33	Repair and installation services of machinery and equipment

- **Intervention 2: Smart metering & smart data management**

Table 26: Assignment of the cost component with the corresponding subsector or commodity for the intervention 2.

Component	CODE	Commodity
Central unit WMG type	CPA_C27	Electrical equipment
Active antenna type 868	CPA_C27	Electrical equipment
Wireless M-Bus	CPA_C27	Electrical equipment
Wireless M-Bus	CPA_C27	Electrical equipment
Zener batery	CPA_C27	Electrical equipment
Assembly and parameterization, testing and commissioning	CPA_C33	Repair and installation services of machinery and equipment
System maintenance	CPA_C33	Repair and installation services of machinery and equipment
Database -	CPA_C33	Repair and installation services of machinery and equipment

- **Intervention 3: RES integration, PV panels, energy storage and sharing**

Table 27: Assignment of the cost component with the corresponding subsector or commodity for the intervention 3.

Component	CODE	Commodity
Supply, setup and connection: SOLVIS SV60-225 PHOTOVOLTAIC MODULE; 225W peak power	CPA_C27	Electrical equipment
Supply, setup and connection: Photovoltaic exchanger	CPA_C27	Electrical equipment
Supply, setup and connection: Cable RADOX Solar	CPA_C27	Electrical equipment
Production and installation of	CPA_C31_C32	Furniture; other manufactured goods
Supporting substructure of photovoltaic modules for flat roof	CPA_C31_C32	Furniture; other manufactured goods
Cable channels PK100	CPA_C27	Electrical equipment
Installation/commisioning commissioning	CPA_C33	Repair and installation services of machinery and equipment
Maintenance (cleaning)	CPA_C33	Repair and installation services of machinery and equipment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.2.4.3 Step III Evaluation of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) in each city

Most of the equipment can be produced and then purchased from national providers. In the case of smart metering and smart management solutions, the equipment is distributed at local level (city). The installation and maintenance services are also generally provided locally at the city level.

- **Intervention 1: Smart public lighting**

Table 28: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 1.

	Local (city level)		Regional level	
Cost breakdown	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
High pressure sodium	NO	NO	YES	YES
High pressure sodium	NO	NO	YES	YES
250W high pressure	NO	NO	YES	YES
Electromagnetic preamp	NO	NO	YES	YES
Electromagnetic preamp	NO	NO	YES	YES
Electromagnetic preamp	NO	NO	YES	YES
70-400 W sodium lamp	NO	NO	YES	YES
FRA Fuse 6-10 A	NO	NO	YES	YES
Circuit breaker 10 A,	NO	NO	YES	YES
Road lamp with 70W	NO	NO	YES	YES
Road lamp with 150W	NO	NO	YES	YES
Park lamp with 70W	NO	NO	YES	YES
Park lamp with 150W	NO	NO	YES	YES
Road LED lamp, 83 W,	NO	NO	YES	YES
Park LED lamp, 53 Watt	NO	NO	YES	YES
10 kV overvoltage	NO	NO	YES	YES
LED flashlight preamp	NO	NO	YES	YES
Management and maintenance of the public lightning	YES	YES	YES	YES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

- **Intervention 2: Smart metering & smart data management**

Table 29: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 2.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Central unit WMG type	NO	YES	YES	YES
Active antenna type 868	NO	YES	YES	YES
Wireless M-Bus	NO	YES	YES	YES
Wireless M-Bus	NO	YES	YES	YES
Zener batery	NO	YES	YES	YES
Assembly and installation	NO	YES	YES	YES
Parameterization, testing and commissioning	NO	YES	YES	YES
System maintenance	YES	YES	YES	YES
Data-management	YES	YES	YES	YES

- **Intervention 3: RES integration, PV panels, energy storage and sharing**

Table 30: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 3.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Supply, setup and connection: SOLVIS SV60-225 PHOTOVOLTAIC MODULE; 225W peak power	NO	NO	YES	YES
Supply, setup and connection: Photovoltaic exchanger	NO	NO	YES	YES
Supply, setup and connection: Cable RADOX Solar	NO	NO	YES	YES
Production and installation of measuring cabinet	NO	NO	YES	YES
supporting substructure of photovoltaic modules for flat roof	NO	NO	YES	YES
cable channels PK100	NO	NO	YES	YES
Installation and commissioning	NO	NO	YES	YES
Maintenance (cleaning)				

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.2.4.4 Step IV Identification of the main stakeholder related to each cost component

It is possible to use co-financing by the Croatian Energy Efficiency Fund to replace pre-prescribed modules.

- **Intervention 1: Smart public lighting**

Table 31: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 1.

			Who makes the payment?			
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
High pressure sodium lamp 70W	6	€/unit		100 %		
High pressure sodium lamp 150W	7	€/unit		100 %		
250W high pressure sodium lamp	8	€/unit		100 %		
Electromagnetic preamp for 70W sodium lamp	7	€/unit		100 %		
Electromagnetic preamp for a 150W sodium lamp	11	€/unit		100 %		
Electromagnetic preamp for sodium bulb 250W	13	€/unit		100 %		
70-400 W sodium lamp bulb	3	€/unit		100 %		
FRA Fuse 6-10 A	3	€/unit		100 %		
Circuit breaker 10 A, 230 V, AC, 1P	2	€/unit	70 %	30 %		
Road lamp with 70W high-pressure sodium source	167	€/unit	70 %	30 %		
Road lamp with 150W high-pressure sodium source	208	€/unit	70 %	30 %		
Park lamp with 70W high-pressure sodium source	257	€/unit		100 %		
Park lamp with 150W high-pressure sodium source	257	€/unit		100 %		
Road LED lamp, 83 W, with multi-stage light control	382	€/unit		100 %		
Park LED lamp, 53 Watt	472	€/unit		100 %		
10 kV overvoltage protection for LED lamp	10	€/unit		100 %		
LED flashlight preamp	52	€/unit		100 %		
management and maintenance of the public lightning	500.000	€/year		100 %		

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

- **Intervention 2: Smart metering & smart data management**

Table 32: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 2.

Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (citizens)	% paid by private companies
Central unit WMG type	2 362	€/Unit	50 %	50 %		
Active antenna type 868 AAO	715	€/Unit	50 %	50 %		
Wireless M-Bus PulseReader	250	€/3Unit	50 %	50 %		
Wireless M-Bus PulseRepeater	551	€/3Unit	50 %	50 %		
Zener batery	350	€/Unit	50 %	50 %		
Assembly and installation	2000	€/Unit	50 %	50 %		
Parameterization, testing and commissioning	1000	€/Unit	50 %	50 %		
System maintenance and control	13500	€ per year (30 buildings)		100 %		
Database - management	10000	€ per year		100 %		

- **Intervention 3: RES integration, PV panels, energy storage and sharing**

Table 33: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 3.

Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (citizens)	% paid by private companies
Supply, setup and connection: SOLVIS SV60-225 PHOTOVOLTAIC MODULE; 225W peak power	17500	€/117 Units		100 %		
Supply, setup and connection: Photovoltaic exchanger	2600	€/3 Units		100 %		
Supply, setup and connection: Cable RADOX Solar	2000	€/950m		100 %		
Production and installation of measuring cabinet	600	€/Unit		100 %		
Supporting substructure of photovoltaic modules for flat roof	1100	€/180m2		100 %		
Cable channels PK100	2300	€/260m		100 %		
Installation and commissioning	3000	€/Unit		100 %		
Maintenance (cleaning)	1500	€/ year		100 %		

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.3 Case of Bydgoszcz

5.3.1 Phase I Selection of interventions

A selection of interventions has also been made in the case of Bydgoszcz in order to carry out the techno-economic analysis. These actions have been selected according the following criteria: relevance according the political context, the environmental and economic issues, the technical feasibility, the social awareness and the potential acceptance. The potential replication and deployment at larger scale (regional, national) are also considered.

Based on the criteria defined, the city of Bydgoszcz has pre-selected the following interventions:

- **E-mobility (E-buses, public charging station, EV)**

  The action consists in the deployment of 210 EV charging points to be located in the city by Dec. 2020, and also 30 e-buses to be procured in year 2020.

- **PV in public buildings**

  The action corresponds to a group of PV production actions including: a solar plant on the Astoria Swimming Pools, the total installation power estimated at 140 kW, RES investments on 11 facilities with a total capacity of 229.5 kW, installation of photovoltaic panels on the roof surface of the unloading hall by PRONATURA (Intermunicipal Waste Treatment Facility), Construction of photovoltaic power plants together with energy storage, infrastructure and intelligent control system of the main MV switchgear at MWiK facilities (Municipal Water and Sewage Company, for a total of 5 MW).

- **Smart lighting system**

  The action includes the deployment of 16.000 lighting points to be replaced with LED technology.

5.3.2 Phase II Harmonization of interventions categories

According to the intervention categories described above, the interventions pre-selected in the follower cities can be classified (according to the existing classification of the interventions of lighthouse cities) as it is showed in the table below.

Table 34: Categorization of interventions into intervention categories for the example described.

Intervention to be replicated	Intervention category	Specific intervention from lighthouse pilots
E-mobility (E-buses, public charging station, EV)	Electro-mobility	HAM action 22: Electrification of public vehicle fleet
PV in public buildings	Solar photovoltaic	HEL: solar power plants
Smart lighting system	Public lighting	NAN: Smart Lighting

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.3.3 Phase III Analysis of the socioeconomic and sectoral structure for the disaggregation of the supply chain

As mentioned in the case of Palencia and Rijeka, the public available IO tables of the World Input-Output Database (WIOD) [15] are used also for the follower cities and the classification of sectors and commodities has therefore been prepared according to the NACE codes described previously.

5.3.4 Phase VI Supply chain characterization of the interventions

All the interventions that are being evaluated in the current study for Bydgoszcz are characterized in detail in this section, under the four steps that follow.

5.3.4.1 Step I Disaggregation of costs per intervention

As mentioned in the case of Palencia and Rijeka, this step focuses on the disaggregation of the costs for each intervention. The disaggregation takes into account the main components that conform the intervention.

- **Intervention 1: E-mobility (E-buses, public charging station, EV)**

Bydgoszcz divided the costs into H1a and H1b - making a distinction between the e-buses and EV - infrastructure. The purchase of 30 Solaris-type articulated electric buses along with the accompanying infrastructure in the form of 20 fast 60 kW chargers and 5 pantographs on selected lines were taken into account. The costs analysed were taken from the tender made by the City of Warsaw, PL with an analogous scope to the Bydgoszcz scope. The assumptions are that batteries get replaced after 6 years of service when the warranty period is over, and they are no longer effective in their performance.

Table 35: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 1a.

Project / intervention lifetime: 20 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
E-vehicle cost (without the battery cost) - bus (30 pcs.)	719.258	€/1 bus	20	21.577.726,22 €
Desing, projects, procurments	116.279	€	1	116.279,07 €
Battery cost - bus	139.535	€/1 bus	6	13.953.488,37 €
E-vehicle charger cost - e-bus pantographs	97.674	€/unit	10	976.744,19 €
E-vehicle charger cost - e-bus 60 kW	23.256	€/unit	10	930.232,56 €
Grid connection	10.000	€/unit	20	250.000,00 €
Grid maintenance	5.000	€	5	500.000,00 €
Taxes	incl.	€		
Insurance	16804	€	1	336.075,11 €
Grid electricity price (variable costs of the	86,02	€/MWh		
Grid electricity distribution price (variable)	74,42	€/MWh		
Grid electricity base-price (fixed costs)	11.088,37	€/year	1	221.767,44 €
Operation & Maintenance cost (materials)	incl.			
Operation & Maintenance costs (labour)	incl.			
Scrap value of vehicle	837,21	EUR/unit	20	25.116,28 €

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 36: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 1b

Project / intervention lifetime: 15 years		
Cost breakdown	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Infrastructrure design	15	€ 28.538,28
EV Quick Charger 50 kWDBT Tristandard -	15	€ 170.000,00
Assebly EV Quick Charger 50 kWDBT	20	€ 8.250,00
EV Charger Circontrol 2 x 22 kW eVolve	15	€ 425.100,00
Assembly EV Charger Circontrol 2 x 22 kW	20	€ 1.044,08
Autorization	20	€ 15.313,23
Monitoring IT system	20	€ 27.842,23
Grid connection works	20	€ 5.357,14
Operation & Maintenance cost (service)	1	191.415,31 €

- **Intervention 2: PV in public buildings**

Bydgoszcz has divided the costs into the H2a and H2b –the objective is to make a distinction between the 5 MW solar plant investment and RES systems on public buildings.

The list of costs includes 10 fast charging stations with the capacity of 50 kW in the CHADEMO, CSS, COMBO standards, Type 2 as well as 100 Type 2 double stations. The city covers the preparation costs and acts as a market animator, while demand stimulates the supply proportionally with the development of market dynamics.

Table 37: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 2a.

Project / intervention lifetime: 20 years		
Cost breakdown	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Feasibility study	1	12.300,00 €
Projects	1	5.104,41 €
11 instalations (Inverters, PV panels,	20	301.624,13 €
Investor supervisor	1	2.320,19 €
Project operation costs	20	10.000,00 €
Operation & Maintenance cost (materials)	1	55.000,00 €
Insurance costs (Fee per year)	20	12.064,97 €

Table 38: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 2b

Project / intervention lifetime: 25 years		
Cost breakdown	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
Design phase (administrative phase, access to grid, project design)	25	75.000,00 €
PV panels (5010 pcs.) (transport and assembly incl.)	25	2.640.440,84 €

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Inverters (170 pcs.) (transport and assembly incl.)	25	542.227,38 €
Constructions, montage systems (transport and assemblu incl.)	25	796.078,89 €
Cables, electrical systems AC + DC, (transport and assembly incl.)	25	411.786,54 €
Fencing	25	243.619,49 €
Operation costs (construction manager, cctv, security, waste	25	106.496,52 €
Grid integration works, transformation station (without design phase)	25	83.990,72 €
Operation & Maintenance cost (materials)	1	397.833,53 €
Tax (Fee per year)	1	- €
Insurance costs (Fee per year)	1	247.273,20 €

- **Intervention 3: Smart lighting system**

The cost modelling assumed the replacement of 1.000 luminaires with different powers (26 W, 36W, 99W and 122W) on 7 and 10 m lamp posts (in a 1: 1 ratio). The costs also include dismantling old devices and installation of automation and energy management units on the lighting points.

Table 39: Data for the disaggregation of costs (CAPEX and OPEX) for the intervention 3.

Project / intervention lifetime: 15 years				
Cost breakdown	Costs	Unit	Specific lifetime of the component (years)	Total cost in the lifetime (including replacement)
LED light fixtures 26 W (assembly incl.) x 100	€ 452,26	€/UNIT	20	67.838,28 €
LED light fixtures 36 W (assembly incl.) x 200	€ 476,70	€/UNIT	20	143.010,21 €
LED light fixtures 99 W (assembly incl.) x 600	€ 664,11	€/UNIT	20	597.700,23 €
LED light fixtures 122 W (assembly incl.) x 100	€ 711,68	€/UNIT	20	106.751,28 €
Lamp post 7 m (assembly incl.) (x500)	€ 481,95	€/UNIT	30	240.974,48 €
Lamp post 10 m (assembly incl.) (x500)	€ 629,65	€/UNIT	30	314.822,51 €
Sensors and controls (1 controls per 15 lapms)	€ 2.500,00	€/UNIT	10	500.000,00 €
Control cabinets (group controls) (1 controls per 15	€ 1.164,70	€/UNIT	10	232.940,00 €
Meassures, Installation and connection works	€	€/UNIT	30	19.000,00 €
IT control system (incl. Year fee)	€	€	30	200.000,00 €
Disassembly x 1000	€ 73,20	€ /	30	73.201,86 €
Grid electricity price (variable costs of the electricity)	€ 88,07	€/MWh		42.497.575,71 €
Grid electricity distribution price (variable)	€ 31,71	€/MWh		
Grid electricity base-price (fixed costs)	€ 2.075,43	€/year		62.262,86 €
Operation & Maintenance cost (materials)	€	€/year		825.000,00 €
Operation & Maintenance costs (labour)	€	€/year		600.000,00 €
Insurance costs (Fee per year)	€ 9.500,00	€/year		285.000,00 €

5.3.4.2 Step II Assignment of each cost component with the corresponding subsector or commodity

This section provides the details of the assignation of the main cost components that are involved in each of the three big interventions of the city.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

- **Intervention 1: E-mobility (E-buses, public charging station, EV)**

Table 40: Assignment of the cost component with the corresponding subsector or commodity for the intervention 1a.

Component	CODE	Commodity
E-vehicle cost (without the battery cost) - bus (30 pcs.)	CPA_C29	Motor vehicles, trailers and semi-trailers
Desing, projects, procurments	CPA_M71	Architectural and engineering services; technical testing and analysis
Battery cost - bus	CPA_C27	Electrical equipment
E-vehicle charger cost - e-bus	CPA_C27	Electrical equipment
E-vehicle charger cost - e-bus	CPA_C27	Electrical equipment
Grid connection	CPA_K64	Financial services, except insurance and pension funding
Grid maintenance	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory
Taxes	CPA_K64	Financial services, except insurance and pension funding
Insurance	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory and social security
Grid electricity price (variable	CPA_D35	Electricity, gas, steam and air-conditioning
Grid electricity distribution price	CPA_D35	Electricity, gas, steam and air-conditioning
Grid electricity base-price (fixed	CPA_D35	Electricity, gas, steam and air-conditioning
Operation & Maintenance cost	CPA_C27	Electrical equipment
Operation & Maintenance costs	CPA_C33	Repair and installation services of machinery and equipment
Scrap value of vehicle	CPA_C29	Motor vehicles, trailers and semi-trailers

Table 41: Assignment of the cost component with the corresponding subsector or commodity for the intervention 1b.

Component	CODE	Commodity
Infrastructrure design	CPA_M71	Architectural and engineering services; technical testing and analysis
EV Quick Charger 50 kWDBT	CPA_C27	Electrical equipment
Assebly EV Quick Charger 50	CPA_C33	Repair and installation services of machinery and equipment
EV Charger Circontrol 2 x 22	CPA_C27	Electrical equipment
Assembly EV Charger	CPA_C33	Repair and installation services of machinery and equipment
Autorization	CPA_K64	Financial services, except insurance and pension funding
Monitoring IT system	CPA_C33	Repair and installation services of machinery and equipment
Grid connection works	CPA_C33	Repair and installation services of machinery and equipment
Grid electricity price (variable	CPA_D35	Electricity, gas, steam and air-conditioning
Grid electricity distribution price	CPA_D35	Electricity, gas, steam and air-conditioning
Grid electricity base-price (fixed	CPA_D35	Electricity, gas, steam and air-conditioning
Operation & Maintenance cost	CPA_D35	Electricity, gas, steam and air-conditioning
Insurance costs (Fee per year)	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory

- **Intervention 2: PV in public buildings**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 42: Assignment of the cost component with the corresponding subsector or commodity for the intervention 2a.

Component	CODE	Commodity
Feasibility study	CPA_M71	Architectural and engineering services; technical testing and analysis
Projects	CPA_M71	Architectural and engineering services; technical testing and analysis
11 instalations (Inverters,	CPA_C27	Electrical equipment
Investor supervisor	CPA_M71	Architectural and engineering services; technical testing and analysis
Project operation costs	CPA_C27	Electrical equipment
Operation & Maintenance Insurance costs (Fee per year)	CPA_C33	Repair and installation services of machinery and equipment

Table 43: Assignment of the cost component with the corresponding subsector or commodity for the intervention 2b.

Component	CODE	Commodity
Design phase (administrative phase, access to grid, project design)	CPA_M71	Architectural and engineering services; technical testing and analysis services
PV panels (5010 pcs.)	CPA_C27	Electrical equipment
Inverters (170 pcs.)	CPA_C27	Electrical equipment
Constructions, montage	CPA_C33	Repair and installation services of machinery and equipment
Cables, electrical systems	CPA_C27	Electrical equipment
Fencing	CPA_C25	Fabricated metal products, except machinery and equipment
Operation costs	CPA_D35	Electricity, gas, steam and air-conditioning
Grid integration works,	CPA_C27	Electrical equipment
Operation & Maintenance	CPA_C27	Electrical equipment
Tax (Fee per year)	CPA_K64	Financial services, except insurance and pension funding
Insurance costs (Fee per year)	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory and social security

- **Intervention 3: Smart lighting system**

Table 44: Assignment of the cost component with the corresponding subsector or commodity for the intervention 3.

Component	CODE	Commodity
LED light fixtures 26 W (assembly incl.) x 100	CPA_C27	Electrical equipment
LED light fixtures 36 W (assembly incl.) x 200	CPA_C27	Electrical equipment
LED light fixtures 99 W (assembly incl.) x 600	CPA_C27	Electrical equipment
LED light fixtures 122 W (assembly incl.) x 100	CPA_C27	Electrical equipment
Lamp post 7 m (assembly incl.) (x500)	CPA_C25	Fabricated metal products, except machinery and
Lamp post 10 m (assembly incl.) (x500)	CPA_C25	Fabricated metal products, except machinery and
Sensors and controls (1 controls per 15 lapms)	CPA_C26	Computer, electronic and optical products

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Control cabinets (group controls) (1 controls per 15 lapms)	CPA_C25	Fabricated metal products, except machinery and equipment
Meassures, Installation and connection works	CPA_C33	Repair and installation services of machinery and equipment
IT control system (incl. Year fee)	CPA_C26	Computer, electronic and optical products
Disassembly x 1000	CPA_C33	Repair and installation services of machinery and
Grid electricity price (variable costs of the	CPA_D35	Electricity, gas, steam and air-conditioning
Grid electricity distribution price (variable)	CPA_D35	Electricity, gas, steam and air-conditioning
Grid electricity base-price (fixed costs)	CPA_D35	Electricity, gas, steam and air-conditioning
Operation & Maintenance cost (materials)	CPA_C27	Electrical equipment
Operation & Maintenance costs (labour)	CPA_C33	Repair and installation services of machinery and equipment
Insurance costs (Fee per year)	CPA_K65	Insurance, reinsurance and pension funding services, except compulsory and social security

5.3.4.3 Step III Evaluation of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) in each city

The equipment related to PV actions is generally distributed at local level. Some services such as installation operations are also provided by local stakeholders.

- **Intervention 1: E-mobility (E-buses, public charging station, EV)**

Table 45: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 1a.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
E-vehicle cost (without the battery cost) - bus (30 pcs.)	NO	NO	NO	NO
desing, projects, procurments	YES	YES	YES	YES
Battery cost - bus	NO	NO	NO	NO
E-vehicle charger cost - e-bus	NO	NO	NO	NO
E-vehicle charger cost - e-bus	NO	NO	NO	NO
Grid connection	YES	YES	YES	YES
Grid maintenance	YES	YES	YES	YES
Insurance	YES	YES	YES	YES
Scrap value of vehicle	YES	YES	YES	YES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 46: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 1b.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Infrastructrure design	YES	YES	YES	YES
EV Quick Charger 50 kWDBT	NO	YES	NO	YES
Assebly EV Quick Charger 50	YES	YES	YES	YES
EV Charger Circontrol 2 x 22	YES	YES	YES	YES
Assembly EV Charger	YES	YES	YES	YES
Autorization	YES	YES	YES	YES
Monitoring IT system	NO	NO	NO	NO
Grid connection works	YES	YES	YES	YES
Operation & Maintenance cost	YES	YES	YES	YES
Insurance costs (Fee per year)	YES	YES	YES	YES

- **Intervention 2: PV in public buildings**

Table 47: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 2a.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Feasibility study	YES	YES	YES	YES
Projects	YES	YES	YES	YES
11 instalations	YES	YES	YES	YES
Investor supervisor	YES	YES	YES	YES
Project operation costs	YES	YES	YES	YES
Operation & Maintenance cost (materials)	YES	YES	YES	YES
Insurance costs (Fee	YES	YES	YES	YES
Feasibility study	YES	YES	YES	YES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 48: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 2b.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
Design phase	YES	YES	YES	YES
PV panels (5010 pcs.)	NO	YES	NO	YES
Inverters (170 pcs.)	NO	YES	NO	YES
Constructions, montage	YES	YES	YES	YES
Cables, electrical	YES	YES	YES	YES
Fencing	YES	YES	YES	YES
Operation costs	YES	YES	YES	YES
Grid integration works,	YES	YES	YES	YES
Operation &	YES	YES	YES	YES
Tax (Fee per year)	YES	YES	YES	YES
Insurance costs (Fee	YES	YES	YES	YES

- **Intervention 3: Smart lighting system**

Table 49: Analysis of the capacities for the manufacturing and distribution of each cost component (commodity/subsector) for the intervention 3.

Cost breakdown	Local (city level)		Regional level	
	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)	local producer? (YES/NO)	Local distribution / stockist? (YES/NO)
LED light fixtures 26 W (assembly incl.) x 100	NO	YES	NO	YES
LED light fixtures 36 W (assembly incl.) x 200	NO	YES	NO	YES
LED light fixtures 99 W (assembly incl.) x 600	NO	YES	NO	YES
LED light fixtures 122 W (assembly incl.) x 100	NO	YES	NO	YES
Lamp post 7 m (assembly incl.) (x500)	YES	YES	YES	YES
Lamp post 10 m (assembly incl.) (x500)	YES	YES	YES	YES
Sensors and controls (1 controls per 15 lapms)	NO	NO	NO	NO
Control cabinets (group controls) (1 controls per 15	YES	YES	YES	YES
Meassures, Installation and connection works	YES	YES	YES	YES
IT control system (incl. Year fee)	NO	NO	YES	NO
Disassembly x 1000	YES	YES	YES	YES
Operation & Maintenance cost (materials)	YES	YES	YES	YES
Operation & Maintenance costs (labour)	YES	YES	YES	YES
Insurance costs (Fee per year)	YES	YES	YES	YES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.3.4.4 Step IV Identification of the main stakeholder related to each cost component

Smart Action 1

The e-Bus project is to be implemented as part of the so-called innovation partnership, where local governments will co-order thebuses, and the public procurement will be carried out by the National Center for Research and Development. By accumulating orders of nearly 30 local governments, it will be possible to obtain the best solutions and prices.

The Act on electromobility assumes the functioning of nearly 210 EV charging points in Bydgoszcz. As part of the activities, it is envisaged to develop a strategy for developing mobility for the city and to involve the private sector in the infrastructure development.

Smart Action 2

A total of 230 kW are planned to be obtained through the use of renewable energy sources. The value of eligible costs of the project will amount to PLN 1.4 million, of which over 50% is EU funding under the Regional Operational Program of the Kuyavian-Pomeranian Voivodeship for 2014-2020. The project is expected to be implemented in year 2020 (Intervention: RES investments on 11 facilities).

In the EU perspective for 2021-2027, support for large renewable energy plants is forecast. A possible form of EU funding under the Regional Operational Program of the Kujawsko-Pomorskie Voivodeship for 2014-2020 may range from 45% to 85% of eligible costs (Intervention: Construction of photovoltaic power plants together with energy storage 5 MW).

Smart Action 3

Transportation Board in Bydgoszcz proposes streets for lighting installation and modernization of lighting on the basis of the following criteria: the number of residents registered at a given street, thetechnical possibilities of lighting supply, and the applications for the construction of lighting from residents and District Councils.

In year 2015, street lighting was modernized in Bydgoszcz and the investment was carried out based on 45% refinancing obtained from the National Fund for Environmental Protection and Water Management. In the future, various financing options are being considered from the Regional Operational Programme, the National Fund for Environment and to Smart Growth Operational Programme.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

- **Intervention 1: E-mobility (E-buses, public charging station, EV)**

Table 50: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 1a.

			Who makes the payment?			
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
E-vehicle cost (without the battery cost) - bus (30 pcs.)	21.577.726,22 €	€	**15 %**	85 %	0 %	0 %
Desing, projects, procurments	116.279,07 €	€	**100 %**	0 %	0 %	0 %
Battery cost - bus	13.953.488,37 €	€	**100 %**	0 %	0 %	0 %
E-vehicle charger cost - e-bus pantographs 400 kW (5 pcs.)	976.744,19 €	€	**15 %**	85 %	0 %	0 %
E-vehicle charger cost - e-bus 60 kW chargers (20 pcs.)	930.232,56 €	€	**15 %**	85 %	0 %	0 %
Grid connection	250.000,00 €		**100 %**	0 %	0 %	0 %
Grid maintenance	500.000,00 €		**100 %**	0 %	0 %	0 %
Taxes		€ /MWh				
Insurance	336.075,11 €	€ /MWh	**100 %**	0 %	0 %	0 %
Grid electricity price (variable costs of the electricity)		€ /year	0 %	0 %	50 %	50 %
Grid electricity distribution price (variable)			0 %	0 %	50 %	50 %
Grid electricity base-price (fixed costs)	221.767,44 €		0 %	0 %	50 %	50 %
Operation & Maintenance cost (materials)						
Operation & Maintenance costs (labour)						
Scrap value of vehicle	25.116,28 €		100 %	0 %	0 %	0 %

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 51: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 1b.

			Who makes the payment?			
Cost breakdown	Costs	Unit	% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (Citizens)	% paid by private companies
Infrastructrure design	28.538,28	€ / UNIT	**100 %**	0 %	0 %	0 %
EV Quick Charger 50 kWDBT Tristandard - CHADEMO, CSS, COMBO, Type 2 (x10)	17.000,00	€ / UNIT	0 %	0 %	0 %	100 %
Assebly EV Quick Charger 50 kWDBT Tristandard - CHADEMO, CSS, COMBO, Type 2 (x10)	1.100,00	€ / UNIT	0 %	0 %	0 %	100 %
EV Charger Circontrol 2 x 22 kW eVolve Smart T - wersja na słupku, 3G/4G, OCCP, RFID (x100)	4.251,00	€ / UNIT	0 %	0 %	0 %	100 %
Assembly EV Charger Circontrol 2 x 22 kW eVolve Smart T - wersja na słupku, 3G/4G, OCCP, RFID (x100)	1.392,11	€ / UNIT	0 %	0 %	0 %	100 %
Autorization	185,61	€ / UNIT	0 %	0 %	0 %	100 %
Monitoring IT system	27.842,23	€	0 %	0 %	0 %	100 %
Grid connection works	7.142,86	€ / UNIT	0 %	0 %	0 %	100 %
Grid electricity price (variable costs of the electricity)	88,07	€ /MWh	0 %	0 %	50 %	50 %
Grid electricity distribution price (variable)	31,71	€ /MWh	0 %	0 %	50 %	50 %
Grid electricity base-price (fixed costs)	2.075,43	€ /MWh	0 %	0 %	50 %	50 %
Operation & Maintenance cost (service)	116,01	€ /MWh	0 %	0 %	0 %	100 %
Insurance costs (Fee per year)		€	100 %	0 %	0 %	0 %

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

- **Intervention 2: PV in public buildings**

Table 52: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 2.

Cost breakdown	Costs	Unit	Who makes the payment? % paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (citizens)	% paid by private companies
Feasibility study	12.300,00	€	100 %	0 %	0 %	0 %
Projects	464,04	€ / UNIT	50 %	50 %	0 %	0 %
11 instalations (Inverters, PV panels, mounting system, electrical system)	301.624,13	€	50 %	50 %	0 %	0 %
investor supervisor	2.320,19	€	50 %	50 %	0 %	0 %
Project operation costs	10.000,00	€	50 %	50 %	0 %	0 %
Operation & Maintenance cost (materials)	250,00	€ /year*1 PV plant	100 %	0 %	0 %	0 %
Insurance costs (Fee per year)	603,25	€ /year	100 %	0 %	0 %	0 %

Table 53: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 2b.

Cost breakdown	Costs	Unit	Who makes the payment? % paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (citizens)	% paid by private companies
Design phase (administrative phase, access to grid, project design)	75.000,00	€	**15 %**	85 %	0 %	0 %
PV panels (5010 pcs.) (transport and assembly incl.)	2.640.440,84	€	**15 %**	85 %	0 %	0 %
Inverters (170 pcs.) (transport and assembly incl.)	542.227,38	€	**15 %**	85 %	0 %	0 %
Constructions, montage systems (transport and assemblu incl.)	796.078,89	€	**15 %**	85 %	0 %	0 %
Cables, electrical systems AC + DC, (transport and assembly incl.)	411.786,54	€	**15 %**	85 %	0 %	0 %
Fencing	243.619,49	€	**15 %**	85 %	0 %	0 %
Operation costs (construction manager, cctv, security, waste managment, fuel, lightnings, etc.)	106.496,52	€	**15 %**	85 %	0 %	0 %
Tax (Fee per year)	-	€/year	**15 %**	85 %	0 %	0 %
Insurance costs (Fee per year)	9.890,93	€/year	**100 %**	0 %	0 %	0 %

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

- **Intervention 3: Smart lighting system**

Table 54: Analysis of the main stakeholder related to each cost component (commodity/subsector) for the intervention 3.

Cost breakdown	Costs	Unit	Who makes the payment?			
			% paid with public funding (Out of the region)	% paid with public (Regional) funding	% paid by the individual (citizens)	% paid by private companies
LED light fixtures 26 W (assembly incl.) x 100	452,26	€ / UNIT	**29 %**	71 %	0 %	0 %
LED light fixtures 36 W (assembly incl.) x 200	476,70	€ / UNIT	**29 %**	71 %	0 %	0 %
LED light fixtures 99 W (assembly incl.) x 600	664,11	€ / UNIT	**29 %**	71 %	0 %	0 %
LED light fixtures 122 W (assembly incl.) x 100	711,68	€ / UNIT	**29 %**	71 %	0 %	0 %
Lamp post 7 m (assembly incl.) (x500)	481,95	€ / UNIT	**29 %**	71 %	0 %	0 %
Lamp post 10 m (assembly incl.) (x500)	629,65	€ / UNIT	**29 %**	71 %	0 %	0 %
Sensors and controls (1 controls per 15 lapms)	2.500,00	€ / UNIT	**29 %**	71 %	0 %	0 %
Control cabinets (group controls) (1 controls per 15 lapms)	1.164,70	€ / UNIT	**29 %**	71 %	0 %	0 %
Meassures, Installation and connection works	19.000,00	€	**100 %**	0 %	0 %	0 %
IT control system (incl. Year fee)	200.000,00	€	**29 %**	71 %	0 %	0 %
disassembly x 1000	73,20	€ / UNIT	**100 %**	0 %	0 %	0 %
Grid electricity price (variable costs of the electricity)	88,07	€/MWh	**100 %**	0 %	0 %	0 %
Grid electricity distribution price (variable)	31,71	€/MWh	**100 %**	0 %	0 %	0 %
Grid electricity base-price (fixed costs)	2.075,43	€/year	**100 %**	0 %	0 %	0 %
Operation & Maintenance cost (materials)	27.500,00	€/year	**100 %**	0 %	0 %	0 %
Operation & Maintenance costs (labour)	20.000,00	€/year	**100 %**	0 %	0 %	0 %
Insurance costs (Fee per year)	9.500,00	€/year	**100 %**	0 %	0 %	0 %

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

6. Conclusions

This deliverable includes a description of the work carried out in mySMARTLife project related to the techno-economic analysis of the interventions. This step is relevant for the entire socioeconomic impact analysis since the accuracy obtained in the supply chain characterization of each intervention will directly affect the type of results that can be obtained in the following steps.

The results obtained in the Subtask 6.2.3 (described in this deliverable) have contributed to prove the applicability of the methodology defined in WP1 for the evaluation of the supply chain of city interventions. As in the case of the activities of WP1, all the created shocks (which represent the interventions) will have the same format so that the socioeconomic modelling process is simplified.

The work carried out has once again shown that the contact between the analyst and the municipality is a key aspect in ensuring that the economic information as well as other aspects to be evaluated throughout the value chain of the actions is as accurate as possible. It should be noted that this is an indispensable aspect for obtaining reliable results in the evaluation phase.

An important consideration is that when referring to follower cities, they do not have the real cost of the actions that are evaluated here, but in several cases, they have to use references or design values.

The effort made by the cities in this case is highlighted, both to try to obtain real data when appropriate and to define the design costs for the rest of the cases. In any case, for all the cases it was finally possible to complete the analysis including also the capabilities for the local manufacturing and distribution of components in each city per each intervention included in the pilots, as well as an analysis of the origin of the investments.

Finally, results inevitable to mention that it is a very demanding methodology in terms of data collection. However, its input is expected to be very relevant for the evaluation of the socioeconomic impact associated due to the implementation and deployment of the interventions evaluated in its corresponding city and region.

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