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TOWARDS SMART ZERO CO_2 CITIES ACROSS EUROPE

VITORIA-GASTEIZ + TARTU + SØNDERBORG

Deliverable 6.1: CIOP Functional and Non-Functional Specifications

WP6, Task 6.1

Date of document

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[1] PU = Public

PP = Restricted to other programme participants (including the Commission Services)

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			- Identification of Added value servcies
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31/07/2016	1.0	Jose Luis Izkara, Alberto Armijo /TEC	Final review Conclusions and Summary

Table of content:

Table of Tables:

Table of Figures:

Abbreviations and Acronyms

Abbreviation/Acronym	Description
AEC	Architecture, Engineering and Construction
CEN	European Committee for Standardization
CIOP	City Information Open Platform
ESCO	Energy Savings Company
GIS	Geographic Information Systems
ICT	Information and Communication Technologies
IFC	Industry Foundation Classes
IoT	Internet of Things
JSON	JavaScript Object Notation
LH	Lighthouse City
M2M	Machine to Machine
OASIS	Organization for the Advancement of Structured Information Standards
OGC	Open Geospatial Consortium
OS	Operating System
POC	Proof Of Concept
REST	Representational State Transfer
SmartEnCity	Towards Smart Zero CO2 Cities across Europe
SDK	Software Development Kit
SQL	Structured Query Language
WP	Work Package
API	Application Programming Interface
KPI	Key Performance Indicator
EU	European Union
XML	eXtensible Markup Language

Table 1: Abbreviations and Acronyms

0 Publishable Summary

SmartEnCity project focuses on the development of a highly adaptable and replicable systemic approach towards urban transformation into sustainable, smart and resource-efficient urban environments in Europe, through the planning and implementation of measures aimed at improving energy efficiency in the main consuming sectors in cities, increasing the supply of renewable energy. This approach will be firstly defined in detail, and subsequently laid out and implemented in the three Lighthouse demonstrators (Vitoria-Gasteiz in Spain, Tartu in Estonia and Sonderbørg in Denmark), to be further refined and replicated with the development of Integrated Urban Plans (IUPs) in all participant (both Lighthouse and Follower) Cities.

WP6 aims to devise a common ICT platform that will be the reference for the deployment of the “City Information Open Platform” (CIOP) in each one of the pilot lighthouse projects. The platform will provide a standardized data model to accommodate data from each pilot and will also define standardized services and modules for data consumers, being especially relevant those related with the monitoring of pilots’ KPIs, those requested by the EC in the call and those identified as ICT solutions for the project.

Deliverable D6.1 presents the results of Task 6.1 “Platform Functional/Non Functional Specifications” within WP6 of the SmartEnCity project. The objective of this task is to identify the requirements and specifications of the SmartEnCity City Information Open Platform (CIOP). These requirements will be later considered to build the CIOP, its data model and the mechanisms to interoperate and build solutions. Demonstrator system providers, solution providers and end customers (municipalities, ESCO…) need to be involved in the identification and definition of the features the platform has to offer. Specifications will consider standardization and openness of the architectures and technologies

This document presents a collection of functional and non-functional requirements to be addressed by the CIOP reference model to be implemented in following tasks in WP6. The collections of requirements have been performed through a complementary work between domain experts and end users of the platform. On the one hand, generic requirements have been identified from the functionalities of the frameworks already existing for Smart cities combined with the specifications of existing standards from different perspectives (i.e. energy, mobility, social engagement and urban modelling) to be applied in Smart city project. Also the most relevant Smart city projects and initiatives have been analyzed and considered. On the other hand, expectations and wishes from stakeholders of each of the lighthouse cities have been collected through a tailored questionnaire. Analysis of the answers and contributions have served as relevant inputs to identify main relevance services and functionalities to be provided by the reference platform as well as the issues about interaction, type of users or data provided or required.

Functional and non-functional requirements represent a formal specification of requirements for the architectural design of the CIOP. Functional requirements are grouped into different categories, based on the vertical domains (i.e. energy assessment, sustainable mobility and social engagement) and the technical requirements (e.g. data and user management, data analysis). CIOP reference model to be defined (T6.2, T6.3 and T6.4) based on the collected requirements will then be implemented tailored to the specific constraints and expectations of each lighthouse city (WP3, WP4 and WP5).

1 Introduction

1.1 Purpose and target group

This report constitutes the Deliverable "D6.1 – CIOP Functional and Non-Functional Specifications", the main outcome of the task "T6.1 – Platform Functional/Non Functional Specifications".

The main objective of this document is to identify the requirements and specifications of the SmartEnCity City Information Open Platform (CIOP). These requirements will be later considered to build the CIOP, its data model and the mechanisms to interoperate and build solutions. Demonstrator system providers, solution providers and end customers (municipalities, ESCO…) need to be involved in the identification and definition of the features the platform has to offer. Specifications will consider standardization and openness of the architectures and technologies.

The main activities carried out in this task are listed here:

- Analyse frameworks and architectures on Internet of things, City Modelling, energy and mobility verticals, application architecture, etc. and their usage in previous Smart City projects
- Identify the value proposition of data/products/services offered in the project and their requirements
- Write specification report including functional and non-functional requirements. This report includes a state of the art on frameworks and architectures used in previous Smart City projects.

The approach followed in Task 6.1 to collect the platform requirements and specification is based on three main processes developed in parallel and merging into the identification of the requirements of the functional and non-functional requirements.

1. Review of the State of the Art of existing frameworks and standards for smart cities.
2. Identification and analysis of previous smart city projects and initiatives
3. Requirements elicitation. Based on a defined questionnaire and the assessment of the answers of different stakeholders to the questionnaire.

This report is structured in the following sections:

Section 2 presents and state of the art of most representative existing frameworks and standards for Smart cities. First, existing alternatives of IoT platforms, both commercial and free, are identified, analysed for a first filtering and a short description is presented for the first list of 11 platforms candidate to be used in SmartEnCity. Then, the most relevant standards for the smart city modelling are presented as well as their relevance for SmartEnCity CIOP. These standards are mainly focused on existing data models for geospatial information defined at different levels of representation (urban, building, element). Finally, for each of the three verticals addressed in SmartEnCity (i.e. Energy, Mobility and Citizen Engagement) the most relevant existing standards from the point of view of ICT are identified and presented.

Section 3 identify and analyse the most relevant projects and initiatives carried out at European level regarding Smart Cities. This section starts with the identification of a large list of projects in the different EU programmes, focused on those that could be taking into consideration for the development of the CIOP in SmartEnCity. Then, the list of representative initiatives in the field is identified. A selection of the most relevant ones, including a short description of them, is them presented. And finally, a comparison table and some conclusions are pointed out regarding the identified projects and the relation with SmartEnCity.

Section 4 presents the process and results of capturing and analysis of user requirement. Different stakeholders have been identified for each of the lighthouse cities. A questionnaire prepared for the collection of requirements is then presented. The analysis of the answers to the questionnaires by the different stakeholders is performed and summarized. And finally the identification of services and high level added value services of potential interest to be developed in SmartEnCity are presented.

Section 5 presents the requirements obtained from previous section into a formal specification of requirements for the architectural design of the CIOP. Section is divided into functional and non-functional requirements.

Section 6 presents the main conclusions.

All questionnaires collected by the stakeholders, as well as the detailed analysis of each of the main issues of the questionnaires are attached to the report as an Appendix of the document.

Main target group of the information and conclusions collected in this deliverable are the partners in charge of the development of the CIOP platform.

1.2 Contributions of partners

The following Table 2 depicts the main contributions from participant partners in the development of this deliverable.

Participant short name	Contributions
TEC	Task Leader. Responsible of the content of the deliverable. Main contributor of Section 1 (Introduction), Section 2.2 (Smart City Modelling Standards), Section 4.1 (Identification of key stakeholders for the project), Section 4.2 (Questionnaire), Section 6 (Conclusions), and contributor of Section 2.1 (review of Existing frameworks and architectures) and Section 5 (Functional and Non-Functional requirements). Has reviewed contributions to all the sections
AVG	Contributor of Section 4.3 (User requirements for lighthouse cities) for the case of Vitoria-Gasteiz.
MON	Main contributor of Section 2.3 (Standards for verticals) for Energy and Citizen engagement and contributor of Section 4.3 (User requirements for lighthouse cities) collecting questionnaires for the case of Vitoria-Gasteiz, Section 2.1 (Review of Existing frameworks and architectures) and Section 5 (Functional and Non-Functional requirements).

ACC	Main contributor of Section 3.1 (Identification of Smart City Projects)
CAR	Main contributor of Section 3.2 (Analysis of the relevant projects and initiatives for Smart cities) and Section 4.4 (Identification of high level added value services and products)
GIS	Main contributor of Section 2.3 (Standards for verticals) Mobility, and contributor of Section 4.3 (User requirements for lighthouse cities) for the case of Vitoria-Gasteiz and Section 5 (Functional and Non-Functional requirements).
ZERO	Contributor of Section 4.3 (User requirements for lighthouse cities) for the case of Sonderbørg.
TAR	Contributor of Section 4.3 (User requirements for lighthouse cities) for the case of Tartu.
ET	Main contributor of Section 2.1 (Review of Existing frameworks and architectures) and contributor of Section 4.3 (User requirements for lighthouse cities) collecting questionnaires for the case of Tartu and Section 5 (Functional and Non-Functional requirements).

Table 2: Contribution of partners

1.3 Relation to other activities in the project

The following Table 3 depicts the main relationship of this deliverable to other activities (or deliverables) developed or under development within the SmartEnCity project and that should be considered along with this document for further understanding of its contents.

Deliverable Number	Contributions
D2.2	Recommendations for updating standards or generating new ones
D7.1	KPIs definition

Table 3: Relation to other activities in the project

2 State of the Art of existing Frameworks and standards for Smart Cities

The objective of this section is to analyse existing frameworks and architectures on Internet of Things (IoT), city modelling, different vertical domains relevant for the project (e.g. energy, mobility or citizen engagement) and hardware and software architectures for the deployment of ICT solutions for Smart Cities.

2.1 Review of Existing Frameworks and Architectures

This subsection provides a review on existing frameworks and architectures for the deployment of ICT solutions for Smart Cities. This analysis considers commercial as well as open and free alternatives and covers both hardware and software aspects.

An extensive market research has been performed into which solutions there are available in the world and how well would they suit our needs. The general process is presented in the following figure (Figure 1). First step is to list a large number of possible solutions and perform initial filtering based on their features and suitability. Then go on to study a smaller number of platforms in more detail, building proof-of-concept (POC) implementations if needed and finally try to settle on a single best solution or the smallest number of those. This review process have been partially implemented in Task 6.1 which results are included in this deliverable, but the final steps of the process will be carried out in Task 6.2, so the final results will be described in *D6.2 CIOP Architecture generic implementation.*

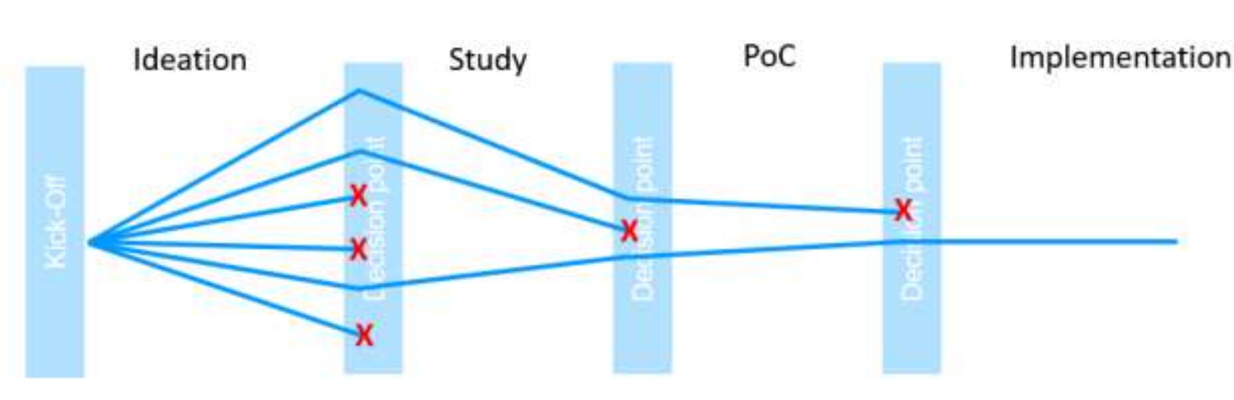

Figure 1 Existing Frameworks review process

2.1.1 Considered platforms

The following is a list of possible platforms to consider of interest for SmartEnCity in no specific order. Not all of them are candidate base platforms as such but there can still be something to be learned from them.

1. FIWARE: https://www.fiware.org/
2. IBM Watson: http://www.ibm.com/cloud-computing/bluemix/solutions/iot/
3. Tieto Connect: http://www.tieto.com/news/tieto-industrial-internet-start-up-launches-the-tieto-connect-platform-to-speed-up-the-industrial
4. Cumulocity: https://www.cumulocity.com/

5. ThingWorx: http://www.thingworx.com/
6. Google Brillo: https://developers.google.com/brillo/
7. Apple HomeKit: http://www.apple.com/ios/homekit/
8. Microsoft Azure IoT suite: https://azure.microsoft.com/en-us/solutions/iot-suite/
9. Amazon AWS IoT: https://aws.amazon.com/
10. Cisco IoT: http://www.cisco.com/c/en/us/solutions/internet-of-things/overview.html
11. Jasper: https://www.jasper.com/
12. IoTivity: https://www.iotivity.org/
13. AllJoyn Framework: https://allseenalliance.org/framework
14. Kaa IoT Platform: http://www.kaaproject.org/
15. Ericsson DCP: http://www.ericsson.com/ourportfolio/products/device-connection-platform?nav=productcategory002%7Cfgb_101_973
16. Oracle IoT: https://www.oracle.com/solutions/internet-of-things/index.html
17. HP IoT: http://www8.hp.com/us/en/industries/communications-media-entertainment.html?compURI=1272986#.VuZ61Sh96Uk
18. Xively: https://xively.com/
19. SAP IoT: http://go.sap.com/product/technology-platform/iot-platform-cloud.html
20. AggreGate: http://aggregate.tibbo.com/
21. Octoblu: https://octoblu.com/
22. ThingSpeak: https://thingspeak.com/
23. Arrayent: http://www.arrayent.com/
24. B-Scada: http://www.scada.com/
25. Verizon ThingSpace: https://thingspace.verizon.com/developer/
26. Carriots: https://www.carriots.com/
27. Evrythng: https://evrythng.com/
28. Exosite: https://exosite.com/
29. LinuxMCE: http://www.linuxmce.com/
30. Qivicon: https://www.qivicon.com/en/
31. Clayster: http://www.clayster.com/
32. XMPP-IoT: http://www.xmpp-iot.org/

2.1.2 Evaluation criteria

The main evaluation criteria for the initial filtering of suitable platforms are as following:

1. Service type (PaaS,[2] SaaS[3], IaaS[4]).
2. Can the solution be hosted by project partners. This is one of the most important attributes as being able to host our own service is very important.
3. Is the customer data owned by us or some 3rd party?
4. Is the solution scalable?
5. Is the platform open source?
6. Does the service provide a good API?
7. Does the solution provide device management capabilities?
8. Does it integrate with big data services?

[2] https://en.wikipedia.org/wiki/Platform_as_a_service
[3] https://en.wikipedia.org/wiki/Software_as_a_service
[4] https://en.wikipedia.org/wiki/Cloud_computing#Infrastructure_as_a_service_.28IaaS.29

9. Does it provide a decision engine?
10. Does it provide sound security architecture?
11. Does it provide geo-requests (give me devices in a 1km circle around a coordinate etc)?
12. Does it have telecom references?
13. Supported device protocols?
14. How many real deployments are there based on given platform?
15. Community support.

2.1.3 First round of elimination

Based on the evaluation process and criteria described above, we eliminated a large number of candidate platforms and were left with the list below. The main reason for elimination was that project partners intend to host the service to have control over the client data and ensure security, performance and availability. Another important criteria used for the filtering of candidate IoT platforms were: the envisaged scalability, the possibility to use RESTful interfaces to interact with the platform, the capability of managing devices in an uniform way through gateways, the possibility to leverage data analysis, dashboards, automated business rules, geo-localization features and the quantity of supported protocols for M2M interaction. In addition, the tools derived from EU Future Internet initiatives were considered in the study.

Details of the analysis for IoT frameworks are included as annex (See Section 8.1)

The list of remaining platforms to consider is:

1. FIWARE
2. Cumulocity
3. ThingWorx
4. Jasper
5. Xively
6. Octoblu
7. ThingSpeak
8. Kaa IoT Platform
9. Amazon IoT
10. HP
11. IBM Watson

2.1.4 Platform details

This section presents a short description of the selected list of candidate platforms.

2.1.4.1 FIWARE

2.1.4.1.1 Overview

FIWARE or FI-WARE is a middleware platform, driven by the European Union, for the development and global deployment of applications for Future Internet. The objective of FIWARE is to facilitate a cost-effective creation and delivery of Future Internet applications and services in a variety of areas, including smart cities, sustainable transport, logistics, renewable energy, and environmental sustainability. FIWARE is supported by the Future Internet Public-Private Partnership (FI-PPP) project of the European Union.

It is developed by Telefonica[5] and defines architecture and specifications of how to setup smart applications, how to manage and secure large amounts of data and share it with the world. It also includes a reference implementation.

2.1.4.1.2 Architecture

FIWARE architecture consists of a number of loosely coupled and replaceable parts they call generic enablers (GE for short). These deal with topics such as:

- Data management
- Enabling IoT device communication
- Security and authentication
- Cloud hosting
- User interfaces

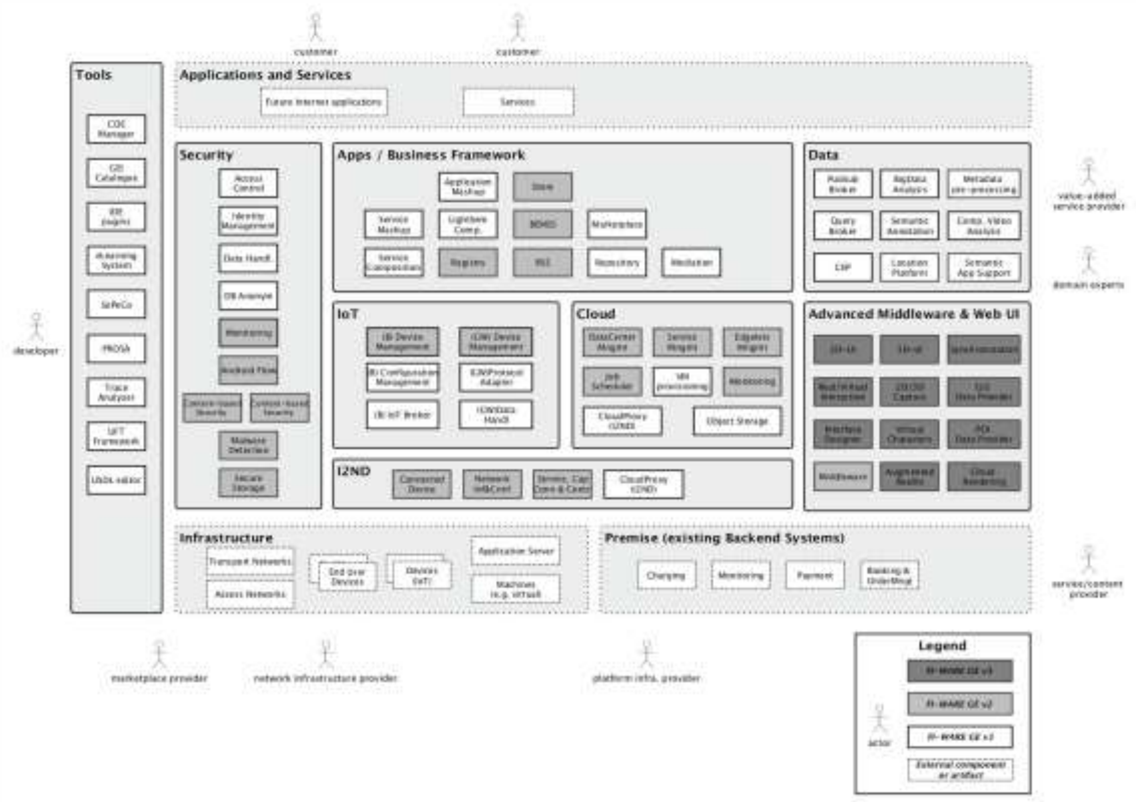

Figure 2 FIWARE Components[6]

At the core of the solution is the context manager that defines a set of APIs for storing and fetching data, subscribing for changes, querying and securing the data and sharing it with third party applications.

This data or context is stored in context elements or entities which have a unique id, arbitrary type and a number of attributes which also have a type and some value. The attributes can have additional metadata associated with it (see Figure 3).

5 https://www.telefonica.com/en/

6 https://forge.fiware.org/plugins/mediawiki/wiki/fiware/index.php/FIWARE_Architecture

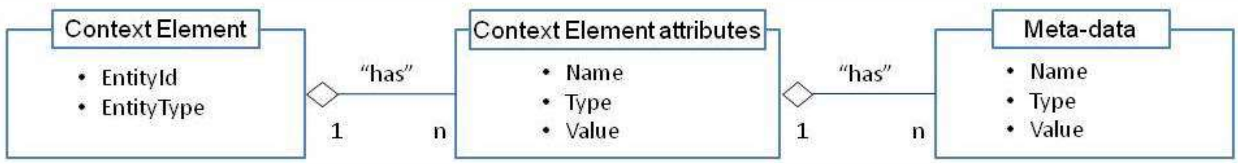

Figure 3 FIWARE entity structure[7]

2.1.4.1.3 Useful links

1. FIWARE homepage: https://www.fiware.org/
2. Wiki: http://forge.fiware.org/plugins/mediawiki/wiki/fiware/index.php/
3. Developers guide: https://www.fiware.org/developers-entrepreneurs//
4. Catalogue: http://catalogue.fiware.org/
5. Github repositories: https://github.com/telefonicaid
6. Orion documentation: https://fiware-orion.readthedocs.org/en/develop/
7. Orion Installation guide: https://fiware-orion.readthedocs.org/en/develop/admin/install/index.html
8. IoT stack: https://www.fiware.org/iot-ready-stack/

2.1.4.2 Cumulocity

Cumulocity is a widely-used mature and powerful commercial IoT platform. It's closed source but can be deployed on the premises as a white-label solution. It's feature rich, well documented and has a strong REST API.

Solution features

- Works on various wired, wireless and mobile networks.
- Support various embedded environments[8].
- Has over 30 certified devices[9].
- Provider strong audited security model.
- Has a web application for managing the assets, users, events and alarms.
- Provides remote operations capability.
- Provider fine-tuned user access control.
- User interface supports tablets and mobile.

[7] https://forge.fiware.org/plugins/mediawiki/wiki/fiware/index.php/Data/Context_Management_Architecture

[8] http://cumulocity.com/dev-center/#device-platforms

[9] http://cumulocity.com/dev-center/#devices

The devices functionality can be built up from logical “fragments” so that a power meter in your home might have “voltmeter” and “amp-meter” functionalities.

Figure 4 Cumulocity Overview

The platform includes Cumulocity Event Language (CEL) that is syntactically similar to the SQL language. In SQL, though, a statement is run against a logically fixed database, produces a result and then terminates. In Cumulocity, a statement is continuously running against a stream of input data (input events) and is continuously calculating its output (output events)[10].

Useful links.

1. Homepage: https://www.cumulocity.com/
2. Features: https://www.cumulocity.com/features/
3. Devices: https://www.cumulocity.com/dev-center/#devices
4. SmartREST: http://www.cumulocity.com/guides/reference/smartrest/
5. Concepts: https://www.cumulocity.com/guides/concepts/introduction/
6. User guide: https://www.cumulocity.com/guides/users-guide/overview/
7. REST API: https://www.cumulocity.com/guides/rest/introduction/

2.1.4.3 ThingWorx

ThingWorx is a set of integrated IoT-specific development tools and capabilities. At the center of this infrastructure is the IoT platform, which is a suite of components that enable:

[10] http://cumulocity.com/guides/concepts/realtime/

- Deployment of applications that monitor, manage, and control connected devices
- Remote data collection from connected devices
- Independent and secure connectivity between devices
- Device/sensor management
- Integration with 3rd party systems

The IoT platform exists independently between the hardware and the application layers of the IoT technology stack. The ideal platform will integrate with any connected device and blend in with device applications, and enable implementation of IoT features and functions into any device in the same way.

The IoT platform comprises the next components:

- **Foundation**: It is a complete, end-to-end technology platform designed specifically for the Internet of Things. It empowers developers to connect, create, and deploy breakthrough, enterprise-ready IoT applications, solutions, and experiences. It connects to all of the ThingWorx components, providing a simplified, seamless approach for developers to create comprehensive IoT solutions.
- **Utilities**: These provide device management capabilities easily used by business analysts and line-of-business users for day-to-day management of connected devices, without the need for developer skills.
- **Analytics**: It is an integrated capability of the ThingWorx IoT technology platform that enables developers to quickly and easily add real-time pattern & anomaly detection, predictive analytics and simulation to the solutions they build.
- **Augmented Reality**: Augmented reality is changing the landscape for enterprise and developers of IoT solutions. Instead of stand-alone, limited applications, augmented reality can be used to create a dynamic user experience through one powerful tool. Augmented reality presents unique opportunities for rapid scale and adoption in the enterprise. By incorporating augmented reality into their IoT strategy, enterprises can improve service, customer experiences, operations, and the engineering and manufacturing of products.
- **Industrial Connectivity**: It connects disparate devices and applications, providing a single source for all industrial automation data in IoT solutions.

2.1.4.4 Jasper

Jasper is an American corporation headquartered in Santa Clara, California that provides a cloud-based software platform for the Internet of Things (IoT) and, more specifically, to enable product businesses to become IoT service businesses. The platform is designed to help organizations launch, manage, and monetize the deployment of the Internet of Things worldwide.

Jasper was founded in 2004, Jasper partners with over 120 mobile operator networks to serve IoT and machine-to-machine (M2M) companies across a wide range industries including: automotive, home security and automation, agriculture, food/beverage, wearable technology, healthcare, advertising and industrial equipment.

On February 3, 2016, Cisco Systems announced its plans to acquire Jasper for $1.4 billion, and on March 22, 2016, finalized the $1.4B acquisition. With the acquisition, Jasper becomes the IoT Cloud business unit within Cisco.

Jasper solutions rely on the Jasper Control Center Platform where devices, mobiles and applications are connected (see Figure 5). The Jasper Control Center Platform is a cloud-based solution for enterprises that delivers visibility and real-time control for connected service businesses, along with IoT Machine to Machine (M2M) capabilities like provisioning, mobile service management, real-time engagement, support diagnostics, billing and business automation. Jasper's platform operates on a single base of code that can be configured to meet specialized enterprise needs across a wide range of business models, technologies, and industries. The platform is deeply integrated with 26 mobile operator groups, representing more than 120 affiliates around the world — including: AT&T, China Unicom, Telefónica, SoftBank, NTT DoCoMo, América Móvil, SingTel, Telenor, and Telstra. Currently more than 3,500 enterprises across 6 continents and dozens of industries have deployed millions of connected devices with Jasper Control Center.

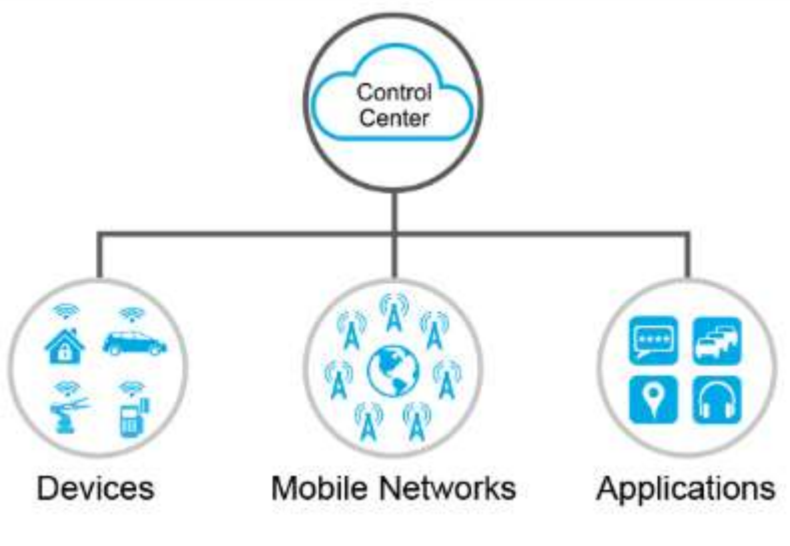

Figure 5 Jasper Control Center Platform architecture

The functionality offered by Jasper Control Center is outlined next:

Integrate IoT with IT: The platform enables the seamlessly integration of existing IT systems with Control Center's comprehensive set of APIs to manage devices. Ramp-up quickly and automate critical business processes to get the most out of those IoT services.

Deliver services at the right time: The platform simplifies provisioning enabling to customize devices and services deployment processes. Near zero-touch management helps lower operational costs, increase reliability, and scale rapidly.

Automate for set-and-forget control: The platform permits the definition of automated business rules to control how connected devices and services should work. The developer can easily launch services and optimize performance.

Track performance: The platform provides real-time visibility and reporting that eases the monitoring of the status and performance of all the connected devices so changes can be made on the fly increasing the efficiency.

Maximize uptime with actionable insights: The platform offers continuous monitoring and diagnostics of changing network conditions and device behavior keeping users informed and equipped to improve performance, quickly identifying and resolving issues, and ensuring reliable services.

2.1.4.4.1 Useful links

1. Jasper website: http://www.jasper.com/
2. Jasper Resources: http://www.jasper.com/resources-landing
3. Jasper Control Center: http://www.jasper.com/iot-service-platform/control-center

2.1.4.5 Xively

Xively (formerly known as Cosm and Pachube) is a division of LogMeIn Inc. [11], a global, public company that provides remote access and collaboration products including Rescue, Boldchat, join.me, and Cubby. Xively offers an Internet of Things (IoT) platform as a service, business services, and partners that enable businesses to quickly connect products and operations to the Internet.

Xively simplifies the interconnection of devices, data, people and places, accelerating the creation of compelling solutions. To do so they offer several products and services:

Xively Cloud Services: A Platform as a Service built for the IoT. According to their website, this includes directory services, data services, a trust engine for security, and web-based management applications. Xively's messaging is built on a publish-subscribe protocol called MQTT. The API supports REST, WebSockets, and MQTT.

Xively Business Services: The company also offers consulting services for building IoT-based products. No prices are specified but the company offers the opportunity to get a quotation.

Xively Partner Network: Xively has partnered with chipset companies such as ARM, Atmel and TI as well as solution providers and IoT industry alliances like OASIS.

Xively Cloud Services provide messaging, data archiving, provisioning and directory services which are accessible through the Xively API. Xively 's web applications leverage the API to provide connected product lifecycle management capabilities through Xively Developer Workbench and Xively Management Console. **Xively Developer Workbench**: Xively offers a workbench for developers that enables the interoperability of custom and existent prototypes. There are three stages in the Xively development process: Develop, deploy and manage. More information can be found in the API documentation[12] and the tutorials[13].

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[11] https://www.logmeininc.com/

[12] https://personal.xively.com/dev/docs/api/

[13] https://personal.xively.com/dev/tutorials/xively/

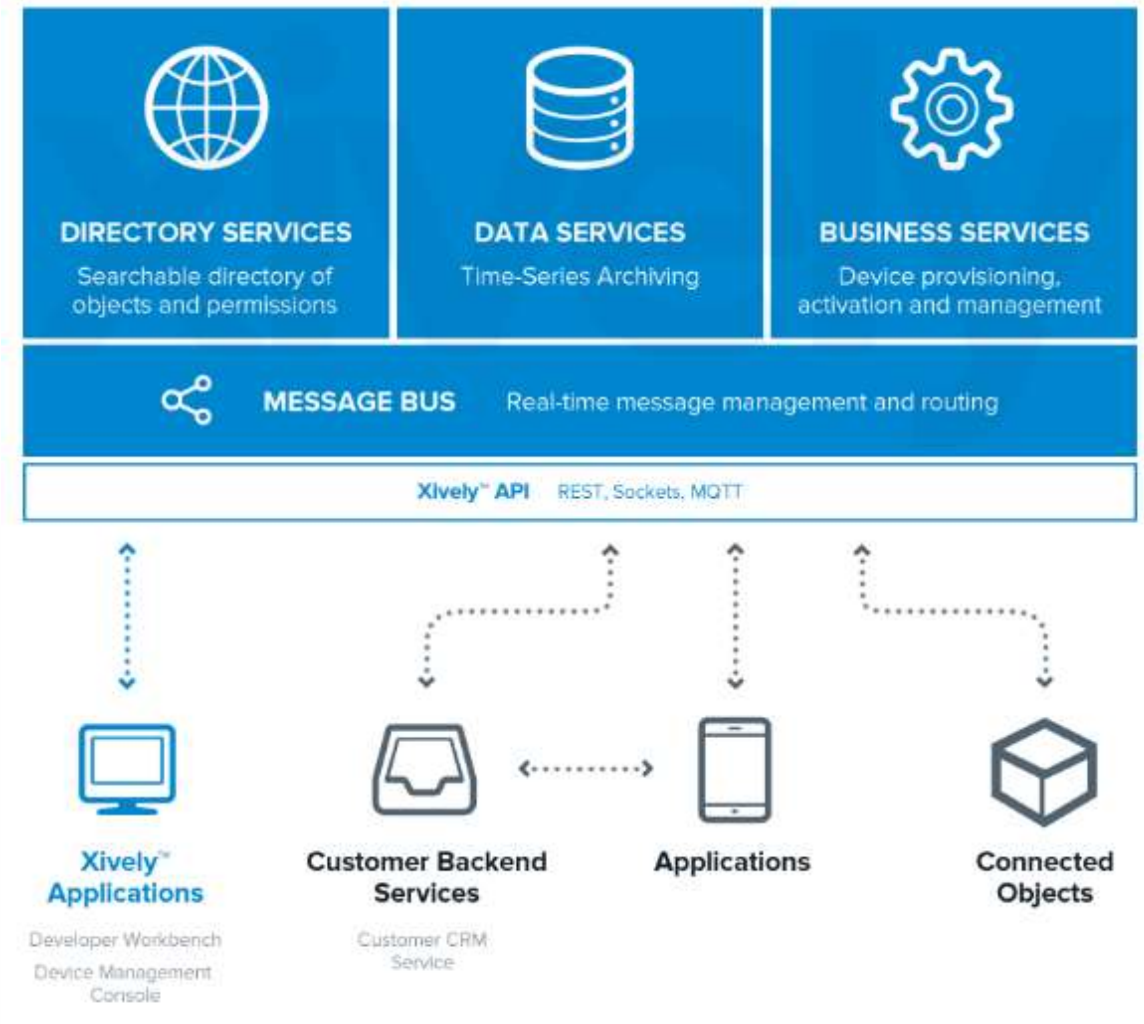

Figure 6 Xively Cloud Services architecture

Xively also offers libraries that enable the integration of custom code for devices, applications and services with Xively's API. Libraries are ready for Android, Arduino, C, Java, JavaScript, All Xively libraries are Open Source and hosted on Github.

Almost any hardware device connected through Ethernet, WIFI, Zigbee, Bluetooth, etc can connect to Xively. Xively is enabled on any major platform such as Linux, Android, an Embedded C OS (Realtime or non), Arduino, electric imp … Below are the examples of the popular hardware setups customers use to build connected products in Xively.

Board	Platform	Gateway
TSmarT	Embedded C	WiFi
SimpleLinks	Linux, Android	WiFi
IMX53QSB	Linux, Android	Ethernet
Hitex OM13031	FreeRTOS	Ethernet
Beaglebone	Linux, Android	Ethernet
RX62N	FreeRTOS	Ethernet
Raspberry Pi	Linux	Ethernet
Android PC 8750	Android	Ethernet
LPCXpresso	FreeRTOS	Ethernet Optional
ARM mbed LPC1768	Embedded C/C++	Ethernet
Zolertia Z1	Embedded C	6loWPAN
PIC32 Ethernet Kit	Embedded C	Ethernet
Arduino Uno	Arduino	Ethernet, WiFi, Cellular
Arduino Due	Arduino	Ethernet, WiFi, Cellular
Arduino Ethernet	Arduino	Ethernet
Arduino Mega 2560	Arduino	Ethernet, WiFi, Cellular
Arduino Leonardo R3	Arduino	Ethernet, WiFi, Cellular
RedBack 1.0	Arduino	WiFi
DiamondBack 1.0	Arduino	WiFi

Figure 7 Hardware setups for Xively[14]

Finnaly Xively offers a series of high level services that multiply the potential of any connected product or solution. Those services enable to run data analysis, create visualizations or render dashboards.

2.1.4.5.1 Useful links

4. Xively website: http://xively.com/
5. Xively API Docs: https://personal.xively.com/dev/docs/api/ or http://developer.xively.com/api/
6. Xively Tutorials: https://personal.xively.com/dev/tutorials/xively/ or http://developer.xively.com/tutorials/
7. Xively Github API libraries: https://github.com/xively/

2.1.4.6 Octoblu

Octoblu (now part of Citrix) is a full-stack Internet of Things messaging and automation platform that enables companies to create IoT services with secure real-time exchange of data. Octoblu's IoT services are built on the open source Meshblu[15] platform, an open communications and management platform that supports a variety of protocols for physical devices to communicate seamlessly with each other, people, and web services. Through public, private, or hybrid clouds users can connect, design, process, and analyze the flow of

[14] https://personal.xively.com/dev/hardware/
[15] https://developer.octoblu.com/

information. All services have been designed through a robust security and right management architecture.

2.1.4.6.1 Features

Octoblu is a full-stack Internet of Things platform capable of automating solutions in any vertical market. Approximately 80% of Octoblu IoT stack is open source with over 800 repositories available on GitHub.

Figure 8 Octoblu Architecture

- **Connectors**: Octoblu connects smart devices, wearable devices, sensors, cars, homes, offices, robots and web services (REST APIs) together via a global mesh network. The platform allows like and unlike devices to communicate using HTTP, WebSockets, MQTT, CoAP, XMPP, and AMQP. Additional protocols such as AllJoyn, BLE, SNMP, etc. can be bridged into Octoblu using the Gateblu gateway. It is possible to connect things to Octoblu via their native protocols. All of Citrix's products and third-party REST APIs are connected together.
- **Designer**: The drag-and-drop designer makes automation simple. It's powerful enough to handle complex interactions, yet simple enough for even non-engineers to use. Just drag, drop, and deploy, without ever writing a single line of code. Engineers can extend designs beyond the out-of-the-box tools. The designer includes a function node allowing engineers to write JavaScript routines to extend payloads, etc. It also includes REST operators for interacting with private APIs. Engineers can also write Gateblu plug-ins for adding smart devices to Octoblu.
- **Computing Engine**: Automated workflows are stored securely and are designed to run with high availability. The secure environments are flexible enough to run in a cloud, laptop or microcomputer, and can be hosted publically or privately. Every time the "play" button is pushed in the designer, the automation is deployed to the real-time computing engine. It runs forever (or until you stop it).
- **Mesh Network**: Octoblu's Meshblu platform is the core communication layer. It is a secure, cross-protocol scalable cloud-based system enabling communication between smart devices, sensors, cloud resources, Arduinos, Raspberry Pi's, and any other IP based hardware device, non-IP based hardware device or software API.

- **IoT Gateway**: Gateblu is the Octoblu gateway offering and is the smart software hub working within the Octoblu platform connecting to Meshblu any smart device that has an IP address and any not-so-smart devices lacking an IP address. This software based hub is supported on Mac, Linux or Windows operating systems as well as iOS and Android for mobile operations.
- **Analyze**: It streams sensor data and machine-to-machine instant messages to bigdata stores in real-time. The bigdata forwarding adapters currently support Splunk, ElasticSearch, TempoIQ, InitialState, Intel Analytics, and Microsoft Analytics. As trends and anomolies are detected, these analytics platforms can call Octoblu webhooks and trigger automations to close the loop on machine learning and actions.
- **Microcontroller OS**: Tentacle is Octoblu's Microcontroller Operating System that allows the connection of Arduino compatible devices to Meshblu with or without the use of a CPU. This allows controlling the voltage of any GPIO pin on the device as well as stream analog and digital sensor data into Meshblu.

2.1.4.7 ThingSpeak

ThingSpeak is a free web service that lets users collect and store sensor data in the cloud and develop Internet of Things applications. The ThingSpeak™ web service provides apps that let users analyze and visualize their data in MATLAB®, and then act on the data. Sensor data can be sent to ThingSpeak from Arduino®, Raspberry Pi™, BeagleBone Black, and other hardware. For example, with ThingSpeak, users can create sensor-logging applications, location-tracking applications, and a social network of things with status updates, so that users could have their home thermostat control itself based on their current location.

The primary element of ThingSpeak activity is the channel, which contains data fields, location fields, and a status field. After a user creates a ThingSpeak channel, the user can write data to the channel, process and view the data with MATLAB® code, and react to the data with tweets and other alerts. The typical ThingSpeak workflow lets a user:

- Create a Channel and collect data
- Analyze and visualize the data
- Act on the data using any of several Apps

The ThingSpeak API is available on GitHub® and includes the complete ThingSpeak API for processing HTTP requests, storing numeric and alphanumeric data, numeric data processing, location tracking, and status updates.

2.1.4.7.1 Features

The next features are provided by the ThinkSpeak suite:

- Real-time data collection and storage
- MATLAB analytics and visualizations
- Alerts
- Scheduling
- Device communication
- OPEN API
- Geolocation data

- Available on GitHub
- Works with:
  - Arduino
  - Particle Photon and Core
  - Raspberry Pi
  - Electric Imp
  - Mobile and web apps
  - Twitter
  - Twilio
  - MATLAB

2.1.4.7.2 Useful links

1. Collect Data in a New Channel:
https://es.mathworks.com/help/thingspeak/collect-data-in-a-new-channel.html
2. Data analysis
https://es.mathworks.com/help/thingspeak/analyze-your-data.html
3. Reaction on data analysis
https://es.mathworks.com/help/thingspeak/act-on-your-data.html
4. GitHub Repository for ThingSpeak
https://github.com/iobridge/thingspeak
5. Channels and Charts API
https://es.mathworks.com/help/thingspeak/channels-and-charts.html
6. Examples
https://es.mathworks.com/help/thingspeak/examples.html
7. MATLAB Analysis and Visualization
https://es.mathworks.com/help/thingspeak/functionlist.html

2.1.4.8 Kaa IoT Platform

Kaa project is an open source IoT platform featuring scalability, redundancy, high availability and focus on security. It's a production-ready, multi-purpose middleware platform for building complete end-to-end IoT solutions, connected applications, and smart products. The Kaa platform provides an open, feature-rich toolkit for the IoT product development and thus dramatically reduces associated cost, risks, and time-to-market. For a quick start, Kaa offers a set of out-of-the-box enterprise-grade IoT features that can be easily plugged in and used to implement a large majority of the IoT use cases[16].

16 http://www.kaaproject.org/overview/

It's built on other large open source components such as MongoDB[17], Apache Avro[18], Apache ZooKeeper[19], Apache Flume[20], Apache Storm[21], Apache Zeppelin[22].

Features

- Manage an unlimited number of connected devices.
- Set up cross-device interoperability.
- Perform A/B service testing.
- Perform remote device provisioning and configuration.
- Perform real-time device monitoring.
- Distribute over-the-air firmware updates.
- Create cloud services for smart products.
- Collect and analyze sensor data.
- Analyze user behaviour, deliver targeted notifications.

The solution is mostly built in Java and hosted on Github[23]. It provides an administration application for managing applications, devices, schemas, users etc. The solution is centered around Apache Avro schemas that allow defining data structures for measurements, events etc. From these schemas, the Kaa platform automatically generates Java/Android/C++/C SDK's to be embedded into end devices.

Kaa is developed by CyberVision. http://www.cybervisiontech.com/

Useful links.

1. Webpage index: http://www.kaaproject.org/
2. Solution overview: http://www.kaaproject.org/overview/
3. Use-cases: http://www.kaaproject.org/iot-use-cases/
4. Platform as a service comparison: http://www.kaaproject.org/kaa-iot-platform-vs-paas/
5. Frequently asked questions: http://www.kaaproject.org/faq/

[17] https://www.mongodb.com/

[18] https://avro.apache.org/

[19] https://zookeeper.apache.org/

[20] https://flume.apache.org/

[21] http://storm.apache.org/

[22] https://zeppelin.incubator.apache.org/

[23] https://github.com/kaaproject/kaa

6. Supported platforms: http://docs.kaaproject.org/display/KAA/Supported+platforms
7. Getting started: http://www.kaaproject.org/getting-started/
8. Forum: http://www.kaaproject.org/forum/
9. Github main repository: https://github.com/kaaproject/kaa
10. Github sample apps: https://github.com/kaaproject/sample-apps

2.1.4.9 Amazon IoT

Amazon Web Service (AWS) IoT is a managed cloud platform that enables to connect devices to AWS Services and other devices, secure data and interactions, process and act upon device data, and enable applications to interact with devices even when they are offline. AWS IoT supports the communication of messages among devices and can process and route those messages to AWS endpoints and to other devices reliably and securely.

AWS IoT pricing is based on the number of messages published to AWS IoT (Publishing Cost), and the number of messages delivered by AWS IoT to devices or applications (Delivery Cost)[24].

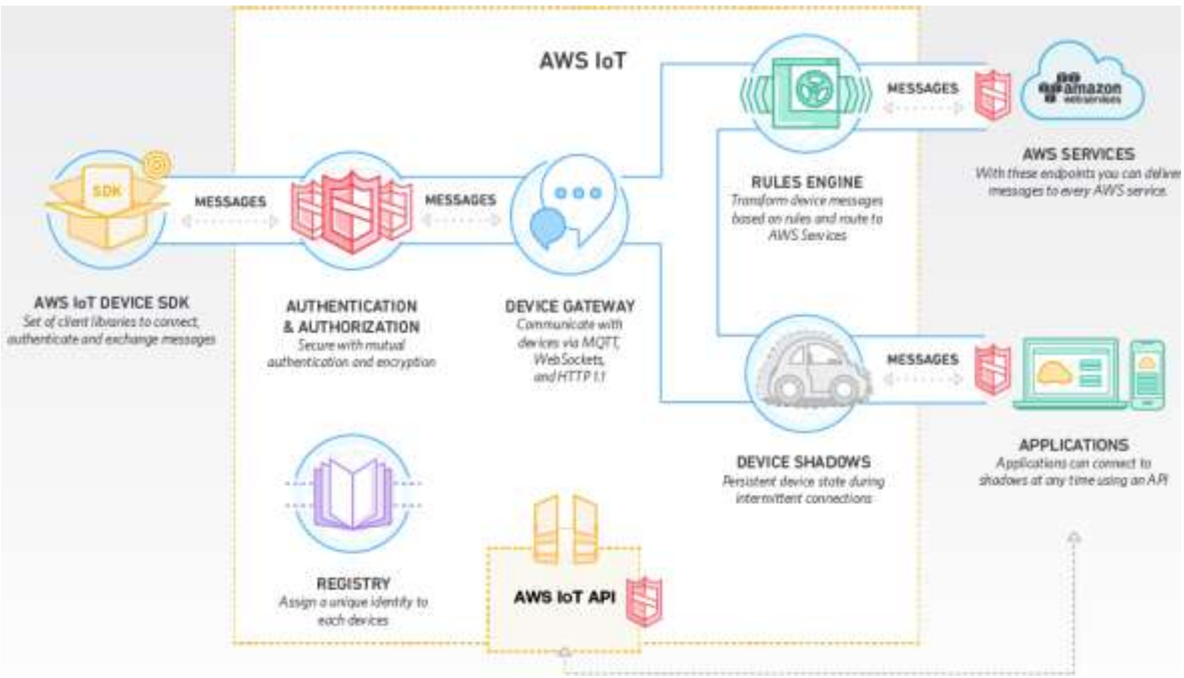

Figure 9 AWS Features Architecture[25]

Figure 9 presents the features offered by AWS IoT. The main modules are outlined next:

AWS IoT Device SDK: AWS IoT provides an SDK to help developers easily and quickly connect hardware devices or mobile applications. The AWS IoT Device SDK enables devices on connecting, authenticating, and exchanging messages with AWS IoT using the

[24] https://aws.amazon.com/iot/pricing/
[25] https://aws.amazon.com/iot/how-it-works/

MQTT, HTTP, or WebSockets protocols. The Device SDK supports C, JavaScript, and Arduino, and includes the client libraries, the developer guide, and the porting guide for manufacturers.

Device Gateway: The AWS IoT Device Gateway enables devices to securely and efficiently communicate with AWS IoT. The Device Gateway can exchange messages using a publication/subscription model, which enables one-to-one and one-to-many communications. With this one-to-many communication pattern AWS IoT makes it possible for a connected device to broadcast data to multiple subscribers for a given topic. The Device Gateway supports MQTT, WebSockets, and HTTP 1.1 protocols and can easily implement support for proprietary or legacy protocols.

Authentication and Authorization: AWS IoT provides mutual authentication and encryption at all points of connection, so that data is never exchanged between devices and AWS IoT without proven identity. AWS IoT supports the AWS method of authentication (called 'SigV4') as well as X.509 certificate based authentication. Connections using HTTP can use either of these methods, while connections using MQTT use certificate based authentication, and connections using WebSockets can use SigV4. AWS IoT generated certificates or certificates signed by any preferred Certificate Authority (CA) can be used indistinctly. The developer can create, deploy and manage certificates and policies for the devices from the console or using the API. AWS IoT also supports connections from users' mobile apps using Amazon Cognito, which takes care of all the steps necessary to create a unique identifier for app's users and retrieve temporary, limited-privilege AWS credentials.

Registry: The Registry establishes an identity for devices and tracks metadata such as the devices' attributes and capabilities. The Registry assigns a unique identity to each device that is consistently formatted regardless of the type of device or how it connects. It also supports metadata that describes the capabilities of a device, for example whether a sensor reports temperature, and if the data are Fahrenheit or Celsius.

Device Shadows: With AWS IoT the developer can create a persistent, virtual version, or "shadow," of each device that includes the device's latest state so that applications or other devices can read messages and interact with the device. The Device Shadows persist the last reported state and desired future state of each device even when the device is offline. The developer can retrieve the last reported state of a device or set a desired future state through the API or using the rules engine. Device Shadows make it easier to build applications that interact with devices by providing always available REST APIs. In addition, applications can set the desired future state of a device without accounting for the devices current state. AWS IoT will compare the difference between the desired and last reported state, and command the device to make up the difference.

Rules Engine: The Rules Engine makes it possible to build IoT applications that gather, process, analyze and act on data generated by connected devices at global scale without having to manage any infrastructure. The Rules Engine evaluates inbound messages published into AWS IoT and transforms and delivers them to another device or a cloud service, based on business rules defined by the user. A rule can apply to data from one or many devices, and it can take one or many actions in parallel. The Rules Engine can also route messages to other AWS endpoints.

AWS presents the main following functionality.

Connect and manage your devices: AWS IoT allows to easily connect devices to the cloud and to other devices. AWS IoT supports HTTP, WebSockets, and MQTT, a lightweight communication protocol specifically designed to tolerate intermittent connections, minimize the code footprint on devices, and reduce network bandwidth requirements. AWS IoT also supports other industry-standard and custom protocols, and devices can communicate with each other even if they are using different protocols.

Secure device connections and data: AWS IoT provides authentication and end-to-end encryption throughout all points of connection, so that data is never exchanged between devices and AWS IoT without proven identity. In addition, secure access to devices and applications can be obtained by applying policies with granular permissions.

Process and act upon device data: With AWS IoT, device data can be filtered, transformed, and acted upon on the fly, based on business rules defined by the developer. Rules can be updated to implement new device and application features at any time. AWS IoT makes it easy to use AWS services like AWS Lambda, Amazon Kinesis, Amazon S3, Amazon Machine Learning, Amazon DynamoDB, Amazon CloudWatch, and Amazon Elasticsearch Service for even more powerful IoT applications.

Read and set device state at any time: AWS IoT stores the latest state of a device so that it can be read or set at anytime, making the device appear to applications as if it were online all the time. This means that an application can read a device's state even when it is disconnected, and also allows to set a device state and have it implemented when the device reconnects.

Apart from the IoT platform Amazon offers a number of cloud services related to the platform[26]. AWS IoT enables the usage of those other AWS services like AWS Lambda, Amazon Kinesis, Amazon S3, Amazon Machine Learning, Amazon DynamoDB, Amazon CloudWatch, AWS CloudTrail, and Amazon Elasticsearch Service with built-in Kibana integration, to build IoT applications that gather, process, analyze and act on data generated by connected devices, without having to manage any infrastructure.

2.1.4.9.1 Useful links

1. AWS web site: https://aws.amazon.com/
2. AWS Device SDK: https://aws.amazon.com/iot/sdk/
3. Protocols used : http://docs.aws.amazon.com/iot/latest/developerguide/protocols.html
4. Developers user guide: http://docs.aws.amazon.com/iot/latest/developerguide/what-is-aws-iot.html

2.1.4.10 HP

The Hewlett Packard Enterprise HPE Universal IoT Platform is common across all HPE IoT offerings and provides federation for device and service management, data acquisition, and exposure to applications. The platform provides agnostic support for smart ecosystems and can be deployed on premises as well as in any cloud environment for a comprehensive as-a-

[26] https://aws.amazon.com/solutions/?nc2=h_ql_ny_livestream_blu

Service model. The Platform allows Communications Service Providers (CSPs) and Enterprises to onboard new IoT use cases.

Regarding the platform architecture, The HPE Universal IoT Platform provides a unique, single vendor and single point of responsibility to manage and connect heterogeneous sets of IoT devices and operate vertical applications on machine-to-machine (M2M) devices from multiple countries.

In terms of data analytics, the focus is on collecting data, validating it, enriching it with analytics, mixing it with other sources, and then exposing it to the applications that enable customers to derive business value from these services.

The Key attributes of the HPE Universal IoT Platform are the following:

- **End-to-end data monetization chain**
    - Offers a data-centric platform that helps manage and analyze collected data
    - Application enablement platform
    - oneM2M pre-defined use cases for quick iteration
- **Simultaneously manage heterogeneous sets of millions of IoT sensors**
    - Manage IoT gateways and devices, as well as sensors
    - Sensor-and-device agnostic
    - Scalability to millions of devices that can be managed
- **Application designer and market place to create new service offerings**
    - Application designer, to enable development on web and mobile channels
    - API monetization and API policy enforcement
    - Partner-oriented layer for securely managing partners and developers
- **One standard alignment, device vendor-independence, and protocol factory**
    - Abstraction of underlining network
    - Ease of use for end developers
    - Reduce infrastructure costs with proven low TCO and high scalability
    - oneM2M standard compliance

2.1.4.11 IBM Watson

Watson Internet of Things Platform is a fully managed, cloud-hosted service that makes simple to derive value from Internet of Things (IoT) devices (see Figure 10). Devices (sensors, gateways …) get connected to the platform using IBM recipes and start sending data securely to the cloud using the open, lightweight MQTT messaging protocol. Then, devices can be setup and managed using customized online dashboards. Using the secure APIs provided by the platform apps can access live and historical data fast. Additionally IBM Watson IoT Platform provides organizations with new insight for innovation and transformation by scaling through cloud-based services and using rich analytics.

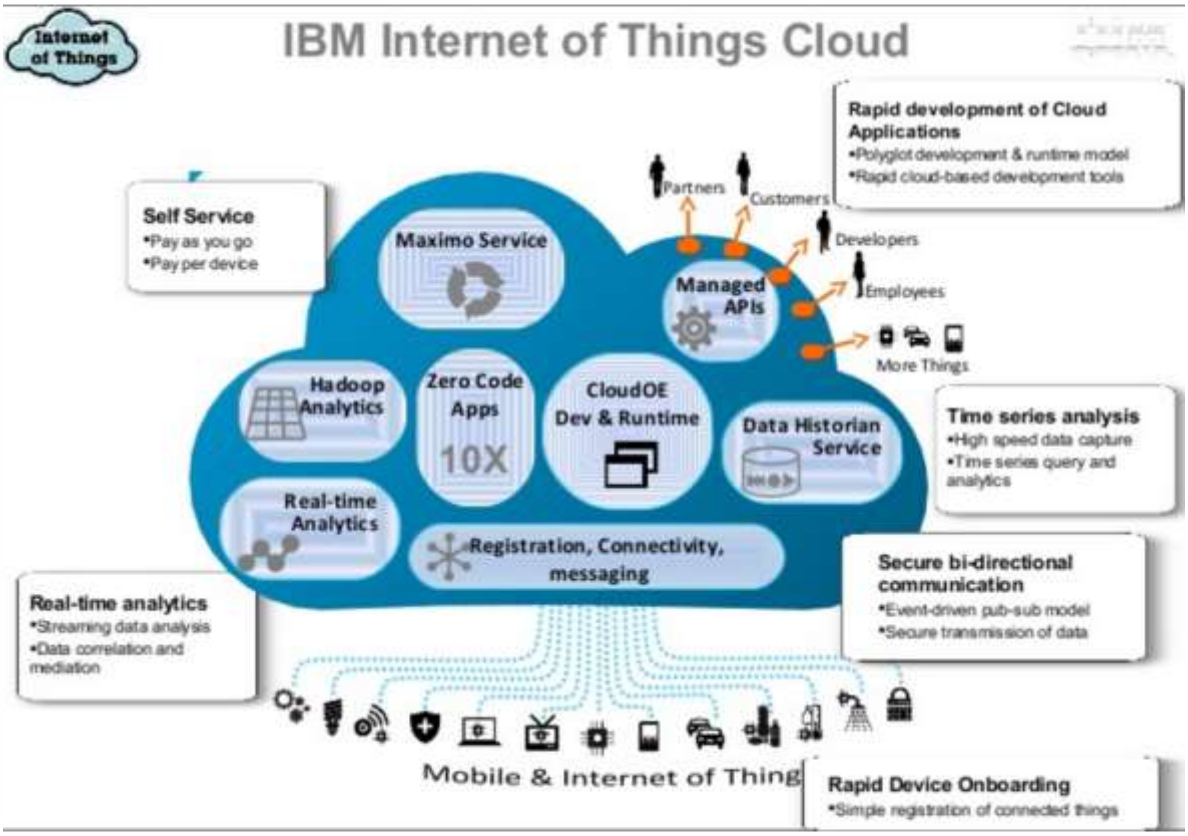

Figure 10 IBM IoT Cloud[27]

The platform considers the following concepts:

Organizations: IBM Watson IoT platform identifies each organization connecting elements to the cloud. Each organization is given an ID. Organization identification ensures that data is only accessible from devices and applications related to that organization. Once registered, devices and API keys are bound to a single organization. When an application connects to the service using an API key it registers with the organization that "owns" the API key.

Devices: A device can be anything that has a connection to the internet and has data it wants to get into the cloud. A device is not able to directly interact with other devices. Devices are able to accept commands from applications. Devices uniquely identify themselves to the Watson IoT platform with an authentication token that will only be accepted for that device. Two types of devices are considered managed and unmanaged devices. Managed devices are defined as devices which contain a management agent. A management agent is a set of logic which allows the device to interact with the Watson IoT platform Device Management service via the Device Management protocol. Managed devices can perform device management operations including location updates, firmware download and updates, and reboot and factory reset. An unmanaged device is a device without a management agent. An unmanaged device can still connect to the Watson IoT platform and send and receive events and commands. However, it cannot send any device management requests, or perform any of the device management operations.

[27] http://www.slideshare.net/ArrowECSMarketing/internet-of-things-and-ibm

Applications: An application is anything that has a connection to the internet and wants to interact with data from devices and/or control the behaviour of those devices in some manner. Applications identify themselves to the Watson IoT platform with an API key and a unique application ID. Applications do not need to be registered before they can connect to the Watson IoT platform, however they must present a valid API key that has previously been registered.

Gateway Devices: Gateways are a specialized class of Device. They have the combined capabilities of an Application and a Device allowing them to serve as access points providing connectivity to the service for other devices without the ability to directly connect. Gateway devices can register new devices and can send and receive data on behalf of devices connected to them. Gateway Devices must be registered before they can connect to the service.

Events: Events are the mechanism by which devices publish data to the Watson IoT platform. The device controls the content of the event and assigns a name for each event it sends. When an event is received by the Watson IoT platform from a device the credentials of the connection on which the event was received are used to determine from which device the event was sent. With this architecture it is impossible for a device to impersonate another device. Devices are unable to receive events, regardless of whether they are its own events or those of another device. Applications are able to process events from devices in real time. When an application receives an event it has visibility of the source of the event and the data contained in that event. Applications can be configured to subscribe to all events from all devices, a subset of events, a subset of devices or a combination of these events. Historical Event Storage allows users to store the data from devices added to their Watson IoT platform organization. Historical event storage activity and duration can be controlled from the settings panel in the Watson IoT platform dashboard.

Commands: Commands are the mechanism by which applications can communicate with devices. Only applications can send commands, which must be issued to specific devices. The device must determine which action to take on receipt of any given command, and even controls which commands it will subscribe to in the first place. It is possible to design a device to listen for any command, or to simply subscribe to a set of specific commands.

The main features enabled by the platform are outlined next:

Device Registry: The platform enables the management of the organization inventory, configure the security, and store metadata for millions of unique devices. Define device types to represent individual device models and apply default metadata to all devices of that type.

Connectivity: Permits to securely connect devices, gateways and applications directly to the Watson IoT platform via MQTT. It aslo permits to model the data from the device as events and control the flow of events into applications.

Gateway Support: In many cases where a direct connection cannot be made between the service and a device, the Watson IoT platform allows gateway devices to connect and provide indirect connectivity for multiple devices.

Device Management: Optionally, a user can allow the Watson IoT platform to manage the lifecycle of devices by implementing support for the Watson IoT platform’s device management protocol in the devices. The means by which the device connects to the service does not affect the device management protocol, which functions the same for directly connected, indirectly connected, and gateway devices.

External Service Integration: The Watson IoT platform supports integration with external services to bring data and operations supported by other online services into the platform, allowing application and device developers to seamlessly interact with those services without ever leaving the comfort of the Watson IoT platform APIs.

Historian: the Watson IoT platform can be configured to store a record of the events devices generate.

Last Event Cache: The API can return the last recorded value of an event-id for a specific device, or the last recorded value for each event-id reported by a specific device.

Developers can build their applications using several protocols and language such as HTTP, MQTT, Python, C, Java or Node.

IBM Watson IoT platform presents several pricing formats[28] where payment changes depending on the number of devices and the traffic their messages generate.

On top of the data collected through the platform IBM Watson offers a number of applications based on natural language processing and machine learning to reveal insights from large amounts of unstructured data.

2.1.4.11.1 Useful links

1. IBM Watson IoT web site: http://www-03.ibm.com/software/products/en/internet-of-things-platform
2. IBM Watson IoT doc: https://docs.internetofthings.ibmcloud.com/index.html
3. IBM Watson: http://www.ibm.com/smarterplanet/us/en/ibmwatson/index.html

2.2 Smart City modelling standards

A city model is defined as a georeferenced digital representation of objects, structures and phenomena that correspond to a real city (Ross, L. 2010). The city data model defines the representation and storage of data describing the city. To facilitate subsequent processing of the data contained in the city model it is important to use standards or widely adopted data formats. The use of standards is always a key element to ensuring long-term impact of the proposed solutions. A city model is basically represented by a combination of static and dynamic data. First set represents buildings and other city elements as structures with no or very low modifications along the time. The second set represents the data captured by the sensors which varies over time. The following sections present some of the most relevant standards and initiatives for data modelling of cities. The analysis is divided into the three main scales to be addressed by a city model, the urban level, the building level and the sensor level. They are still separate fields with specific methods, tools and processes, although synergies between all of them are appearing in the recent years. First of all a short

[28] https://www.ibm.com/marketplace/cloud/internet-of-things-cloud/purchase/us/en-us#product-header-top

introduction to smart city standards relevant for the city modelling are introduced in the following subsection.

2.2.1 Standards for Smart Cities

There are several standards development organizations at International, European or National level developing standards relevant for smart cities. Some of the most relevant ones are ISO[29], ITU[30], OGC[31], ETSI[32], IEEE[33] and BSI[34]. A detailed review of the most representative standards in the relevant disciplines for SmartEnCity is performed within *Task 2.3 Standards* and documented into the *Deliverable D2.2 Recommendations for updating standards or generating new ones*.

This section tries to introduce a set of Smart City standards from the point of view of data modelling and information frameworks, which provide the basis on which to build a collaborative, innovative and sustainable city.

The British Standards Institute (BSI) created some standards that are considered relevant to SmartEnCity project, such as the PAS 180 – Smart City Vocabulary and the PAS182 – Smart City Concept Model[35]. While PAS 180 defines a standard taxonomy for Smart Cities, covering information and city processes, the PAS 182 describes a model called the “Smart City Concept Model” (SCCM). The aim of the model is to address the lack of interoperability between city stakeholders by defining an ontology of concepts and relationships. Currently, within one city, each sector uses a set of taxonomies and models that enable information to be understood only within each sector. To overcome the barrier between sectors, and eventually between cities, the SCCM model leverages data interoperability. In a smart city it’s of vital importance the effective sharing of data in order to build effective added value and reusable services for the citizens. PAS 182 is being translated into an ISO norm: ISO/IEC DIS 30182 Smart city concept model – Guidance for establishing a model for data interoperability[36].

Other supported standards are the PAS 181, Smart City Framework, which provides “how-to” advice based on current best-practice, the PAS 183, Sharing information services, which will set out a guide for Smart Cities to establish a decision-making framework for sharing data and information services. On the other hand PD 8100 offers a guide for Smart City leaders and PD 8101 provides guidance on how infrastructure and development projects can be developed in a way that leverages a city progress towards becoming smarter.

Other ISO relevant standards are; ISO 19152, which provides a reference Land Administration Domain Model (LADM) covering basic information-related components of land administration and ISO 19156, which delivers a conceptual schema for observations and measurements, and for features involved in sampling when making observations.

[29] http://www.iso.org/iso/smart_cities_report-jtc1.pdf
[30] http://www.itu.int/en/ITU-T/ssc/Pages/default.aspx
[31] http://www.opengeospatial.org/pressroom/pressreleases/2181
[32] http://www.etsi.org/technologies-clusters/technologies/smart-cities
[33] http://smartcities.ieee.org/
[34] http://www.bsigroup.com/en-GB/smart-cities/
[35] http://smartklub.org/blog/introducing-the-essential-tools-for-building-the-perfect-smart-city/
[36] http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=53302

2.2.2 Urban Data Models

Urban data models represent georeferenced data of urban areas. Most used and developed tools for representation of urban areas are 2D GIS systems. Current trends search for tools for representation of urban areas through 3D models. A 3D city model consists of the information of digital elevation model, buildings, land use, vegetation and roads, among others. The main characteristic of these models is the ability to store all information of a city in a single data model, which facilitates its use and interoperability. These models can provide, operate and manage urban data which can be used in different applications such as disaster management, urban planning, traffic planning, security, telecommunications, navigation, and tourism.

2.2.2.1 GIS Systems (SHP)

GIS (Geographic Information Systems) systems are the most mature and used systems for the representation of geographically referenced data used to solve problems of spatial planning and management in diverse fields as urban planning, geology, agriculture, management of incidents and natural disasters, sociology, transport, environment and many others.

The information is organized in layers of graphical entities. Each of the layers has georeferenced information of one or more relevant attributes which represent a virtual model of the spatial reality (Earth). The following figure shows an example of some common data layers in GIS systems.

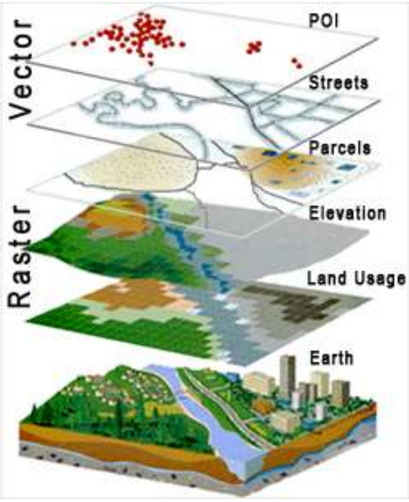

Figure 11 Data layers in a GIS system

The graphical representation of a layer can be of two types: Raster: Raster data type consists of rows and columns of cells, representing generally a rectangular grid, with each cell storing a single value. Examples of raster data are aerial imagery, orthophotos, scanned images (JPEG, GIF, TIFF ...). Vector: Geographical features are often expressed as vectors. Each of the geometries represented by a vector is linked to a row in a database that describes its attributes. There are three main types of geometries: Points, lines and polygons.

SHP (Shape file) is the file format developed by ESRI company to store the geographic information. Although it is not supported by any standardization organization it has become a de-facto standard due to its wide use. There are many applications or programs that allow geo-spatial data processing in both desktop environment (ArcGIS from ESRI is the most used or MapInfo) and through a server (ESRI ArcGIS Server). There are also proprietary solutions, as mentioned above, and also other free or open source desktop applications (gvSIG, QGIS, etc.) and open source server for sharing geospatial data (Geoserver). Data sources and cartography to be processed into GIS systems are also very varied, some of them are proprietary or for restricted use and some free of use for the general public.

2.2.2.2 OpenStreetMap (OSM)

OpenStreetMap[37] is a collaborative project to create a free editable map of the world started in 2004. Main motivation for the development of OSM was the unavailability and restrictions in the usage of official map information. Information in OSM is divided into several thematic layers. There is a straight forward link between thematic areas in OSM and the other main data models (e.g. CityGML). Some of the main elements of the thematic areas are: buildings, transportation, land use, natural, etc. The main advantage of OSM is the availability of data that has not been yet collected in the official maps, it is open source and free of use. However, the quality of the information cannot be fully guaranteed, due to the voluntarily of the contributions and the inexistence of sophisticated quality control procedures.

2.2.2.3 3D Cities in Google (KML)

The best known example of 3D cities is Google. 3D city model represented in google is a geometric model without semantic information associated with this geometry.

The file format used to represent 3D cities in Google is KML (Keyhole Markup Language). KML is an XML schema and file format for modelling and storing geographic features such as points, lines, images, polygons, and models that can be viewed in Google Earth, Google Maps and other applications. This file format is one of the most popular formats for geometric data exchange due to the adoption of Google Earth. It is based on COLLADA which was defined with the purpose of making easy to transport 3D assets between applications.

KML is an official standard defined by the OGC. It may contain geographic vector data as well as raster data in a georeferenced data model allowing also the inclusion of high resolution textured 3D models.

2.2.2.4 CityGML

CityGML[38] is an open data model based on XML format for storage and exchange of virtual models of 3D city defined by the OGC. The aim of the development of CityGML was to reach a common definition and understanding of the basic entities, attributes, and relations within a 3D city model (Kolbe T. H. 2009). What is especially important since it allows the reuse of the same data in different fields of application. The extension of the 3D model with semantic information is the main feature of the CityGML data model. CityGML extends the geometric

[37] https://www.openstreetmap.org/
[38] http://www.opengeospatial.org/standards/citygml

information with additional information on the use and function of objects through an ontology defined in this data model. The aim of this approach is to ensure the integrity and validity of the model city to be useful for administrative use. CityGML is based on GML (Geography Markup Language).

The main characteristics of CityGML Data Model are: *Multi-scale Modelling:* CityGML supports different levels of detail (LoD). The LoD are necessary to adjust the level of detail of the information to the requirements of each application. CityGML represents the same object with different LoD simultaneously. (See Figure 12).

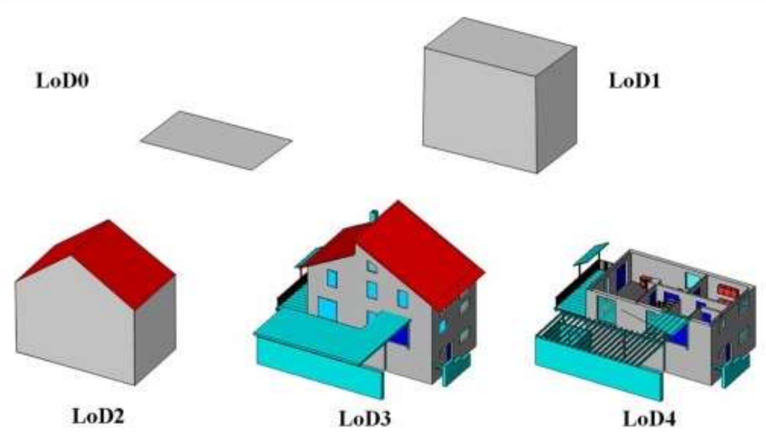

Figure 12 LoDs in CityGML (Kolbe et al. 2012)

Coherence between semantics and geometry: CityGML represents the graphical appearance of city models and also semantic and thematic properties, taxonomies and aggregations. One of the most important design principles of CityGML is the coherent modelling of the semantic and geometrical properties. The model consists of two hierarchies: semantics and geometric objects which are linked by relationships. The following figure (Figure 13) shows the coherence between semantics and geometry in CityGML.

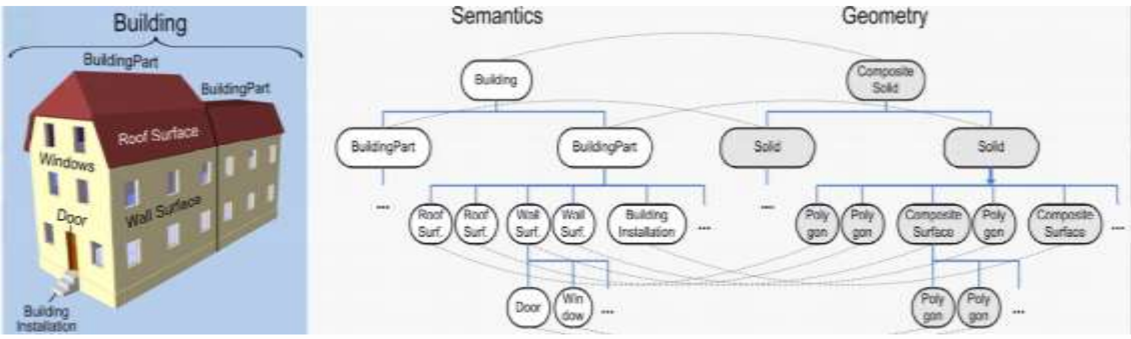

Figure 13 Coherence between semantics and geometry in CityGML (Kolbe et al. 2012)

Extensibility: The most common and powerful way for the extension of the CityGML data model is through the Application Domain Extension (ADE): ADE extensions specify the additions to the CityGML data model required for a specific domain. Such additions include the introduction of new features to existing classes of CityGML. ADE has to be defined in a new file that defines the XML schema. The extension is formally specified. Extended documents can be validated against the schema of CityGML and ADE.

Interoperability: There are many tools that allow the exportation to CityGML. The following figure (Figure 14) shows already identified workflows for the generation of CityGML files.

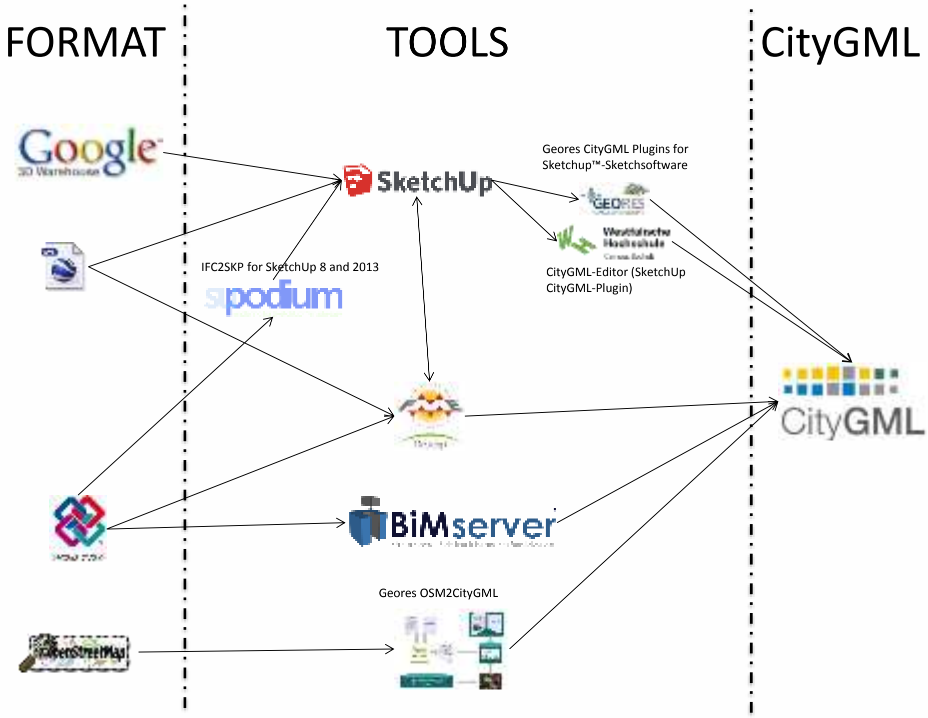

Figure 14 CityGML Interoperability with tools

There are different data exportations and transformations that can be performed in order to obtain a resultant CityGML file. In the above figure a variety of formats have been identified (Collada, KML, IFC and OSM) as inputs. Then different tools and plugins that allow geospatial data exchange can be used, such as SketchUp (with plugin like IFC2SKP, Geores CityGML Plugins for Sketchup™-Sketchsoftware or CityGML-Editor (SketchUp CityGML-Plugin)), FME Desktop, BIMServer or Geores OSM2CityGML. In each tool user manual interaction is needed in order to obtain better final results. As an example, in FME Desktop[39], a basic exportation process can be run; however, the resultant file is not CityGML semantically well completed. A better solution can obtain by creating a workspace with making custom data transformation workflows. Even if it implies mayor user interaction, that have to be done just once and then it is reused, the resultant CityGML quality is greater. As output from the different tools and plugins a CityGML file is obtained.

2.2.2.5 Relevance to SmartEnCity CIOP

SHP files will be used as input files representing the existing information about the city. Several public and non-public data exist in such format and will be used to collect different data sources for the generation of the city model.

OpenStreetMap is not a standard data model, however it is the most extended world-wide collaborative digital map. The availability of data varies very much from a place to another, when no spatial data are available in SHP format the OSM could be an alternative.

KML will be mainly used for visualization purposes due to the fact that no semantic data are included in the file. However, KML/COLLADA format is quite simple and allows the

[39] FME save software: http://www.safe.com/fme/

visualization of the 3D model on the web through virtual globes (e.g. Google Earth, CESIUM) or specific viewers.

CityGML is currently the most prominent standard data model for the representation of urban areas in 3D. It will be used for modelling the geometry and some of the semantic properties of the static elements of the city model.

2.2.3 Building Data Models

2.2.3.1 IFC

The term BIM (Building Information Modelling) is commonly used to denote the process of creation, sharing, use and re-use of digital information about a building or built asset throughout its entire lifecycle, from design through procurement and construction and beyond, into its operation and management. The introduction of the BIM concept into the building construction industry is leaded by buildingSMART International® (bSI)[40], a non-profit organization which promotes the digital transformation of the built environment through creation and adoption of open, international standards.

Among the different standards included under the BIM umbrella for representing products, processes, dictionary data and collaboration, the most popular one is the IFC (Industry Foundation Classes) data schema, accepted as ISO 16739. It is the leading standard for facilitating data exchange of a building or asset between different software tools during the whole life-cycle using vendor-neutral format, i.e. not controlled by any software vendor. There have been several evolutions of the model, being the current one the IFC4[41] model.

There are two possible well established implementations for the IFC format: SPF (STEP[42] Physical File) or XML that are in the industry. Although XML is increasingly used, STEP is by large the most widely adopted format by software developers. It is also more compressed than XML, which is an advantage for big model exchanges.

IFC is structured in four main layers presented in the following figure (Figure 15).

[40] http://buildingsmart.org/standards/technical-vision/
[41] http://www.buildingsmart-tech.org/specifications/ifc-releases/ifc4-release/buildingSMART_IFC4_Whatisnew.pdf
[42] https://en.wikipedia.org/wiki/ISO_10303-21

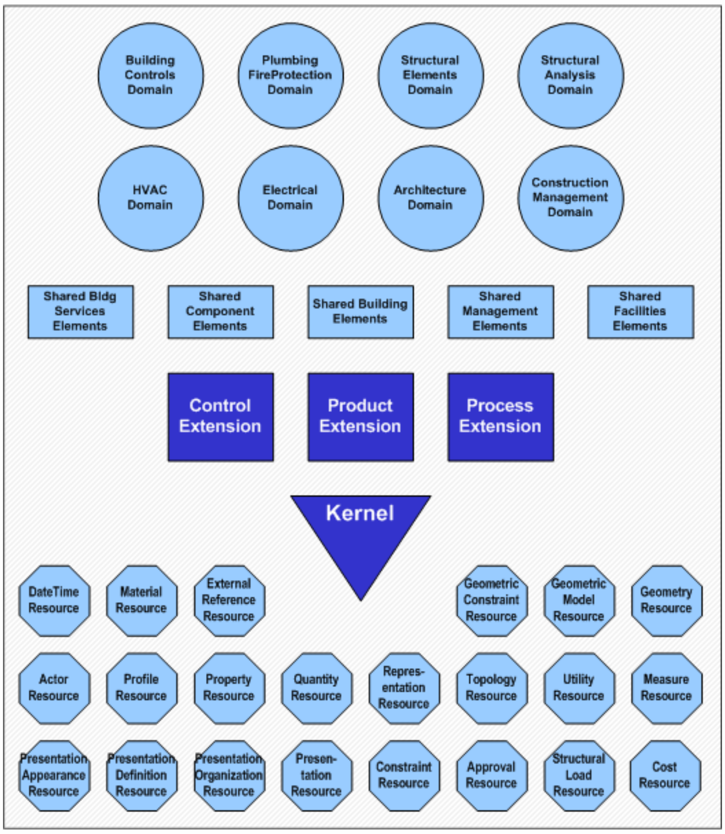

Figure 15 Structure of the IFC model

The Resource Layer is the lowest one in the IFC model architecture. As a base, resources are independent of any other classes in the model. The resource classes compile basic attributes such as geometry and any measurements, quantity, type of material, duration of construction or costs.

The Core Layer provides the kernel and a number of extensions on the core layer and contains entities for products, relationships and processes.

The Interoperability Layer defines objects that are common across AEC interdisciplinary applications within a set of modules or entity categories.

The Domain Layer, also known as Application Layer is the highest one in the IFC Object Model and it provides modules for AEC specific applications targeting concrete domains.

2.2.3.2 INSPIRE

The INSPIRE Directive (Infrastructure for Spatial Information in Europe) (INSPIRE Directive 2007) lays down general rules for the establishment of an Infrastructure for Spatial Information in the European Community. This directive requires data harmonization and interoperability of the systems and aims to create a legal framework to establish an infrastructure for spatial information at European level. The INSPIRE directive will allow to have more spatial data more reliable ones and share those data with everyone (administrations, businesses and citizens). One objective of this directive is to use and optimize the use of the currently existing spatial data.

INSPIRE includes a specification for the implementation of spatial data sets and services about buildings in the INSPIRE directive. This specification is focused mainly in buildings but includes also other constructions of major interest for environmental applications.

The data specification on Buildings defines a data model that allows the multiple representations of buildings and constructions. They have defined four profiles with different levels of detail both in geometry and semantics.

The Core3D profile and Extended 3D profile share many properties with CityGML, particularly the representation of the 3D geometry. There are different tools that allow the generation, storage, visualization and importation/exportation of CityGML files. However, these CityGML tools cannot be used directly for INSPIRE building data, because there are slightly difference between them.

In order to ease the importation / exportation between CityGML and INSPIRE building data a CityGML ADE has been designed for the Core 3D profile.

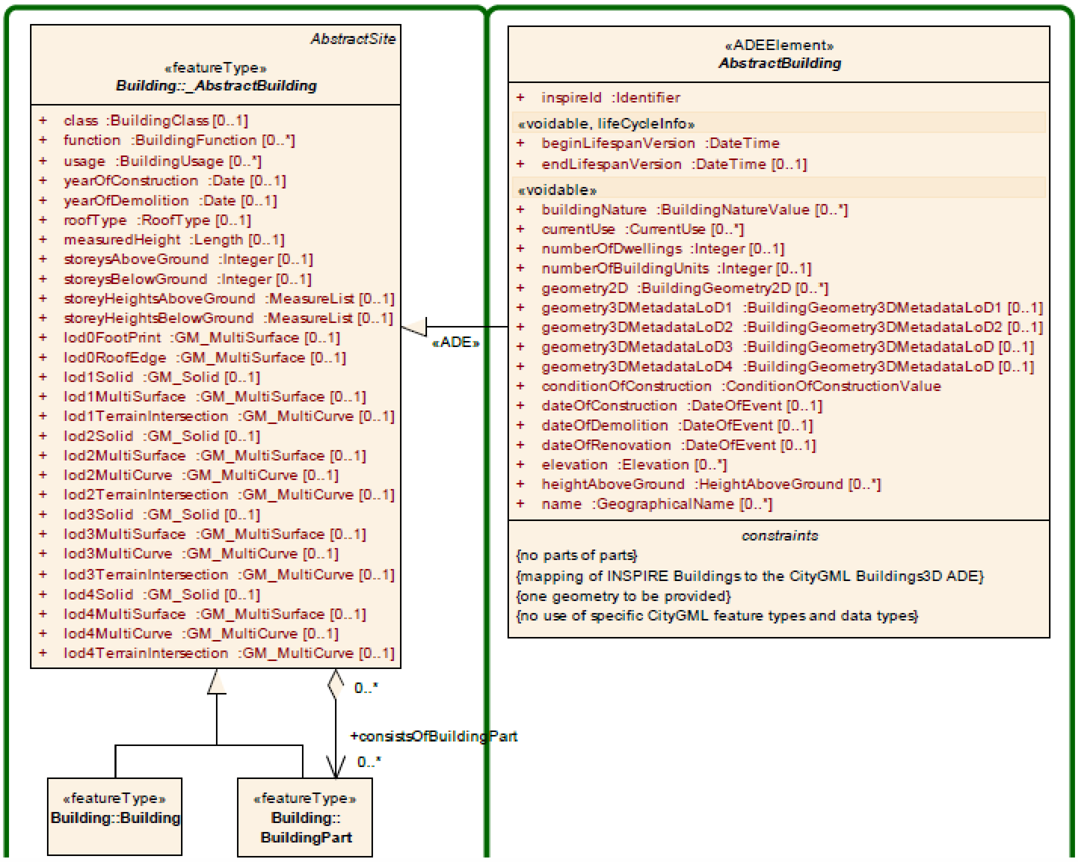

Figure 16 INSPIRE Core3D ADE- UML Diagram [Gröger 2013]

An ADE for the Extended 3D profile (application schema BuildingsExtended3D) is in preparation. In these ADEs, those properties which are shared by INSPIRE and CityGML are inherited from CityGML, while properties which are different or additional in INSPIRE are defined in the CityGML ADE for INSPIRE.

2.2.3.3 Ongoing activities

BuildingSMART continues working on extensions and improvements to the IFC standard. In particular the increasing need of collaboration and more efficient information flows between building and city/infrastructure scales (i.e. between BIM/GIS applications) has led to joint initiatives between buildingSMART and OGC, being the most relevant one the IFC Alignment[43] project.

This projects aims to extend the current IFC specification enabling concepts for the infrastructure domain, such as roads, bridges, tunnels or rails. For such purpose a specific Infrastructure Room has been set up within buildingSMART. It is expected that IfcAlignment entities will become part of the future IFC5 release[44].

Experience and knowledge of other similar standards has also been considered when defining the scope and contents of IfcAlignment extension, e.g. InfraGML and LandXML.

2.2.3.4 Relevance to SmartEnCity CIOP

IFC is the current leading standard for BIM, since it is supported by a large number of software applications, including the most popular and adopted BIM authoring tools from main vendors (Autodesk, Nemetschek/AllPlan, Bentley, Trimble…) and for all project phases, especially for design and construction. Since some of the activities of the Lighthouse projects are related to deep retrofitting of buildings for improving the energy efficiency, the use of BIM seems crucial, and IFC is the candidate format to address the interoperability aspects between the users and tools of the CIOP platform.

The current version of IFC is the IFC4 version, which is already supported by many tools and seems the most appropriate one to be used. Future extensions (IFC5/IFCAlignment) are very promising from the building and city integration perspective, but will not be available during the project evolution, although should be monitored for further evolutions of CIOP.

Regarding the specifications defined by INSPIRE in relation to representation of buildings, there are not still very popular and widely supported by tools, thus at the moment of the redaction of this deliverable it is not expected to be used within the CIOP.

2.2.4 Sensor Web Enablement (SWE) framework

Sensor Web Enablement[45] encompasses a set of standards promoted by the OGC to enable developers to make all types of sensors, transducers and sensor data repositories discoverable, accessible and useable via the Web.

[43] http://www.buildingsmart-tech.org/infrastructure/projects/alignment
[44] https://asiakas.kotisivukone.com/files/buildingsmart.kotisivukone.com/19.11_seminaarin_esitykset/ifc_for_infrastructure_2013_bsi_thomasliebich.pdf
[45] http://www.opengeospatial.org/ogc/markets-technologies/swe

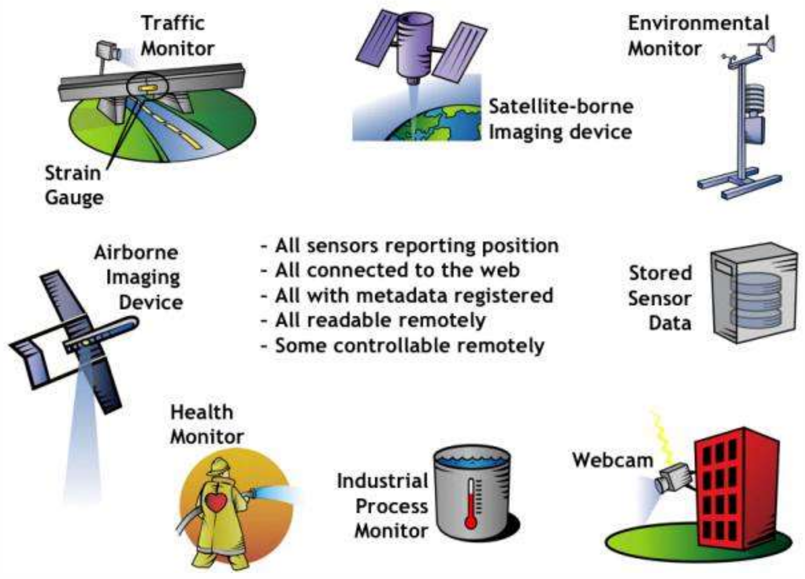

Figure 17. Data covered by the Sensor Web Eneblement standards

The Sensor Web Enablement framework, also referred to as Semantic Sensor Web, which is intended for making visible, accessible and usable via web through standard protocols any type of data produced by sensors, transducers and sensor data repositories. Thus, it is a particular implementation of the Internet of Things (IoT) concept.

For that purpose the **Sensor Model Language**[46] (**SensorML**) is defined, with the aim to provide a robust and semantically-tied means of defining processes and processing components associated with the measurement and post-measurement transformation of observations. This includes sensors and actuators as well as computational processes applied pre- and post-measurement. The main objective is to enable interoperability, first at the syntactic level and later at the semantic level (by using ontologies and semantic mediation), so that sensors and processes can be better understood by machines, utilized automatically in complex workflows, and easily shared between intelligent sensor web nodes.

In parallel, the OGC also defines the **SWE Service Model Implementation**[47] Standard. This standard currently defines eight packages with data types for common use across OGC Sensor Web Enablement (SWE) services. Five of these packages define operation request and response types. The packages are:

- Contents – Defines data types that can be used in specific services that provide (access to) sensors
- Notification – Defines the data types that support provision of metadata about the notification capabilities of a service as well as the definition and encoding of SWES events;
- Common - Defines data types common to other packages;
- Common Codes – Defines commonly used lists of codes with special semantics;
- DescribeSensor – Defines the request and response types of an operation used to retrieve metadata about a given sensor;
- UpdateSensorDescription –Defines the request and response types of an operation used to modify the description of a given sensor;

[46] http://www.opengeospatial.org/standards/sensorml
[47] http://www.opengeospatial.org/standards/swes

- InsertSensor – Defines the request and response types of an operation used to insert a new sensor instance at a service;
- DeleteSensor – Defines the request and response types of an operation used to remove a sensor from a service. These packages use data types specified in other standards. Those data types are normatively referenced herein, instead of being repeated in this standard.

Other standards included in the SWE are:

- Observation & Measurements (O&M)[48]: XML implementation for the OGC and ISO O&M conceptual model. It defines XML schemas for observations, and for features involved in sampling when making observations.
- Sensor Observation Service (SOS)[49]: This standard defines a Web service interface which allows querying observations, sensor metadata, as well as representations of observed features. Descriptions of the sensors are represented in SensorML and measured values in O&M.
- Sensor Planning Service (SPS)[50]: Defines interfaces for queries that provide information about the capabilities of a sensor and how to task the sensor.

Ontologies have been widely used as semantic models for the representation of heterogeneous sensor data. Apart from SensorML described above, some of the most relevant ontologies describing sensors, their capabilities and observations are: Ontosensor [Goodwin C., Russomanno D.J. (2006)] and CSIRO [Neuhaus H., Compton M. (2009)] are the ones covering the wider range of sensing concepts, organizing sensors and data into a hierarchical structure.

2.2.4.1 Relevance to SmartEnCity CIOP

The set of standards included in the SWE Framework represents the most well defined standard way to make accessible via Web the sensors and data captured by a sensor network infrastructure. Several of the existing frameworks and architectures identified and described in section 2.1, they are compatible with some of the SWE standards (e.g. FIWARE support UL2.0, which is a simplification of SensorML). Within the SWE suite of standards, recently approved is SensorThings[51], which defines a standard way to interconnect IoT devices, data servers, and applications over the Web through a REST-like API.

2.2.5 Other standards

In addition to the aforementioned, other standards have also been defined, but with a very limited diffusion. They are briefly described in this section, but since they are not a promising alternative in relation to the CIOP, they are not going to be deeply analyzed.

48 http://www.opengeospatial.org/standards/om
49 http://www.opengeospatial.org/standards/sos
50 http://www.opengeospatial.org/standards/sps
51 http://www.opengeospatial.org/projects/groups/sensorthings

One of these standards is **BIMXML**[52], used to describe concepts like sites, buildings, storeys, spaces, equipment, attributes, etc. It uses a simplified XML schema compared with complex models like IFC.

Additionally, **aecXML**[53] is a similar standard for the AEC industry (Architecture, Engineering and Construction) and it is being used to support software vendors, construction companies, academic bodies, product manufacturers, etc.

LandXML[54] specifies an XML file format for civil engineering design and survey measurement data for serving as a data exchange mechanism between software applications. LandXML data types include: points, survey measurements, alignments, profiles, cross sections, surfaces, parcels, pipe networks, etc. In the beginning of 2016 a viewer has been released. Nevertheless, a new format, **InfraGML**, has been proposed by the OGC since 2013, as a potential replacement for LandXML. InfraGML is a concept model for open infrastructure standard. In addition, concepts from InfraGML are taking into consideration in the joint efforts between OGC and buidlingSMART to develop the IFC Alignment extension, as described in section 2.2.3.3

The Open Geospatial Consortium (OGC) is fostering a GML-based standard for internal representation of the building: **Indoor GML**[55]. In contrast to IFC it is more oriented to provide spatial analysis and route optimization, e.g. to locate and track objects or robots through navigation systems.

The National Information Exchange Model, **NIEM**[56], is an XML-based information exchange framework from the U.S. NIEM is designed to develop, disseminate, and support enterprise-wide information exchange standards and processes that will enable jurisdictions to automate information sharing. NIEM has been gaining adoption in many U.S. federal agencies and state and local governments, as well as expanding into other domains. In addition, other national government agencies are considering NIEM. For example, Eurojust and SEMIC-EU have included an investigation of NIEM as a part of their development of European governmental exchange standards. NIEM, however, is not considered an international standard, nor does it address international vocabularies or taxonomies at this time[57].

Universal Core (**UCore**) is an U.S. Federal information sharing initiative that supports the National Information Sharing Strategy and all associated departmental and agency strategies. UCore specifies a framework, metadata, extension rules, security marking, and physical schema to permit content sharing between dissimilar systems. However, a key objective in creating UCore is to keep it simple, easy to explain, and easy to implement. From a smart city modeling perspective, UCore should be used to define and model the core concepts of entities and assets, events and alerts, people, organizations, locations, and collections, along with the relationships that link them together. In addition, a smarter city model should leverage the OWL-based UCore taxonomy of terms that classify events and entities.

52 http://bimxml.org/
53 http://en.wikipedia.org/wiki/AecXML
54 http://www.landxml.org/
55 http://www.opengeospatial.org/projects/groups/indoorgmlswg
56 https://www.niem.gov/Pages/default.aspx
57 http://www.ibm.com/developerworks/library/os-ind-smartercitydatamodel1/

2.3 Standards for Verticals

2.3.1 Energy

This section presents the state of the art for standards related to the energy domain. Many are the standards in this domain so the approach followed consists on presenting standards for energy in general and later narrow the search on standards for smart cities and those related to buildings and homes where energy issues are addressed. That is, focussing on those standards that have a relation with the SmartEnCity project.

All the standards presented accommodate energy issues with different perspectives. Since the objective for this deliverable is to emphasize on the ICT part of those standards, this section also presents references to communication protocols, interoperability initiatives and information models.

2.3.1.1 Standards for energy in general

Most energy standards found in the literature address energy efficiency and renewable energy. The objective of those standards is the reduction of energy consumption and the dependency on fossil fuels.

ISO International Standards[58] aim to solve the energy challenge by increasing energy efficiency and promoting the development of renewable energy technologies. The standards range from the energy management system standard ISO 50001 that can be used by any organization in any sector, to standards specific to certain sectors, such as building or transportation.

Special mention deserves **ISO 50001**. ISO 50001 :2011[59] supports organizations in all sectors to use energy more efficiently, through the development of an energy management system (EnMS) and provides a framework of requirements for organizations to:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions about energy use
- Measure the results
- Review how well the policy works, and
- Continually improve energy management.

ISO 50001 also guides organizations on taking a systematic approach in order to achieve continual improvement in energy management and energy performance. Energy management will be sustainable and most effective when it is integrated with an organization's overall business processes (e.g. operations, finance, quality, maintenance, human resources, procurement, health and safety and environmental). ISO 50001 can be integrated with other management system standards. Integration can have a positive effect on business culture, business practice, embedding energy management into daily practice, operational efficiency and the operating cost of the management system.

The different standards hierarchically dependent on ISO 50001 are summarized next:

- **ISO 50002:2014**: Energy audits -- Requirements with guidance for use

58 http://www.iso.org/iso/home.htm
59 http://www.iso.org/iso/home/standards/management-standards/iso50001.htm

- **ISO 50003:2014**: Energy management systems -- Requirements for bodies providing audit and certification of energy management systems
- **ISO 50004:2014**: Energy management systems -- Guidance for the implementation, maintenance and improvement of an energy management system
- **ISO 50006:2014**: Energy management systems -- Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) -- General principles and guidance
- **ISO/DIS 50007**: Activities relating to energy services -- Guidelines for the assessment and improvement of the service to users
- **ISO/AWI 50008**: Commercial building energy data management for energy performance -- Guidance for a systemic data exchange approach
- **ISO 50015:2014**: Energy management systems -- Measurement and verification of energy performance of organizations -- General principles and guidance

There are also standards related to renewables and the emerging technologies used in the field. For example the standard **ISO/TC 180 Solar energy**[60] deals with the standardization in the field of solar energy utilization in space and water heating, cooling, industrial process heating and air conditioning. The standard **ISO/TC 238 Solid biofuels** deals with the standardization of terminology, specifications and classes, quality assurance, sampling and sample preparation and test methods in the field of raw and processed materials originating from arboriculture, agriculture, aquaculture, horticulture and forestry to be used as a source for solid biofuels.

The European Committee for Standardization (CEN) similar to ISO presents different standards related to energy concentrating the efforts in energy efficiency, management and performance measurement. A list of those standards is presented next:

- The standard **EN ISO/IEC 13273-1:2016**[61] (Energy efficiency and renewable energy sources - Common international terminology - Part 1: Energy efficiency) addresses Energy and heat transfer engineering in general considering Energy efficiency.
- The standard **EN ISO/IEC 13273-2:2016**[62] (Energy efficiency and renewable energy sources - Common international terminology - Part 2: Renewable energy sources) addresses Energy and heat transfer engineering in general considering Renewable energy sources.
- **EN 16231:2012**[63] (Energy efficiency benchmarking methodology) This European Standard specifies requirements and provides recommendations for energy efficiency benchmarking methodology. The purpose of energy efficiency benchmarking is to establish the relevant data and indicators on energy consumption, both technical and

60 http://www.iso.org/iso/home/standards_development/list_of_iso_technical_committees/iso_technical_committee.htm?commid=54018

61 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:61048,539498&cs=112766B537065B0EA845BB2D339CFE9F1

62 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:61049,539498&cs=135E603A25398609DACA81D79FD8328AE

63 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:34105,738432&cs=167A545EE772C9B66F7FAA98CCCC6DF18

behavioural, qualitative and quantitative in comparing performance between or within entities.

- **EN 15900:2010**[64] (Energy efficiency services - Definitions and requirements) This European Standard specifies the definitions and minimum requirements for an energy efficiency service.
- **EN 16212:2012**[65] (Energy Efficiency and Savings Calculation, Top-down and Bottom-up Methods) This European Standard provides a general approach for energy efficiency and energy savings calculations with top-down and bottom-up methods. The general approach is applicable for energy savings in buildings, cars, appliances, industrial processes, etc. This European Standard covers energy consumption in all end-use sectors. The standard does not cover energy supply, e.g. in power stations, as it considers only final energy consumption.
- **EN 16247:2012**[66] (Energy audits) This European standard specifies the requirements, common methodology and deliverables for energy audits. It applies to all forms of establishments and organizations, all forms of energy and uses of energy, excluding individual private dwellings. It has 4 parts; general requirements, buildings, processes, transport and competence.

2.3.1.2 Energy considerations in Smart Cities Standards

This section presents a couple of Smart City standards where energy issues are considered to demonstrate that this vertical could also be approached using standards that include other verticals also related to Smart Cities. Those two standards are:

ISO/TS 37151[67] (Smart community infrastructures — Principles and requirements for performance metrics) standard outlines 14 categories of basic community needs (from the perspective of residents, city managers and the environment) to measure the performance of smart community infrastructures. These are typical community infrastructures like energy, water, transportation, waste and information and communication technology systems, which have been optimized with sustainable development and resilience in mind. Not only will the metrics in ISO/TS 37151 support city and community managers in planning and measuring performance, they will help compare and select procurement proposals for products and services geared at improving community infrastructures. In this Technical Specification, the concept of smartness is addressed in terms of performance relevant to technologically implementable solutions, in accordance with sustainable development and resilience of communities as defined in the ISO's Technical Committee 268 (ISO/TC 268). Energy is considered a community infrastructure.

ISO 37120:2014[68] (Sustainable development of communities – indicators for city services and quality of life) is the first ISO standard for smart city indicators. ISO 37120 is being

64 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:28200,738432&cs=13E3EB00929A4BE15AA4436BAA762AADF

65 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:34104,738433&cs=106F2D12B8BB40945512BEF3DAD21B7AC

66 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:35014,700835&cs=12756BDB87D6377092BC74613BD2461C7

67 https://www.iso.org/obp/ui/#iso:std:iso:ts:37151:ed-1:v1:en

68 https://www.iso.org/obp/ui/#iso:std:iso:37120:ed-1:v1:en

developed as part of an integrated suite of standards for sustainable community development under the ISO/TC 268. In general, ISO 37120 defines 100 city performance indicators that could or should be measured, and how. Specifically, ISO 37120 defines 46 core and 54 supporting indicators that cities either "shall" (core) or "should" (supporting) track and report. ISO 37120 conformance will require third party verification of data, and the organization is in the process of defining an audit process with pilot cities. ISO 37120 also provides for a set of profile indicators, such as population and GDP, to help cities determine which cities are most relevant for comparisons. ISO 37120 focuses on factors related to energy and environmental sustainability and resiliency, including energy consumption of public buildings and average number of electrical service interruptions per year.

2.3.1.3 Standards for energy in buildings and homes

This section presents building and home representation standards where energy issues are considered to demonstrate that this vertical could also be approached using standards not specific to the energy domain and that are addressed in the SmartEnCity project.

Among the ISO standards for building we identify standards such as ISO 23045 for the energy efficiency assessment of buildings, and ISO 13153 for the design of energy saving family homes, can help reduce energy use in the sector. A short introduction for each standard is presented next:

- **ISO 23045:2008**[69] (Building environment design -- Guidelines to assess energy efficiency of new buildings). ISO 23045:2008 gives guidelines related to energy efficiency in buildings as introduced in ISO 16813. The objectives of ISO 23045:2008 are to assist designers and practitioners when collecting and providing the useful data that are required at different stages of the design process and to fulfil the definitions of the building as prepared by building designers. This International Standard applies to new buildings and is applicable to space air-conditioning equipment and the heating plant in new buildings.
- **ISO 13153:2012**[70] (Framework of the design process for energy-saving single-family residential and small commercial buildings) ISO 13153:2012 specifies a framework of the design process for energy-saving single-family residential and small commercial buildings, with the energy consumption ratio as the key criterion. It is intended to assist in the development of design guidelines for practitioners who design energy-related parts of buildings.
- **ISO/AWI 50008**[71]: Commercial building energy data management for energy performance -- Guidance for a systemic data exchange approach

Among the CEN standards for building performance we identify two standards. A short introduction for each standard is presented next:

- **CEN/TR 15615:2008**[72] (Energy Performance of Buildings Directive (EPBD)) This document provides an outline of the calculation procedure for assessing the energy

[69] https://www.iso.org/obp/ui/#iso:std:iso:23045:ed-1:v1:en
[70] https://www.iso.org/obp/ui/#iso:std:iso:13153:ed-1:v1:en
[71] http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=51871
[72] https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:26384,493634&cs=19CB99B64CE4306DB8ED65C300F0A73A3

performance of buildings. It includes a list of the European standards, both existing and those that are being written, which together form the calculation methodology.

- **CEN/TS 16628:2014**[73] (Energy Performance of Buildings - Basic Principles for the set of EPB standards) This Technical Specification describes the basic principles to be followed in the development of standards intended to support the assessment of the energy performance of buildings using a holistic approach. The main goal is to obtain a set of EPB-standards that are a systematic, clear and comprehensive package for the benefit of professionals and government entities. This Technical Specification gives general, qualitative guidance on the required quality, accuracy, usability and consistency of EPB-standards in order to provide a balance between: - the accuracy and level of detail, and the simplicity and availability of input data.
- **CEN/TS 16629:2014**[74] (Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards) This Technical Specification provides guidance in the form of detailed technical rules based on the basic principles, both for the overarching standard and for each standard within the set of EPB-standards.
- **EN 15603:2008**[75] (Energy performance of buildings - Overall energy use and definition of energy ratings) The purpose of the standard is to: a) collate results from other standards that calculate energy use for specific services within a building; b) account for energy generated in the building, some of which may be exported for use elsewhere; c) present a summary of the overall energy use of the building in tabular form; d) provide energy ratings based on primary energy, carbon dioxide emission or other parameters defined by national energy policy; e) establish general principles for the calculation of primary energy factors and carbon emission coefficients. This standard defines the energy services to be taken into account for setting energy performance ratings for planned and existing buildings, and provides for this: f) method to compute the standard calculated energy rating, a standard energy use that does not depend on occupant behaviour, actual weather and other actual (environment or indoor) conditions; g) method to assess the measured energy rating, based on the delivered and exported energy; h) methodology to improve confidence in the building calculation model by comparison with actual energy use; i) method to assess the energy effectiveness of possible improvements. This European standard is applicable to a part of a building (e.g. flat), a whole building, or several buildings. It is up to national bodies to define under which conditions, for which purposes and for which types of buildings the various ratings apply. This standard handles the energy performance of a building as a whole. The technical report prCEN ISO/TR 52000-2 refers to 15603 standard.

73 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:39435,628909&cs=107BDCF606421F3C552F70E6B24E35CE2

74 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:39436,628909&cs=16B4447D41D8B82267086C5358CD72882

75 https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:27654,628909&cs=1A84125D8BD6D85A28823EF847D456D8D

- **prEN ISO 52000-1**[76] (Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures) This standard provides a systematic, comprehensive and modular overall structure on the integrated energy performance of buildings, in order to ensure consistency among all CEN standards required to calculate the energy performance of buildings according to the EPBD (2010/31/EU). This standard handles the framework of the overall energy performance of a building, covering inter alia: a) common terms, definitions and symbols; b) building and system boundaries; c) building partitioning; d) methodology for calculating the energy performance of a building (set of overall formulae on energy used, delivered, produced and/or exported at the building site and near-by); e) set of overall formulae and input-output relations, linking the various elements relevant for the assessment of the overall energy performance of buildings which are treated in separate standards; f) general requirements to standards dealing with partial calculations; g) general rules in setting out alternative calculation routes according to the calculation scope and requirements; h) rules for the combination of different partitioning; i) performance indicators; j) methodology for measured energy performance assessment.

2.3.1.4 ICT for Energy

This section briefly outlines the interoperability initiatives and information models that can be used in the energy domain. All these topics will be analyzed in more detail in Task 6.3 (Platform Data Model) and Task 6.4 (Platform Interconnectivity Mechanisms).

2.3.1.4.1 Interoperability standards and initiatives

Communication protocols are in most cases standardized, however, there is an immediate need to develop profiling and interoperability specifications for energy issues based on the existing communications standards. There are however interoperability standards that enable the exchanged of information between functions, services and components and have some relation with the energy domain and more specifically with Smart Grids.

Several initiatives (not standards yet) address the interoperability gap between energy entities. In most cases the focus is again on energy efficiency and more specifically on energy demand response flexibility and market trade between energy stakeholders. The main initiatives where interoperability is addressed are:

USEF[77]: The Universal Smart Energy Framework (USEF) is an international common standard that ensures that smart energy technologies and projects are connectable at lowest cost. Its component parts enable the commoditization and market trading of flexible energy use and specify all stakeholder roles (new and existing), how they interact and how they can benefit by doing so. USEF describes the market for flexibility, offering the Framework description, with specifications, designs and implementation guidelines. USEF, currently, solely focusses on market mechanisms to valorize flexibility. Maintenance of equipment is seen as part of the internal business processes and not as a subject for interoperability between organizations. However, USEF has a view on how to use flexibility to positively

[76] https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:39126,628909&cs=12B879FA9CB0107D867641BE595FCFF91
[77] http://www.usef.energy/

influence the equipment for an energy Distribution System Operator (DSO). This is part of capacity management and will be worked out later this year.

OpenADR[78]: Open Automated Demand Response (OpenADR) is an open and standardized way for electricity providers and system operators to communicate DR signals with each other and with their customers using a common language over any existing IP-based communications network, such as the Internet. As the most comprehensive standard for Automated Demand Response, OpenADR has achieved widespread support throughout the industry. The OpenADR Alliance was formed by industry stakeholders to foster the development, adoption and compliance of the Open Automated Demand Response (OpenADR) Smart Grid standard utilizing existing standards from OASIS, UCA and NAESB.

Contacting directly the OpenADR alliance team it was discovered that maintenance data is outside of the scope of the standard.

EEBus[79]: The EEBus initiative is one of the world's leading initiatives in the area of the Internet of things with a consistent focus on cross-domain standardization. EEBus has its roots in the sector of smart and renewable energy. The success of smart energy and smart home / building systems largely depends on the system's interoperability. Interoperability has to be understood here in terms of an identical understanding of messages and data that are exchanged between the respective markets and devices. The distinction between exchanged data of an energy management function or a comfort function becomes secondary, as the limitations of both scenarios are merging.

2.3.1.4.2 Information models

As mentioned in the previous section, while the communication layer standards are available for most protocols, there is an opportunity for improvement with the information layer standards. We need to look elsewhere for available specifications already in wide use to cover for the missing functionality related to smart cities/buildings and energy.

Several options are available that touch on the models for building information management (BIM) and energy efficiency. While these specifications are not only concerned with building energy efficiency, they partially or fully define the data models that can be used to capture this information. Among them, two consolidated specifications and an emerging one are the most promising ones. While some European projects have indirectly touched on these areas, the most mature specifications come out of the North American organizations and national bodies.

The first consolidated specification is the **Green Building XML (gbXML)**[80] which defines an open schema and helps facilitate the transfer of building properties stored in 3D building information models (BIM) to engineering analysis tools. The Green Building XML schema, referred to as "gbXML", was developed to facilitate the transfer of building information stored in CAD building information models, enabling integrated interoperability between building design models and a wide variety of engineering analysis tools and models available today. Today, gbXML has the industry support and wide adoption by the leading CAD vendors, Autodesk, Graphisoft, and Bentley. With the development of export and import capabilities in

78 https://openadr.memberclicks.net/
79 https://www.eebus.org/en/about-us/
80 http://www.gbxml.org/

several major engineering modeling tools, gbXML has become a defacto industry standard schema. gbXML allows intelligent solutions for the design, certification, operation, maintenance, and recycling of buildings.

As part of the specification, it includes the definition of Internal Equipment (IntEquip) element, which is an element that is generalized to be able to contain any type of internal equipment to the building. This element includes, among many others, the attributes that allows us to represent the energy-related characteristics of the equipment, such as the electricity load, the efficiency, the performance, the power consumed by the equipment, the usage cycles, etc.

The second consolidated specification is **Home Performance XML (HPXML)**[81], created by the Building Performance Institute (http://www.bpi.org/). The specification includes two proposed standards:

- BPI-2100-S-2013[82], the Standard for Home Performance-Related Data Transfer (informally known as Home Performance XML, or the HPXML standard) provides requirements for an extensible mark-up language (XML) standard data transfer protocol that can be used to transfer home performance-related data between any party involved in a home performance program, including contractors, program administrators, utilities, and government agencies
- BPI-2200-S-2013[83], the Standard for Home Performance-Related Data Collection, designed to facilitate the exchange of information and data among all actors in the home performance industry by providing a standard vocabulary for describing terms related to buildings, energy consumption, and energy conservation measures. Each of the data elements defined in BPI-2200 can be transferred via HPXML.

The emerging specification is the **Building Energy Data Exchange Specification (BEDES)**[84], led by the U.S. Department of Energy (U.S. DOE). The main goal of BEDES is to facilitate the utilization and sharing of empirical building energy performance data among software tools and data collection and analysis activities, more easily and consistently and at lower cost. BEDES is designed to support analysis of the measured energy performance of commercial and residential buildings, with fields for building characteristics, efficiency measures and energy use.

2.3.2 Mobility

Get efficient public transport information is one of the objectives of this project. The solution to reach this goal is to make easier the exchange of information between different software products. Due to this, using standards is the best approach. A standard is a reference data model for public transport to understand the information needs of a public transport company and for constructing an integrated information system to service end users with the information.

[81] https://hpxml.nrel.gov/
[82] http://www.hpxmlonline.com/uploads/HPXML_BPI-2100-S-2013-Standard-for-Home-Performance-Related-Data-Transfer_20131115.pdf
[83] http://www.hpxmlonline.com/uploads/HPXML_BPI-2200-S-2013-Standard-for-Home-Performance-Related-Data-Collection_20131115.pdf
[84] http://energy.gov/eere/buildings/building-energy-data-exchange-specification-bedes

There are several mobility standards that many European projects use. The most important ones are the following ones, which are described in detail in the following subsections:

- ***DATEX 2***[85]: for Individual Traffic and a general situation message model.

- ***Transmodel***[86]: as the reference model underlying public transport. (CEN standard (EN 12896) for reference data model for public transport information which provides an abstract model of common public transport concepts and data structures that can be used to build many different kind of public transport information system, including for timetabling, fares, operational management, real-time data, journey planning, etc.)

- ***IFOPT***[87]: to describe fixed infrastructure. (Identification of fixed objects in public transport, CEN published standard EN 28701)

- ***SIRI***[88]: for public transport schedule. (Service interface for real-time information, CEN technical specification (TS 15531))

- ***TPEG***[89]: for descriptive location referencing, public transport information messages, and parking facilities.

- ***NeTEX***[90]: for public transport based on Transmodel.

Other transport data formats used in the area of mobility are:

- Geographical Information System: SHP, KML …

- Emergent format: GTFS

- Other information and formats: XLS, CSV, JSON, XML, WMS, WFS, DXF, APIs …

2.3.2.1 DATEX 2 - European standard for traffic and travel

This standard is based on modern technology with an extensive and well-structured data model. It is used for data exchange between traffic control and information centres as well as other actors of the traffic and travel information sector.

The transfer specification is developed to be independent of technology.

DATEX 2 is used in many countries in Europe and is standardized through CEN (European Committee for Standardization).

DATEX 2 is of relevance for all applications where dynamic information on the transport systems and notably the road system is concerned. The main usage areas are:

- Rerouting, network management and traffic management planning.
- Applications where information exchange between individual vehicles and traffic management is crucial.

DATEX 2 reference model for information exchange covers:

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85 http://www.datex2.eu/
86 http://transmodel-cen.eu/
87 http://www.itsstandards.eu/index.php/pt
88 http://user47094.vs.easily.co.uk/siri/
89 https://www.irt.de/en/activities/digital-radio/tpeg-traffic-and-travel-information.html
90 http://user47094.vs.easily.co.uk/netex/

- Service on the network, both in terms of messages for specific situations or as an overall status on the network.
- Travel times, for travel itineraries.
- Incidents and accidents on the road.
- Road works.
- Road infrastructure status.
- Closures, blockages and obstructions
- Road weather, again as events as well as status / measurements
- All kinds of traffic related measurements (speed, flow, occupancy)
- Public events with impact on traffic
- Current settings of variable message signs

DATEX 2 is supported by European Commission and developed and maintained under the umbrella of the EasyWay project.

2.3.2.2 Transmodel

Transmodel is the CEN (European Committee for Standardization) European Reference Data Model for public transport Information.

Transmodel covers:

- Public Transport Network.
- Timing Information and Vehicle Scheduling.
- Operations Monitoring and Control.
- Fare Management.
- Passenger Information.
- Driver Management.
- Management Information and Statistics.

The impact and benefits of using Transmodel in some projects are:

- A more efficient handling of business and public transport processes.
- Reliable and consistent information to intermediate and end users.
- An easy access to the relevant information for the management of the operational departments.
- A better data administration by a qualified staff.
- A precise definition of the access rights to data and thus an efficient data protection.
- Long-term savings as regards system maintenance.
- Operational savings due to the avoidance of multiple data captures.
- An easy integration of new applications.
- Independence of particular suppliers.
- The possibility to change the hardware platform.

2.3.2.3 IFOPT

Identification of Fixed Objects in Public Transport is used mainly for stops and points of interest. It defines the following main models:

- Stop place: bus stops, airports, ferry ports and so on. It distinguishes all physical points of access to transport: taxi ranks, platforms, gates…
- Point of interest: It defines the structure of tourist attractions, public buildings, parks, etc.

It is built upon Transmodel (above mentioned) standard.

2.3.2.4 SIRI

The Service Interface for Real Time Information allows distributed computers to exchange public transport real time information. It is also based on Transmodel.

The SIRI protocol uses open system technologies and is independent of a platform.

- CEN/TC 278 is the standards group responsible for managing the preparation of standards within the field of Intelligent Transport Systems (ITS) in Europe. It is a working group authorized by the CEN, the European Committee for Standardization.
- CEN/TS 15531-5: Public Transport - Service Interface for real-time information relating to public transport operations - Functional service interfaces: Situation Exchange
- CEN/TS 15531-4: Public Transport - Service Interface for real-time information relating to public transport operatiSmartEnCityons - Functional service interfaces: Facility Monitoring
- CEN/TS 15531-3: Public Transport - Service Interface for real-time information relating to public transport operations - Functional service interfaces
- CEN/TS 15531-2: Public Transport - Service Interface for real-time information relating to public transport operations - Communications infrastructure
- CEN/TS 15531-1: Public Transport - Service Interface for real-time information relating to public transport operations - Context and Framework

2.3.2.5 TPEG

Transport Protocol Experts Group is a data protocol for traffic and travel information.

This technology was developed to facilitate the delivery of information messages within the multimedia broadcasting environment from a service provider's database to an end-users client device. The key underlying principle of TPEG technology requires hierarchically structured messages to be delivered to client devices for to decoding and filtering the content to provide language independent presentation either directly for human use, or for agent systems.

TPEG standards are:

- TPEG Binary - originally developed for Digital Radio in CEN/ISO TS 18234-Series.
- TPEGML - developed for Internet bearers & message generation using XML in CEN/ISO TS 24530-Series.

The advantages of using TPEG are the following ones:

- All traffic points can be located on a digital map.
- Services for weather reports can be broadcast.

- Several services can be bundled.
- Availability of information about parking as well as local and regional public transport and traffic conditions can be described in a very detailed manner.

The information that TPEG can relay directly to the motorist includes:

- **TEC**: Traffic Event Compact (corresponds roughly to current TMC, but is more accurate) and enables local hazard warnings, road-specific weather updates and traffic jam information.
- **TFP**: Traffic Flow and Prognoses.
- **PKI**: Parking Information.
- **SPI**: Driver-assistance System (in progress), e.g. speed information on sign bridges.
- **WEA**: Weather Information for Travelers (in progress).
- **PTI**: Public Transport Information (in progress).
- **FPI**: Fuel Price Information
- **CAI**: Conditional Access Information

2.3.2.6 NeTEX

NeTEX is intended to be a general format capable of exchanging timetables for any mode of public transport. It includes full support for rail services and can be used to exchange UIC (International Union Of Railways) data. It is a complex and extensive standard describing statistic elements of the public transport network such as stops, stations, access areas, equipment… and also operational descriptive elements of the network, for instance, transfers.

NeTEx is based on the Transmodel standard which specifies a conceptual model for Public Transport data, extended with additional concepts for stops and stations from the CEN Technical standard IFOPT (Identification of Fixed Objects in Public Transport).

It is also intended to be a general purpose XML format designed for the efficient, updateable exchange of complex transport data among distributed systems. This allows the data to be used in modern web services architectures and to support a wide range of passenger information and operational applications.

The NeTEx schema is free to use under a GPL License and its development is managed by the CEN standards process.

2.3.2.7 Other transport data formats

GTFS – Google Transit Feed Specifications is a standard format to communicate the topography of the network and public transportation schedule.

There are other types of formats to display traffic information in a map in a web viewer. These mentioned formats are XLS, CSV, JSON, XML, WMS, WFS, DXF and so on.

There are some relevant projects that use some of these standards. Those projects are Co-Cities and City SDK Mobility (http://www.citysdk.eu).

The Co-Cities project includes a mobile application that allows in real-time, inform citizens about the most important aspects of mobility in the city (traffic, parking, public transport, etc.). Another key point of this application is citizen participation as part of the published information in the application, which will come from the obtained feedback from citizens.

Both applications publish information in Open Data.

2.3.3 Citizen engagement

This contribution to citizen engagement builds upon sections specifically dedicated to the standards in this area described somewhere else in SmartEnCity project. In particular, Deliverable D2.2, which deals with the Recommendations for Updating Standards or Generating New Ones (as in DoA). These developments are centred on the universal approach of existing citizen engagement standards, namely;

- Aarhus Convention[91] and it implementation guide[92]
- Torremolinos Charter[93],
- UN REDD+ Social and Environmental Standards and guides[94]
- ISEAL Alliance's standards[95] (credibility principles).

In this deliverable, the focus of the involvement of the people in a particular community is placed on the methodologies which will effectively enable processes like participation, consultation and so on. These standards are universally applied for general social and environmental approaches which, as a matter of fact, can also be applied for e-engagement, but rather in a methodical and operational approach with no provision of guidelines for the actual implementation of the technology in this process.

As the process of citizen involvement is thoroughly dealt with and referenced above, this section will place the focus on the ICT side of the process and its e-implementation, identifying which are the basis of the process and the existing guidelines (if not standards) for the development of adequate supporting tools for the citizen engagement process.

2.3.3.1 Principles for ICT-enabled Citizen Engagement

These principles are a guide for public agencies wishing to involve citizens in their processes using ICTs. They are based on national and international principles and refer to the involvement of "citizens" in a wide sense, including individuals, business and companies, associations and other social stakeholders.

To grade this process, the OECD[96] has developed a three level maturity model using ICT:

[91] http://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf
[92] http://www.magrama.gob.es/es/ministerio/servicios/informacion/Guia_convenio_Aarhus_2%C2%AA_tcm7-274132.pdf
[93] http://mait.camins.cat/ET2050_library/docs/landuses/policies/1983_European_Planning_Charter.pdf
[94] http://www.redd-standards.org/images/site/Documents/Guidelines/REDD_SES_Guidelines_Version_2_-_16_November_2012.pdf
[95] http://www.isealalliance.org/
[96] 1 *Promise and Problems of E-Democracy: Challenges of Online Citizen Engagement*, 2003, OECD,

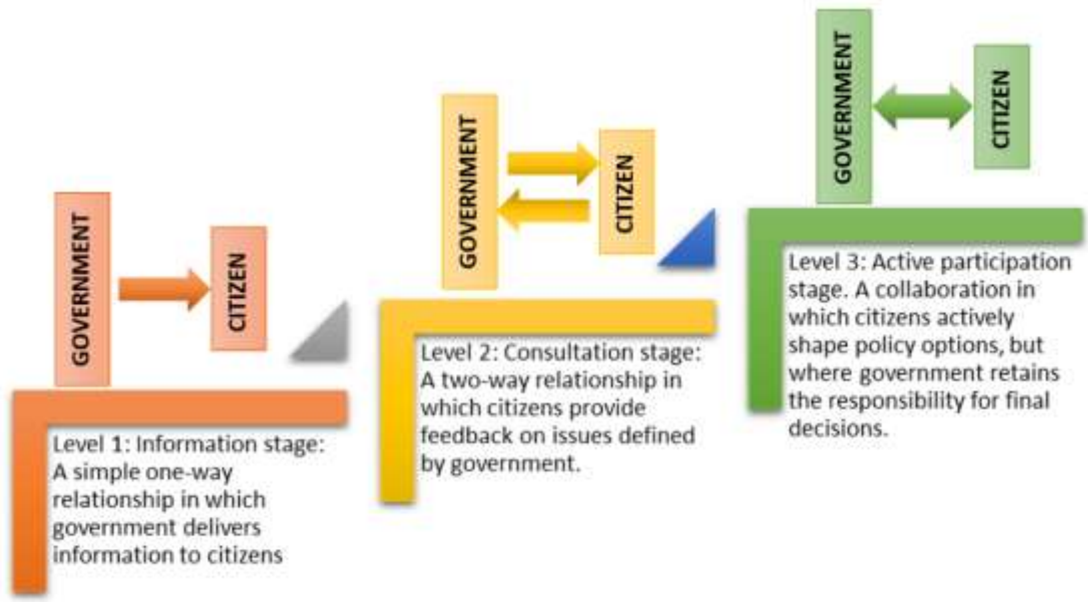


Figure 18 Three level maturity model using ICT

As ICT have the ability to increase the levels of public discussions and the potential to promote a widespread culture of democratic decision making, these principles as supporting tools for public agencies to interact with citizens using ICTs. These principles should be considered by these public bodies before entering the engagement process.

- ***Commitment:*** *Agencies committing to engagement using ICT need to ensure citizens have appropriate mechanisms to communicate and participate effectively. Commitment to engagement using ICT is strengthened through the development of partnerships between governments and citizens.*
- ***Community Focus:*** *When adopting ICT for engaging with citizens, agencies should facilitate information access, knowledge-sharing and discussion amongst participants and, through this, strengthen community consultation, participation and input into government policymaking.*
- ***Community Capability and Inclusiveness:*** *Agencies need to seek broad and diverse involvement across all sections of the community, and not exclude citizens without access to ICT or those who face other barriers. Employing methods that are accessible and/or complement traditional means of engagement will assist individuals to participate and will build their capability for contributing to policy development.*
- ***Mutual Respect, Confidence and Trust:*** *To demonstrate respect and build confidence and trust in online engagements, agencies and citizens should agree on consistent standards for communication when engaging with citizens. Agencies need to facilitate clarity of understanding and transparency of engagement processes by disseminating information, guiding participants' input and explaining how the input will be used in government decision-making. Confidence and trust between the citizens and government will be built by ensuring that engagement using ICT is a two-way and responsive process.*
- ***Interactivity and Flexibility:*** *Agencies need to promote active engagement and discussion while employing flexible and innovative ICT-enabled mechanisms to take account of participants' diversity of capability, location, and socio-economic circumstances. The 24/7 capabilities of ICT can be used to help participants inform themselves and enable them to provide considered views in their own time and space.*
- ***Responsibility and Accountability:*** *Agencies need to inform participants at the outset about how their input will be received and used in policy-making. Once a decision has been taken, agencies should indicate how citizen input through online engagement has been used. Agencies also need to be clear about who is responsible and accountable for the online engagement process and any decisions resulting from such engagement.*

- ***Security and Privacy:*** *Agencies need to implement privacy protection, information security and, where appropriate, identity authentication measures. Agencies should comply with relevant security and privacy legislation.*
- ***Evaluation and Efficiency:*** *Agencies can maximise the efficiency of online engagement through planning and effective collection, facilitation and processing of participants' input. Agencies need to evaluate the benefits of online engagement by identifying and measuring the impact of online engagement to policy-making.*

2.3.3.2 Objectives for ICT Citizen Engagement

The public administration and governing bodies engage in a process of implementing ICT solutions to involve citizens and other stakeholders driven by the needs to get closer and be recognised for producing better quality policies, to get to a higher degree of trust, and to project its share of the responsibility of the policy making process to the citizens.

These driving forces define clear objectives when trying novel ICT approaches, like the urge to reach new and wider audience, make sure enough and relevant information gets through accordingly to the defined message. In return the public body or agency will expect to open a two-way communication channel which allows seamlessly reception and evaluation of contributions with return information and the capacity to easily monitor and evaluation of the overall process.

The following figure summarises the drives and objectives for the use of ICTs in citizen involvement processes:

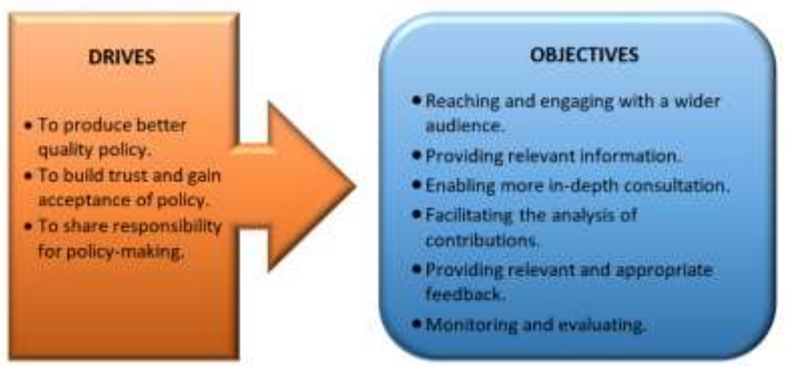


Figure 19 Drives and objectives for the use of ICTs in citizen engagement

2.3.3.3 Interoperability of ICT tools for Citizen Engagement[97]

The continuous developments in the ICT environment of new products and services claim for better and more reliable interoperability among systems. The European Union makes efforts to assure the ICT market remains open to protect consumers.

With ICT standardisation, the developers seek to define technical specifications for products and services. These are focused on the ability for systems to work together - interoperate, thus improving the European competitiveness.

This interoperability is crucial, as today, the value of a device or system depends very much on its ability to work together with other systems or devices. This is important in every area of

[97] http://ec.europa.eu/growth/sectors/digital-economy/ict-standardisation/index_en.htm

ICT. Standards are the technical specifications that assure this connectivity and networking capability is possible.

In this line, the European Commission plays a key role supporting the work of three European standardisation organisations;

- ETSI – the European Telecommunications Standards Institute[98];
- CEN – the European Committee for Standardization[99];
- CENELEC – the European Committee for Electrotechnical Standardization[100].

Also, the research and development projects funded by the different European programmes are requested to facilitate their results to the standardisation work of these organisations.

2.3.3.3.1 European Multi Stakeholder Platform on ICT Standardisation[101]

The platform was set to advise The Commission on standardisation policies on ICTs, legislation and policies, and identification of other standards developed by international ICT Standardisation organizations.

The main issues the Platform deals with are;

- potential future ICT standardisation needs in support of European legislation, policies and public procurement;
- technical specifications for public procurements, developed by global ICT standards-developing organisations;
- cooperation between ICT standards-setting organisations;
- the Rolling Plan[102], which provides a multi-annual overview of the needs for preliminary or complementary ICT standardisation activities in support of the EU policy activities.

There are a set of well define criteria[103] specifications need to meet in order to be considered for reference; Market acceptance, coherence, openness, consensus, transparency, maintenance, availability, IPR, relevance, neutrality and stability, quality.

[98] ETSI – the European Telecommunications Standards Institute
[99] CEN – the European Committee for Standardization
[100] CENELEC – the European Committee for Electrotechnical Standardization.
[101] https://ec.europa.eu/digital-single-market/european-multi-stakeholder-platform-ict-standardisation
[102] https://ec.europa.eu/digital-single-market/en/rolling-plan-ict-standardisation
[103] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:316:0012:0033:EN:PDFç

3 Review of Smart City projects and initiatives

The goal of this section is first to identify and finally to analyse the most relevant projects and initiatives carried out at European level regarding Smart Cities. This includes publicly funded projects, e.g. in different EU programmes like FP7 or Horizon 2020, as well as individual initiatives launched by the private sector or specific municipalities.

There is a general agreement that the primary objective of Smart Cities is the achievement of the 2020 energy targets[104] (to reduce greenhouse gas emissions by 20%, to increase the share of renewable energy to 20% and to make a 20% improvement in energy efficiency). At this respect, the challenge is to offer a wide range of community and citizen based services, through business and governance and where ICT has a key role in replacing physical resources with digital ones and thus contributing to a more carbon neutral society[105] aiming at developing thriving industries founded on technological innovation.

In that sense, Smart cities developments are included in the Energy European Union Strategy being considered in the “Integrated SET Plan”[106] , the “Strategic Transport Research and Innovation agenda”[107] and in the current “Energy Union Integrated Strategy on Research, Innovation and Competitiveness” initiative[108].

In terms of ICT applied to the built environment the efforts rely on bringing together stakeholders and organizations including for instance, relevant trade organisations such as eu.bac[109], the German DIN DKE[110] and emerging networks such as Covenant of Mayors. Nevertheless, the role of the telecoms industry in the smart cities is addressed to continue developing bandwidth, to ensure ubiquitous service provision, to contribute to the development of service oriented architecture (SOA) solutions, and supporting modular collaborative management approaches.

This deliverable´s section specifically collects the main previous Smart City innovative and projects related to frameworks and architectures on Internet of things, city modelling, energy and mobility verticals and/or application architecture that have been addressed in other previous Smart City projects as the baseline for further development of the City Information Open Platform (CIOP) that will be carried out in SmartEnCity.

3.1 Identification of Smart City projects

3.1.1 List of Smart City projects and related programmes

Currently, there are several programmes that consider Projects in the Smart City field. However, projects attached next just refers to those that specifically will be taking into

[104] http://ec.europa.eu/energy/strategies/2010/2020_en.htm
[105] http://ec.europa.eu/information_society/activities/sustainable_growth/docs/smart-cities/smart-cities-adv-group_report.pdf
[106] https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_ACT_part1_v8_0.pdf
[107] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0501:FIN:en:PDF
[108] http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_rtd_001_energy_union_research_strategy_en.pdf
[109] European Building Automation and Controls Association (eu.bac). www.eubac.org
[110] The DKE is the German organization responsible for the elaboration of standards and safety specifications covering the areas of electrical engineering, electronics and information technology. http://www.dke.de

consideration for the development of the City Information Open Platform (CIOP) in Smart en City.

The following list has been made with the information of the projects in proposal phase but there have been added some new ones that are still under proposal and for which there is not yet much information available.

1. **H2020:**

- **SCC2014/2015.**

Projects funded under the last SCC-01-2014 call: Smart Cities and Communities solutions integrate energy, transport, ICT sectors through lighthouse (large scale demonstration-first of the kind) projects. Projects funded under the topic EU 3.3.1.3. Foster European Smart Cities and Communities, and linked with SmartEnCity Platform development will be:

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
REPLICATE	REnaissance of Places with Innovative Citizenship and Technology	Developing and implementing "Smart" measures to improve energy efficiency and mobility through innovation and ICT. Special focus on ICT innovation in Bristol demonstrator.
SHAR-LLM	Sharing Cities.	Adopt a digital first approach which proves the extent to which ICT integration can improve and connect up existing infrastructure, as well as the design and running of new city infrastructure. This will also allow for the creation of a new set of next stage digital services which will help citizens make better and beneficial choices around energy efficiency and mobility, which when scaled up will enhance the city's ability to hit key targets for mobility, housing, energy efficiency and resilience, and economic development.
SMARTER TOGETHER	Smart and Inclusive Solutions for a Better Life in Urban Districts.	5 clusters of co-created, smart and integrated solutions: (1) Living labs for citizen engagement, (2) District heating and RES for low energy districts, (3) Holistic refurbishment for low energy districts addressing public and private housing, (4) Smart Data management platform and smart services (5) E-mobility solutions for sustainable mobility. Expected results regarding ICT are: 1400 created jobs, 130 M€ investments, all deployed with support of integrated ICT solutions and in dialogue with the inhabitants.
ESPRESSO	Systemic standardization approach to empower smart cities and communities.	Development of a conceptual Smart City Information Framework based on open standards. This framework will consist of a Smart City platform (the "Smart City enterprise application") and a number of data provision and processing services to integrate relevant data, workflows, and processes.
CITYKEYS	Smart City performance measurement system.	Develop and validate, with the aid of cities, key performance indicators and data collection procedures for the common and transparent monitoring as well as the comparability of smart city solutions across European cities.
REMOURBAN:	REgeneration	Energy, transport and information and communication technologies (ICT) are key to achieve economical and societal

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
	Model for accelerating the smart URBAN transformation.	benefits and improve citizens' quality of life. They also represent most of the interrelations between people and technology. A big challenge to offer new interdisciplinary opportunities to make cities smarter is already open in the common area where energy production, distribution and use, mobility and transport, ICT work together and are intimately linked. REMOURBAN will implement large scale interventions and intense dissemination initiatives to demonstrate the potential of the urban regeneration model in the energy, mobility and ICT sectors.
GrowSmarter.	Transforming cities for a smart sustainable Europe	Open data platforms can help cities collect and analyse data patterns for essential city activities such as traffic management, communications and infrastructure. This information can then be fed into informed decisions about future investments. Key performance indicators will allow the cities to monitor their overall environmental performance on an ongoing basis. Under this solution a number of sub-solutions will be implemented. To find out in which Lighthouse City they will be implemented the industry partners involved and detailed factsheets.
TRIANGULUM	Demonstrate – Disseminate – Replicate	An exceptional feature of the project is the ICT architecture and smart city framework that will be developed in the flagship cities and rolled out in the follower cities. A modular approach will enable flexible (business) solutions that address individual challenges and requirements of our cities and their stakeholders.
SCIS	Smart Cities Information System	Encompasses data collected from ongoing and future projects under the CONCERTO initiative and Smart Cities calls in Horizon 2020. With a focus on smart cities, energy efficiency, transport and mobility, and ICT, SCIS showcases solutions in the fields of sustainable building and district development, renewable energy sources for cities, energy efficiency and low-carbon technology applications.

- **SCC2016/2017.**

This topic addresses projects for demonstrating innovative nature-based solutions in cities. This call will fund projects in Horizon 2020 that will address renaturing city light house projects. Between challenges to be addressed within the final projects selected it is specifically mentioned the development of ICT and innovative communication strategies and tools securing open access and interoperability along data infrastructures and a continuous building up of the 'knowledge portfolio' through future activities under Horizon 2020 and beyond.

Hence, projects funded under this topic will be also monitored in order to establish relation between SmartEnCity and those, and particularly for ICT and innovative communication tools.

2. FP7.

Even though Smart City Projects did not have an specific call within FP7, some projects already addressed base of knowledge for current developments on LightHouse projects. Some examples, and directly linked with SmartEnCity Platform developments are selected next.

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
FASUDIR	Friendly and Affordable Sustainable Urban Districts Retrofitting	It will design and integrate an Integrated Decision Support Tool to select and priories energy efficiency retrofitting interventions in urban districts. Implementation tool tasks of existing and new cost-effective solutions that will be carried out in the project, will be taking into consideration for SmartEnCity.
ZenN	Nearly Zero Energy Neighborhoods	It will validate innovative Zero energy building renovation processes in five different demonstration neighborhoods. Project results and the identification of key success factors for replicability (technical, financial, social aspects, process and duration) that will be carried out in the project, will serve to explore replicability and collection of best practices in this field that will be integrated in SmartEnCity.
PITAGORAS	Sustainable urban Planning with Innovative and low energy Thermal And power Generation from Residual And renewable Sources	In this project, there will be carried out the demonstration of a highly replicable, cost effective and high energy efficiency large scale energy generation systems that will allow sustainable urban planning of very low energy city districts. Particularly, innovative tools for efficient energy management of the system will be developed that will be considered also for the development of the City Information Open Platform (CIOP).
BaaS	Building as a Service (Ecosystem)	Bass system aims to optimize energy performance in the application domain of non-residential buildings”, in operational stage, and a generic ICT-enabled system will be developed to provide integrated assess, predict and optimize services to guarantee harmonious and parsimonious use of valuable resource. Main outcomes will serve also for CIOP´s development.
MOVESMART	Rapid route planning for energy efficient and personalized mobility	Rapid route planning for energy efficient and personalized mobility. It will addressed the problem of providing time-dependent route planning profiles in large-scale urban traffic networks by integrating the use of public transport, supporting electro-mobility and car-sharing/-pooling, exploiting an extensive ad hoc traffic monitoring infrastructure and a traffic prediction mechanism for foreseen future incidents, based on a novel crowd sourcing platform.
MOVEUS	ICT cloud-based platform and mobility services available, universal and safe for all users	This project will integrate, in a cloud-computing environment, different transport and traffic management components and future internet technologies which are able to capture, store and elaborate a relevant and heterogeneous quantity of mobility and energy assessment data.
CELSIUS	Combined Efficient Large Scale Integrated Urban Systems	It will develop a decentralized energy and district heating and cooling networks and utilizing energy more efficiently. A platform of networking and knowledge, CELSIUS takes a holistic approach to overcome technical, social, financial and political barriers to district heating and cooling solutions. The CELSIUS Toolbox/ wiki was launched on 22 March 2016 as a decentralized and multidimensional knowledge base including technologies, methodologies, tools and examples as the

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
		technical element. Specific tools, will be also considered for WP6 development in SmartEnCity.
INDICATE	Indicator-based Interactive Decision Support and Information Exchange Platform for Smart Cities	The project addresses a market analysis in ICT software for urban planning that will be considered in this project.
UrbanAPI	Interactive Analysis, Simulation and Visualization Tools for Urban Agile Policy Implementation	In this project, Information and Communication Technology (ICT) will provide urban planners with new tools to actively plan and manage urban environment. These developments will be linked with urban environment.
SmartKYE	Smart Grid Key Neighbourhood Indicator Cockpit	SmartKYE proposes the development of an advanced, integrated, management system which enables energy efficiency in neighbourhoods from a holistic perspective. (A common Service Oriented Architecture, Information Models and Interfaces; an Open Energy Services Platform Integration with the different Energy Management Systems; a Business oriented Cockpit; a Monitoring and Control oriented Cockpit; large Demonstration in two scenarios).
COOPERATE	Control & Optimization for Energy Positive Neighbourhoods	The goal is to utilize the power and flexibility of distributed computing to integrate diverse local monitoring & control systems to achieve energy services at a neighborhood scale. The premise is “that by allowing for inter- operability at the data level & by leveraging existing cloud solutions via common communication one can produce a loosely coupled integrated solution that goes beyond the current state of the art & which is likely to be adopted given an existing hybrid-cloud landscape”. The project aims to demonstrate the impact & benefits of ICT to improve the energy management of a neighbourhood, & their environmental performance through an online Neighbourhood Management System
DIMMER	Open Platform for teal-time data processing and visualization at district level	The DIMMER system integrates BIM and district level 3D models with real-time data from sensors and user feedback to analyze and correlate buildings utilization and provide real-time feedback about energy-related behaviors. It allows open access with personal devices and Augmented Reality (A/R) visualization of energy-related information to client applications for energy and cost-analysis, tariff planning and evaluation, failure identification and maintenance, energy information sharing.
Open cities	Open cities	The project aims to validate how to approach Open & User Driven Innovation methodologies to the Public Sector in a scenario of Future Internet Services for Smart Cities. It will do so, by leveraging existing tools, trials and platforms in Crowdsourcing, Open Data, Fiber to the Home and Open Sensor

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
		Networks in seven major European cities.
Entranze	Policies to Enforce the TRAnsition to Nearly Zero Energy buildings in the EU-27	The objective of the ENTRANZE project is to actively support policy making by providing the required data, analysis and guidelines to achieve a fast and strong penetration of nZEB and RES-H/C within the existing national building stocks.
PEOPLE	Smart Cities for Smart Innovation	The project aims at speeding up the uptake of smart cities through the rapid implementation, deployment and uptake of innovative internet-based services in order to allow facing the main challenges of developed cities at present and towards their future quality of life. This will be enabled by designing and implementing user-driven open innovation methodologies and processes. For these purposes, four pilot Smart Open Innovation Urban Ecosystems were created to become seeds towards sustainable smart cities based on ICT services for the people to live better at.

3. CIP – IEE.

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
MESHARTILITY	Access to local energy data	Measure and share data with utilities for the Covenant of Mayors. It aims at developing solutions and tools to help cities (signatories of Covenant of Majors) in the development of their Sustainable Energy Action Plans.
NAVIKI	Energy Efficiency through Web 2.1. Bicycle Navigation and Communication.	The Naviki project will implement a Europe-wide Internet platform for navigation, communication and planning in the field of cycling. This new webportal offers many functions that make cycling even more attractive and thus helps contributing to energy saving and eco-friendliness: With the aid of a tailor-made Service (Naviki Landingpage), local authorities, tourism organisations and other stakeholders gain many benefits

4. CIP – ICT PSP.

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
ICT4EVEU	ICT services for electric vehicles	Service for Electronic Vehicle Enhancing the User Experience. It is related to WP6 development in the deployment of an innovative set of ICT services for electric vehicles in different and complementary pilots across Europe.
BEST Energy	Built Environment Sustainability and Technology in Energy	Built Environment Sustainability and Technology in Energy. The improvement in energy-efficiency in public buildings and street public lighting will be done using ICT based centralized monitoring and management of the energy consumption and production, and providing to decision markers the necessary tools to be able to plan energy saving measures. Outcomes of the project will be also lined with Project´s Platform.

5. ARTEMIS.

It is a JTI that aims to help European industry consolidate and reinforce its world leadership in embedded computing technologies. Projects such as ARTEMIS will be considered for SmartEnCity Platform development.

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
ARROWHEAD	Ahead of the future	The project will be linked with SmartEnCity´s Platform in the developments carried out for the service interoperability enabling collaborative automation considered.

6. CIVITAS.

Demonstration projects seeking to drive innovative policies and technologies needed for the transformation towards cleaner and better urban mobility and transport following a user oriented approach. Main projects related to SmartEnCity are shown next.

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
DYN@MO	DYNamic citizens @ctive for sustainable MObility	Information and communication technologies (ICT) together with intelligent transport systems (ITS) will be used throughout the project to improve service quality of public transport such as communication and maintenance of transport systems. This will also provide support for preparing, discussing and updating sustainable urban mobility plans, involving stakeholders and citizens in related processes.
2MOVE2	New forms of sustainable urban transport and mobility	Deployment of ICT and ITS for traffic management, vehicle guidance, accident avoidance, passenger information and travel planning, road pricing and smart payment systems.
MIMOSA	Making Innovation in Mobility and Sustainable Actions	Innovative telematics systems were installed to improve safety and security conditions. Furthermore, technological solutions were sought to optimize passenger and goods traffic management. Smart Apps for Smarter Travel looks at different means of citizen engagement using digital and social media and smart apps. A database has been created which lists examples of these such as crowdsourcing, data sharing, app development competitions and new apps which are being created to promote smarter travel.
MODERN	Mobility, Development and Energy use ReductioN	Diverse solutions were adopted for the integrated ticketing systems, from single contactless mobility cards for accessing all the mobility services available, to e-ticketing systems installed on buses and trams for connecting the vehicles to a central dispatch system for data collection and processing. Within each city the solutions are very promising and produced relevant results so as to become in the future real best practices in Europe.

7. LIFE.

LIFE is the EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU. Some projects also addresses actions for climate challenges in urban environments that are related to SmartEnCity projects such as:

ACRONYM	TITLE	KEY ASPECTS FOR SmartEnCity CIOP
IRRIGESTLIFE	Smart irrigation system	Life Programme (2007-2013). Telemanagement network using free controllers connected to a GIS for an optimized irrigation in Vitora-Gasteiz.
LIFE GYM	Life GreenYourMove	Life Programme (2014-2020) Development and promotion of a co-modal journey planning platform to minimize GHG emission in Europe. Duration: 2015-2018.

8. COST IC903.

COST is a European Programme where researchers, engineers and scholars develop their own ideas and new initiatives across all fields of science and technology through trans-European networking of nationally funded research activities. Particularly, there are some projects that could also feed to SmartEnCity. That is the case of KDMO (COST IC903): Knowledge Discovery from Moving Objects, project that developed a methodology for measuring urban mobility and developing urban mobility indicators from mobile phone use dataset and questionnaires.

3.1.2 List of Smart City initiatives

At European and regional level, there are several initiatives oriented to contribute to sustainable cities as a whole, towards an ICT infrastructure for energy efficient buildings and carbon-neutral neighbourhoods. The **City Protocol** approved in 2012[111] is a collaborative innovation framework that fosters city-centric solutions which benefit citizens and their quality of life. It aims at working across diverse cities by interconnecting them and ultimate creating the "Internet of Cities". At this moment it is composed by 40 countries, 80 organizations, 12 city projects and 350 experts. It is organized in different Task forces. For instance, the Building Information Model for Cities Task Team aims at developing a data model that could be used:

- by local authorities to know the global surface of the built environment
- by ESCOs to identify the districts / areas / buildings where it is more useful to carry out refurbishment works depending on the state of the buildings, age and energy efficiency conditions
- by local authorities in order to assess and improve the equipment of each district

The definition and share of common data by the different city stakeholders through this BIM would allow them to obtain quality data from a common repository, which would be updated and curated by all the stakeholders. The stakeholders could reuse the data to deploy new services based on this set of coherent data. Also the costs of the data access would be shared by all stakeholders. On the other hand, the Open Sensor Platform Task Team is

[111] http://cityprotocol.org/the-task-force/work-teams/

interested in the integration of all the information collected by the sensors deployed in a city. It will be a basic point when working to break the traditional silos in which the solutions of the cities are built and it means enhancing efficiency in its management. In a horizontal platform, all the vertical solutions can be integrated so that all the data about the city that comes from sensors can be collected by the same platform regardless of where it comes from.

EIP of Smart Cities and Communities[112] is structured on 6 Action Clusters that organise a market place of 4700 partners from 31 countries. Each specific focus activities are: (i) Sustainable Districts and Built Environment, (ii) Sustainable Urban Mobility, (iii) Integrated Infrastructure & Processes, business models, (iv) finance and procurement, (v) citizen focus and (iv) policy & regulations integrated planning. Particularly, within the Integrated Infrastructure & Processes Cluster, last May 2015 a Memorandum of Understanding[113] (MoU) titled “Towards Open Urban Platforms for Smart Cities and Communities” was launched and signed by 38 entities aiming at accelerating smart cities market penetration, ensuring open dialogue between industry, cities and communities, and developing the Urban Platform market by creating competition for supply side and confidence for demand side. It covers three main inter-dependent urban platform initiatives that cover; Demand side Management (covering status and needs assessment of cities), Supply Side MoU (committing to open common reference architecture for UP solutions) and Standards[114].

Moreover, in different member states there are also light house initiatives important to be mentioned, particularly, in Spain, the **RECI**[115] (Spanish network of Smart cities) organize conferences and forums for researchers, companies, entrepreneurs as well as citizens about actions and measures to carry out to move a step forward on Smart cities at national level. Public and private cooperation is a key element to perform innovation projects into real ones, and for that cities can act as motor to boost this cooperation and transform Smart cities communities from living labs to new business opportunities providing citizens with innovative services. At this moment, the RECI is composed by 65 municipalities and is organized in different Task forces. Some of the relevant working groups are:

- **Energy:** The themes developed within this task force involve information, learning and dissemination in the frame of the energy efficiency. On the other hand, municipality facilities are included, such as smart space buildings, public lighting efficiency and RES integration.
- **Urban mobility:** The themes developed in this group include electric mobility and transport intelligent systems.
- **Social innovation:** Some of the topics developed in this area are accessibility, e-participation, tele-assistance, open government and opendata.

There are also a growing number of initiatives leveraged by municipalities, such as **Barcelona (BCN) Smart City**[116], which is a new concept defining a city that works to improve the quality of its citizens' lives by guaranteeing sustainable social, economic and urban development. A smart city is based on the use and modernisation of new information and communication technologies (ICT) to provide more efficient management of the city's

[112] https://eu-smartcities.eu/
[113] https://eu.smartcities.eu/sites/all/files/Memorandum%20of%20Understanding%20on%20Urban%20Platforms_0.pdf
[114] https://eu-smartcities.eu/sites/all/files/Urban%20Platform%20EIP%2010-11%20event%20briefing%20%28v03%29%20%281%29.pdf
[115] http://www.redciudadesinteligentes.es/
[116] http://smartcity.bcn.cat/en/

services and resources. In this regard, the initiative supports an urban transformation programme, which is the municipality system for compiling the information it receives from different sources, and then processing and treating it in order to provide an effective, smart response for the city's services and to offer this information to businesses and companies that need it, so that they can develop new products and/or services that make people's lives easier. Within the urban transformation programme the City OS[117] technological platform of services and solutions was created. The technological platform was set up to help Barcelona City Council take decisions in real time, in order to meet the needs of governing the city and improve the quality of life of its citizens. It has the capacity to acquire and process information on the running of the city quickly, effectively, efficiently and in a sustainable manner. It has smart systems that allow it to analyse and relate events so it can produce simulations and anticipate any problem that might affect the city (including emergency situations). Some of the City OS objectives are to:

- Integrate and correlate city data (sensorisation elements, municipal and non-municipal system databases and social media network data) and transform them into information
- Guarantee the quality of the information stored and security in accessing it
- Enable knowledge of the different services offered by Barcelona to be handled both horizontally (between services) and vertically (to a global supervision centre)
- Enable the data to be analysed and predictions to be made based on the data stored
- Run simulations of potential city situations
- Enable event behaviour patterns to be established
- Enable the integration of the services and production platforms through technological architecture
- Serve as a basis or model for future city platforms

3.1.3 Selection of relevant projects and initiatives

The analysis carried out in the previous two points yields a significant number of projects, which are filtered in current subsection in order to provide a manageable list (around 10-15 projects) of most relevant ones in order to proceed with a more detailed analysis in view of the objectives which are foreseen in SmartEnCity.

Regarding the precedent research, a selection of projects according to several criteria: smart cities ICT focus, similitude with work to be done in WP6, open data platform implementation, etc.

[117] http://smartcity.bcn.cat/en/city-os.html

SmartKYE

SmartKYE, Smart grid KEY neighbourhood indicator cockpit	
Programme	FP7
Coordinator	ETRA I+D
Duration	30 months (October 2012 - March 2015)
Budget	3.127.874€
Web page	http://smartkye.eu/
Figure	 **Figure 20: SmartKYE Open Energy Service Platform scheme**
General overview and objectives	The SmartKYE project proposes the development of an advanced, integrated, management system which enables energy efficiency in neighbourhoods from a holistic perspective. To that end, the Energy Management Systems (EMS) deployed in a typical district that is consuming or producing energy, and which nowadays normally count with an isolated ICT management solution, will be able to share data and services through and open platform among themselves and to external third party applications. This enables the design and development of higher level applications (SmartKYE cockpits) that are able to process real-time data and generate valuable analytics to affect the business and Monitoring and Control strategies that operate a district (or a subset of the energy services deployed). The deployment of the open platform proposed by SmartKYE provide a more granular and accurate tool to respond to emergency situations without actually interrupting the service. In this way, to avoid an overload, the grid operator could request to reduce the consumption from public lighting, or electric vehicle points of charge; it could request the generation of energy in the case of facilities with their own generators, or the access to previously stored energy, etc. On the other hand, the more granular solution proposed by SmartKYE also enables a finer control of different Qualities of Service managed by ESCOs. SmartKYE targets specifically public authorities responsible of a number of public services demanding energy. These services can be run by ESCOs (as it is the case for most electric vehicle sharing systems) or directly by the local authority. In any case, it is the responsibility of the district operator to grant the efficiency (also from the energy point of view) of such public services. Thus, the SmartKYE cockpits will offer public authorities with a high level view of the energy and business processes on going in a neighbourhood.

Table 4: Main data (SmartKYE European Project, 2015)

COOPERATE

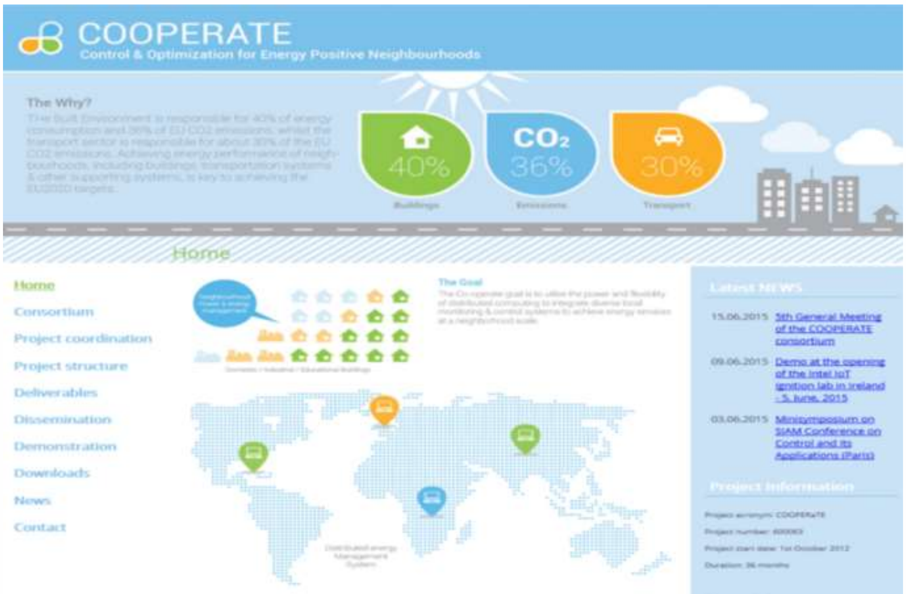
COOPERATE, Control and Optimisation for Energy Positive Neighbourhoods	
Programme	FP7
Coordinator	RWTH Aachen University
Duration	36 months (October 2012 – October 2015)
Budget	5,8M€
Web page	http://www.cooperate-fp7.eu/
Figure	 **Figure 21: COOPERATE webpage**
General overview and objectives	Demonstrate the impact and benefits of ICTs to improve the energy management of a neighbourhood, and their environmental performances through an online Neighbourhood Management System, helping people to optimise their energy consumption while keeping them connected into a new concept of local community. The goal is to utilise the power and flexibility of distributed computing to integrate diverse local monitoring & control systems to achieve energy services at a neighbourhood scale, by allowing for interoperability at the data level & by leveraging existing cloud solutions via common communication one can produce a loosely coupled integrated solution which is likely to be adopted. Substantial validation of the project objectives in two demo sites, in order to demonstrate how the proposed platform and services move the two neighbourhoods towards energy positivity. Reduction in energy consumption and in CO2 emissions through local generation, in the order of 10% - 15% within both of the test sites. Regarding scientific, Economic & Societal impact, the project targets barriers to adoption, hence impact, and demonstrates the benefit of ICT in improving energy & environmental performance at the neighbourhood levels.

Table 5: Main data (COOPERATE European Project, 2015)

DIMMER

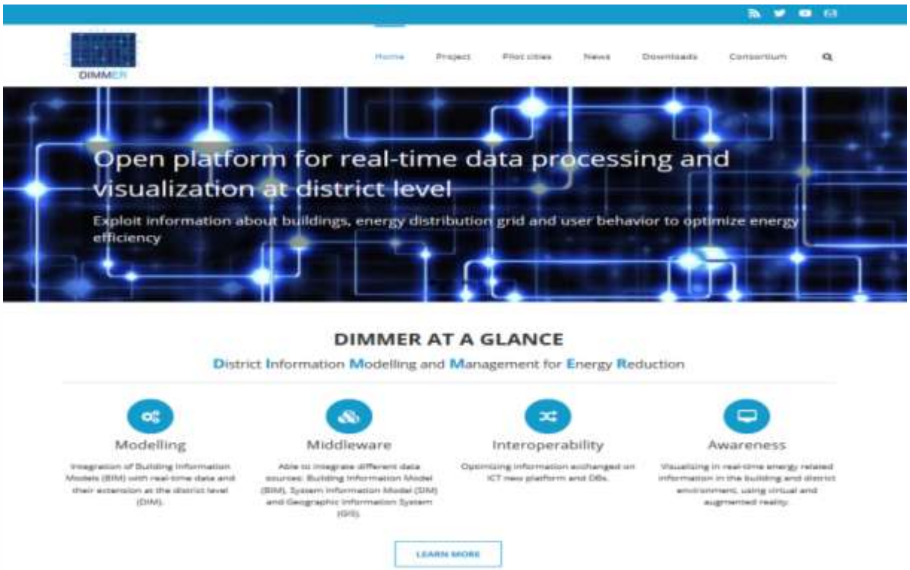
DIMMER, District Information Modelling and Management for Energy Reduction	
Programme	FP7
Coordinator	Politecnico di Torino
Duration	36 months (October 2013 – October 2016)
Budget	5.740.560€
Web page	http://dimmer.polito.it/
Figure	 **Figure 22: DIMMER webpage**
General overview and objectives	Integration of Building Information Models (BIM) and district level 3D models (DIM) with real-time data from sensors and user feedback to analyse and correlate buildings utilization and provide real-time feedback about energy-related behaviours. Open access with personal devices and Augmented Reality (AR) visualization of energy-related information to client applications for energy and cost-analysis, tariff planning and evaluation, failure identification and maintenance, and energy information sharing. In order to validate the DIMMER innovative system, both public (university campuses, schools) and private buildings included in mixed-up (mixité) urban districts are considered in two different cities, in the North and South Europe, Turin (IT) and Manchester (UK). As most energy usage of buildings throughout their life cycle is during the operational stage (80%), the project gives special attention to existing and historical buildings The expected results are a consistent reduction in both energy consumption and CO_2 emissions by enabling more efficient energy distribution policies, according to the real characteristics of district buildings and inhabitants as well as a more efficient use and maintenance of the energy distribution network, based on social behaviour and users attitudes and demand.

Table 6: Main data (DIMMER European Project, 2016)

TRIANGULUM

TRIANGULUM, Demonstrate·Disseminate·Replicate	
Programme	H2020
Coordinator	Fraunhofer Institute for Industrial Engineering IAO
Duration	60 months (February 2015 – January 2020)
Budget	29.621.430,98€
Web page	http://triangulum-project.eu/
Figure	 **Figure 23: TRIANGULUM**
General overview and objectives	The three point project Triangulum is one of the three European Smart Cities and Communities Lighthouse Projects, set to *demonstrate, disseminate* and *replicate* solutions and frameworks for Europe's future smart cites. The flagships cities Manchester (UK), Eindhoven (NL) and Stavanger (NO) will serve as a testbed for innovative projects focusing on sustainable mobility, energy, ICT and business opportunities. An exceptional feature of the project is the ICT architecture and smart city framework that will be developed in the flagship cities and rolled out in the follower cities. A modular approach will enable flexible (business) solutions that address individual challenges and requirements of our cities and their stakeholders. Several districts will be transformed into sustainable living environments during the course of the project. Actuations about smart mobility (electric vehicles, recharging infrastructures…), about building renovation, about autonomous energy grid and about information exchange will be held out. Citizen engagement and dissemination will be key aspects as well in order to favor replication in follower cities and other cities of smart city framework.

Table 7: Main data (TRIANGULUM European Project, 2016)

MOVESMART

MOVESMART, Renewable Mobility Services in Smart Cities	
Programme	FP7
Coordinator	Ayuntamiento de Vitoria – Gasteiz / Vitoria – Gasteizko Udala
Duration	36 months (November 2013 – October 2016)
Budget	3.205.583€
Web page	http://www.movesmartfp7.eu/
Figure	 **Figure 24: MOVESMART Innovative Route Planner**
General overview and objectives	MOVESMART aims at providing time-dependent route planning and renewable personal mobility services using a set of crowd-sourcing tools for collecting real-time information by multimodal travelers. The core of MOVESMART is a hierarchical urban-traffic infrastructure that is hosted and maintained by a cloud architecture. MOVESMART envisions the server-based creation and maintenance of time-dependent urban-traffic metadata as well as live-traffic logging, hosted in an urban traffic knowledge base (UTKB). MOVESMART addresses the problem of providing time-dependent route planning profiles in large-scale urban traffic networks by integrating the use of public transport, supporting electro-mobility and car-sharing/-pooling, exploiting an extensive ad hoc traffic monitoring infrastructure and a traffic prediction mechanism for foreseen future incidents, based on a novel crowd sourcing platform. This exploitation of fixed and ad hoc sources of real time traffic sensing information provides proper alerts for emergent (either reported, or predicted) incidents to the involved end users and appropriate contingency plans for the predicted/reported disruptions.

Table 8: Main data (MOVESMART European Project, 2016)

CITYkeys

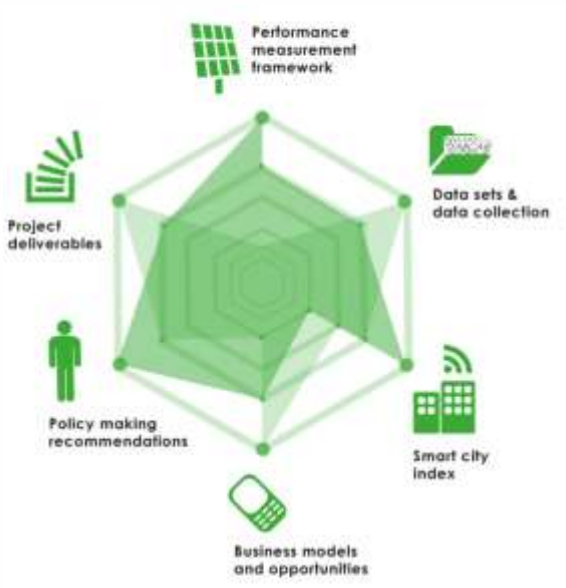
CITYkeys	
Programme	H2020
Coordinator	VTT
Duration	24 months (February 2015 – January 2017)
Budget	962.846,25€
Web page	http://www.citykeys-project.eu/
Figure	 **Figure 25: CITYkeys main structure**
General overview and objectives	The mission of CITYkeys is to develop, and validate, a holistic performance measurement framework for future harmonized and transparent monitoring and comparability of the European cities activities during the implementation of Smart City solutions. The work methodology will be based on the following key factors: • Extensive collaboration and communication with European cities • Establish a baseline by analysis and integration of existing results from previous initiatives • Develop a set of Key Performance Indicators (KPIs) specific for Smart Cities initiatives evaluation and comparability Smart solutions for transparent and open data collection and processing The tangible objectives of the CITYkeys project are to: 1) Develop and validate a transparent performance evaluation framework: including KPIs definition, guidelines for data collections, performance system prototype and testing in case-cities 2) Develop recommendations for the implementation of the performance system into the cities decision-making process and recommendations for the development of new business 3) Engage stakeholders in identifying and exploiting opportunities for synergy and replicability; and establish a collaboration platform for European cities

Table 9: Main data (CITYkeys European Project, 2016)

Open cities

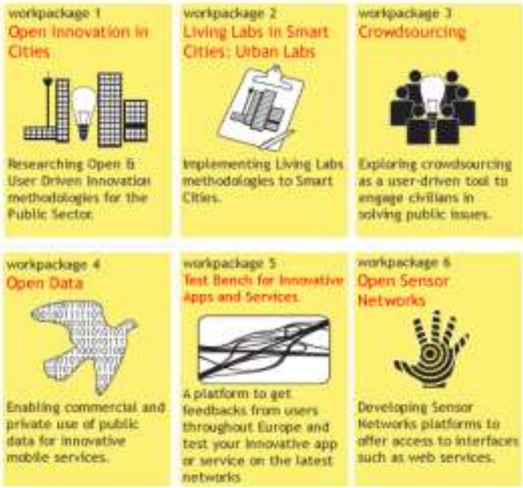
Open cities	
Programme	FP7
Coordinator	ESADE
Duration	30 months (February 2011 – July 2013)
Budget	
Web page	http://opencities.net/
Figure	 **Figure 26: Open Cities structure**
General overview and objectives	Open Cities aims to advance our understanding on Open innovation management in the public sector by conducting experimental driven research in real life settings around Future Internet services for Smart Cities. In order to accomplish this objective, on-line platforms and repositories should be built and advance Future Internet services should be put in place, so their dynamics, limits, adequacy and best practices could be distilled and inferred. Therefore the four main objectives of Open Cities could be further broken down in concrete sub-objectives that refer to the specific areas that the project addresses. Cities will learn how to integrate Open Innovation methodologies in their fabric and users will benefit from pilots on Future Internet services around Augmented Reality in mobile devices as a result of the project. The aim is that the project could help in jump-start a dynamic of private and public-private provide services triggered by opening common resources such as Data, Platforms and Networks. Open Innovation Intermediaries use ad-hoc collaborative web 2.0 platforms for Crowdsourcing, Competitions or as way to broadcast and gather challenges and ideas. A porting of these platforms will be used in the project. Also the project will deliver a pan-European Open Data repository implemented in the participant cities and a platform interconnecting Sensor Data coming from fix and mobile sensors with Open services. The project will provide three different types of contributions: a) New understandings on how to approach Open Innovation from the Public Sector and especially towards Smart Cities, b) Functioning platforms for Open Data and Open Networks encompassing several important cities in Europe and c) Actual Future Internet Services provided by developers using this platforms.

Table 10: Main data (Open Cities European Project, 2013)

Entranze

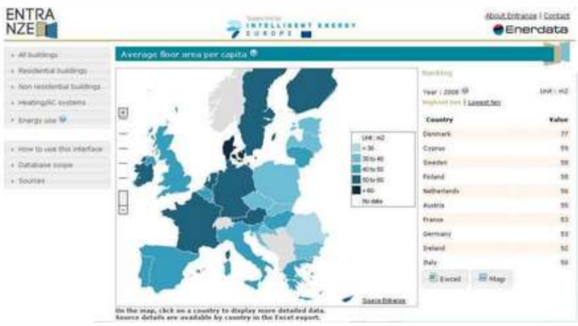
Entranze, Policies to Enforce the TRAnsition to Nearly Zero Energy buildings in the EU-27	
Programme	FP7
Coordinator	Energy Economics Group from the Vienna University of Technology
Duration	30 months (April 2012 – September 2014)
Budget	
Web page	
Figure	 **Figure 27: Entranze Data Tool**
General overview and objectives	The objective of the ENTRANZE project was to actively support policy making by providing the required data, analysis and guidelines to achieve a fast and strong penetration of nZEB and RES-H/C within the existing national building stocks. The project intended to connect building experts from European research and academia to national decision makers and key stakeholders with a view to build ambitious, but reality proof, policies and roadmaps. **Content** The project allowed for evidence based policy making by providing • An online data mapping tool allowing user friendly access to building data, energy demand indicators and scenario results; • Analyses regarding cost-optimal levels of NZEB; • An overview of principle integrated policy sets that aim at the NZEB standard; • Model-based scenarios up to 2030 (for different policy settings built on the discussions with policy makers); • International comparative policy analyses. Dissemination activities have transferred results to other countries and the EU-level. **Benefits** Policy makers and other key stakeholders • Gained a deep understanding of the impact of policy instruments for supporting deep renovation and RES-H/C increases and their specific design (detailed elements of policy implementations have been elaborated); • Got accesses to a broad set of data relevant for decision making. This provides transparency and assures confidence in the long-term perspective of this sector; • Were strongly involved in the process, and in in-depth discussion; • Learnt from the experience in other countries.

Table 11: Main data (Entranze European Project, 2014)

PEOPLE

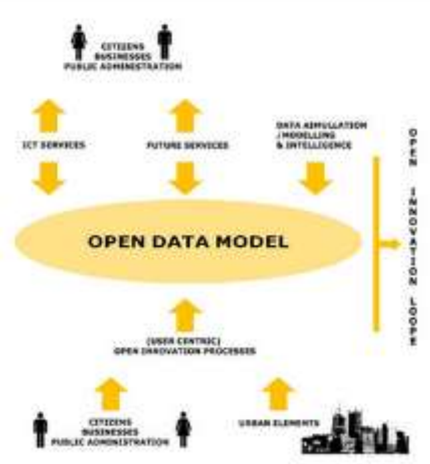
PEOPLE, Smart Cities for Smart Innovation	
Programme	FP7
Coordinator	Anova IT
Duration	26 months (November 2010 – January 2013)
Budget	
Web page	http://www.people-project.eu/
Figure	 **Figure 28: PEOPLE services architecture diagram**
General overview and objectives	The project follows the trend of open innovation as well as the future internet technologies. Open data model(s) and information flows will describe how this data are represented, accessed and shared along the scenarios defined, and used for services implementation, allowing compose smart internet based services for addressing modern cities challenges and citizens needs creating innovative inclusion ecosystems. Users will be involved in the design of services and their needs and feedback will be taken into consideration by the service providers while design and create the services. User-driven development methodologies will utilize to tackle this. The project will provide access to the data needed by the service providers which will transform the city data into a true enabler of smart cities services. The final aim is to end the project with a portfolio of ICT services really integrated, composed, adapted and/or deployed at each Pilot: 1) Resulting from/giving answer to the actual interests and needs of the different stakeholders in the Pilot; 2) Although they could be deployed as prototypes at the end of the project, they would have been completely tested and validated by users, also considering the businesses models needed for their final time-to-market and future exploitation. Please visit each pilot's webpage for more information

Table 12: Main data (PEOPLE European Project, 2013)

SCIS

SCIS, Smart Cities Information System	
Programme	H2020
Coordinator	
Duration	
Web page	http://smartcities-infosystem.eu/
Figure	**Figure 29: SCIS logo**
General overview and objectives	The Smart Cities Information System: • Collects valuable data and expertise from smart cities demonstration projects and sites and channels them into a comprehensive database to promote replication of projects; • Presents a thematic overview of projects with a focus on technologies and expertise in fields such as energy-efficient buildings, districts and cities, sustainable energy, geothermal communities, sustainable urban planning, low-carbon cities and zero-energy neighbourhoods; • Offers an outline of renewable energy sources and low-carbon technologies and examples of their use; • Establishes best practice by analysing and visualising project results, enabling project developers and cities to learn and replicate; • Identifies barriers and points out lessons learnt, with the aim of finding better solutions for technology implementation and replication, and policy development; • Provides recommendations to policy makers on support and policy actions needed to address market gaps. The Smart Cities Information System (SCIS) brings together project developers, cities, institutions, industry and experts from across Europe to exchange data, experience and know-how and to collaborate on the creation of smart cities and an energy-efficient urban environment. With a focus on smart cities, energy efficiency, transport and mobility, and ICT, SCIS showcases solutions in the fields of sustainable building and district development, renewable energy sources for cities, energy efficiency and low-carbon technology applications.

Table 13: Main data (SCIS European Project, 2016)

ESPRESSO

ESPRESSO, systemic Standardization aPRoach to Empower Smart citieS and cOmmunities	
Programme	H2020
Coordinator	ATOS Research and Innovation
Duration	24 months (January 2016 – December 2017)
Budget	1.068.186,25€
Web page	http://espresso.ru.uni-kl.de/
Figure	 **Figure 30: ESPRESSO structure of work**

General overview and objectives	A Smart City integrates physical, digital and human systems to deliver a sustainable, prosperous and inclusive future for its citizens. Many of these innovative solutions will be based on sophisticated information and communication technologies. However, technological complexity, as well as the **complexity of the various sectorial services** involved within a Smart City, require a system approach to standardisation. In an effort to leverage the promise of a system approach, will focus on the development of a **conceptual Smart City Information Framework based on open standards**. This framework will consist of a **Smart City platform** (the "Smart City enterprise application") and a number of data provision and processing services to integrate relevant data, workflows, and processes. Main objectives are: • **A case study-based approach to define key requirements for Smart Cities** as the baseline for further standard analysis activities and development of the conceptual Smart City information framework. • **The development of a conceptual Smart City Information Framework** to be built around CityGML as a reference data model and encoding with data services to integrate and process data efficiently in Smart City enterprise applications. • **A communication ecosystem** to allow tight interaction between all participants in Smart City initiatives and activities, serving as a dialogue platform facilitating the exchange of information and experiences. • **Creation of shared semantics through the establishment of open and shared vocabularies** to foster linking data and metadata. • **Standards analysis activities** to identify strengths and weaknesses of existing and currently developed standards. • **Integration of research projects** in the domain of standards and Smart City sectors and overall architectures; includes, most notably, SCC-1 projects.

Table 14: Main data (ESPRESSO European Project, 2016)

3.2 Analysis of the relevant projects and initiatives for SmartEnCity

This section treats the comparison between the aforementioned projects and other that are related to the CIOP. It is important to remark that, from the previous list, a subset of projects has been selected. The reason is some of them are not proper SmartCity platforms, but initiatives to collect data. For example, CITYKeys and SCIS platform do not aim at generating a holistic SmartCity platform, but generating a monitoring platform where several projects could report the results and maintain a database about SmartCity projects. More, from the CIOP perspective, there are additional projects with ICT platforms which help the development of SmartEnCity CIOP and, hence, are considered of interest within this section.

	Holistic platform (services)	Involvement of stakeholders	Connection with SCIS	Connection with CITYKeys	Security and privacy	GIS - CityGML	OpenDATA
SmartKye	Integration of energy, mobility and parking lots	Public authorities and decision-makers	No	No	Data protection and safeguarding	Information models	Yes
COOPERATE	Energy-based	Main stakeholders identified from use-cases	No	No	Data privacy	Information models based on gbXML	---
DIMMER	Energy-based	Social models	No	No	Security protocols	Integrates BIM and GIS	Interoperability via middleware and cloud
ESPRESSO	Standards framework	Large number of stakeholders	No	No	International standardization	n.a.	Yes
PEOPLE	Integration of urban elements	User-driven, citizens	No	No	---	No	Yes
R2CITIES	Energy-based, but also parking lot	Local monitoring for end-users	Yes	No	Data privacy	No	Yes
CITyFiED	Energy-based, but also social, economics	Local monitoring for end-users	Partially (manually feeding)	No	Data privacy	No	Yes
SmartEnCity	Energy, mobility, users	Social networks to be integrated	Yes	Yes	Regulation from TaskForce Digital Economy	Increase BIM approach with GIS and CityGML	APIs to share information

Table 15: Comparison between SmartCity projects platforms

Having in mind the aforementioned features, a set of conclusions may be extracted for the SmartEnCity project. First of all, SmartEnCity takes advantage of the current developments in these projects in terms of services and methodologies. Although the services are not detailed, the trends in these projects remark that the energy awareness is one of the main pillars. Nevertheless, the integration of additional services is highly important as happens with the mobility or social engagement. In that sense, SmartEnCity platform goes in the same line tackling the lessons learnt from these services in terms of calculation of KPIs for energy (based on energy assessment procedures) and how to deal with the social acceptance based on HMI (Human Machine Interaction).

On the other hand, another lesson learnt extracted from the projects is the need of including users in the loop. That is why, SmartEnCity takes advantage of the current initiatives about involvement of citizens and the growth of social networks to merge both and, thus, create a widener social impact. Complementary, the OPENData issue supports this argument with the objective of sharing data. This experience is also compiled from previous projects highlighted in the table before. Nevertheless, one pivotal concern is data security and privacy, which previous projects deal with. However, previously, regulations were confusing, whereas currently Task Force regulations are appearing where SmartEnCity might go a step forward.

Moreover, under the European trends, it is observed in the table how some of the projects are already feeding results to the SCIS (before CONCERTO) initiative in order to keep record of such results. Then, thanks to the involvement in these projects, SmartEnCity benefits from these experiences and, through closer communication with SCIS, this data flow could be easily gathered. The same is applicable to CITYKeys.

To sum up, SmartEnCity, as emerging project, is improving the current SmartCity platforms based on the existing results and lessons learnt in order to increase the services provided and stakeholders involved. It is very important this feedback because it facilitates the growth of the scientific community and knowledge, as well as sustainability awareness. In counterpart, in spite of having service-oriented platforms, it is sometimes difficult to reuse the methodologies due to lack of information which complicates the analysis.

4 Requirements elicitation

The objective of this section is to gather the end-user requirements in relation to CIOP, which will allow better addressing of the platform development. The sequential steps followed with this aim are the following ones:

- Identify the key stakeholders for SmartEnCity.
- Prepare customised questionnaires for each stakeholder type, in order to more effectively capture the specific wishes for each of them. Current status in each Lighthouse City is covered, i.e. which systems/platforms are already in use in each LH city.
- Distribute the questionnaires with the relevant stakeholder identified in each LH City, considering also the type of verticals addressed in each one.
- Analyse the received responses and cluster the requirements in order to identify priorities.

4.1 Identification of key stakeholders for the project

List of main stakeholders for each lighthouse and follower cities in SmartEnCity is presented in the following table (Table 16):

	VITORIA-GAZTEIZ		SONDERBORG		TARTU		ASENOVGRAD		LECCE	
STAKEHOLDERS	INSTITUTION	CONTACT PERSON	INSTITUTION	CONTACT PERSON	INSTITUTION	CONTACT PERSON	INSTITUTION	CONTACT PERSON	INSTITUTION	CONTACT PERSON
Municipality	AVG+CEA (TIC)	Eva Mesanza	Sønderborg Kommune		Tartu City	Raimond Tamm	Asenovgrad Municipality	Georgi Angelov, Anelia Lesova	Comune Lecce	Raffaele Parlangeli
	AVG+CEA (Citizen)	Roberto Gonzalez Argote								
Public Company	VISESA	Patxi Hernandez			University of Tartu	Rein Ahas	Municipal enterprise "Tourism";	Georgi Angelov, Anelia Lesova		
					Tartu Energiaagentuur (Energy advisers)	Martin Kikas	Municipal enterprise "Treatment and disposal of household and construction waste"	Georgi Angelov, Anelia Lesova		
							Municipal activity "Markets and Wholesale Markets";	Georgi Angelov, Anelia Lesova		
							Inspectorate "Parking and garages".	Georgi Angelov, Anelia Lesova		
Energy Service Company (ESCO)	GIROA-VEOLIA	Inhar Muruaga cc: Iñaki Herranz	Sønderborg Fjernvarme Sønderborg Forsyning	Iben Nielsen (ibni@sonfor.dk)	Fortumo (District heating company)					
Citizens' Association	Errota Zaharra		Project ZERO	Peter Rathje & Nicolas Bernhardi	Citizen and Apartment Union representative	Tõnis Eelmaa				
Building Owner (Not Individual)			SAB	Torben Esbsensen; te@esbensen.dk						
			SOBO	Torben Esbsensen; te@esbensen.dk						
			B42	Torben Esbsensen; te@esbensen.dk						
Service provider	FAGOR EDERLAN	Javier de Rivas	Sydenergi A/S	Ole Damm	Cityntel (Street Lighting)		EVN Bulgaria” single-stock company, electrical company;	Georgi Angelov, Anelia Lesova		
	ESTUDIOS GIS	Irune Badiola			Elektritakso (Electric taxi company)		Overgas south” joint-stock company, gas distribution;	Georgi Angelov, Anelia Lesova		
							Vivacom” single-stock company, telecommunication company;	Georgi Angelov, Anelia Lesova		
							Mobiltel” single-stock company, telecommunication company;	Georgi Angelov, Anelia Lesova		
							Telenor Bulgaria” single-stock company, telecommunication company	Georgi Angelov, Anelia Lesova		
Investor / Promoter	VISESA	Patxi Hernandez					Hidroelectric power stations “Asenitza”	Georgi Angelov, Anelia Lesova		
Grant Manager										
Energy Network manager							„EVN Bulgaria” single-stock company	Georgi Angelov, Anelia Lesova		
Other Local/Regional/National Authority										
Other										

Table 16 List of stakeholders of lighthouse and follower cities

4.1.1 Vitoria-Gasteiz

The proposed ICT solution has several stakeholders with various interests. For the case of Vitoria-Gasteiz the following figure shows the list of main stakeholders identified concerned with the CIOP solution. Figure 31 represents the Vitoria-Gasteiz CIOP in the centre of the ring, rounded by technological partners participating in the development of the CIOP and those stakeholders who will use the platform and not participating in the technical development outside the ring.

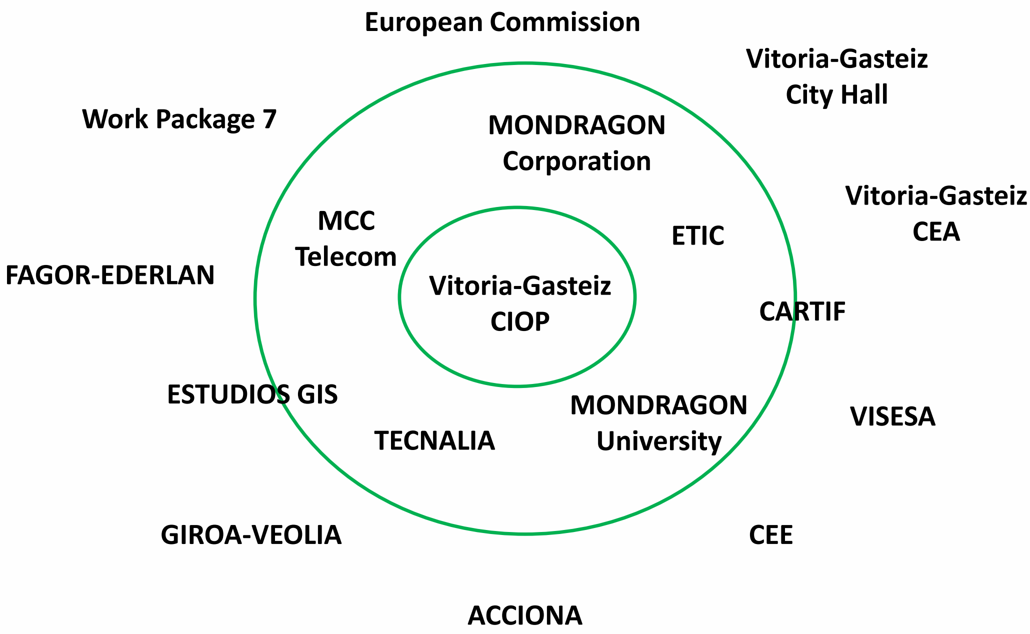


Figure 31 Main stakeholders for the Vitoria-Gasteiz lighthouse city

4.1.2 Sonderbørg

The proposed ICT solution has several stakeholders with various interests. For the case of Sonderbørg the following figure shows the list of main stakeholders identified concerned with the CIOP solution.

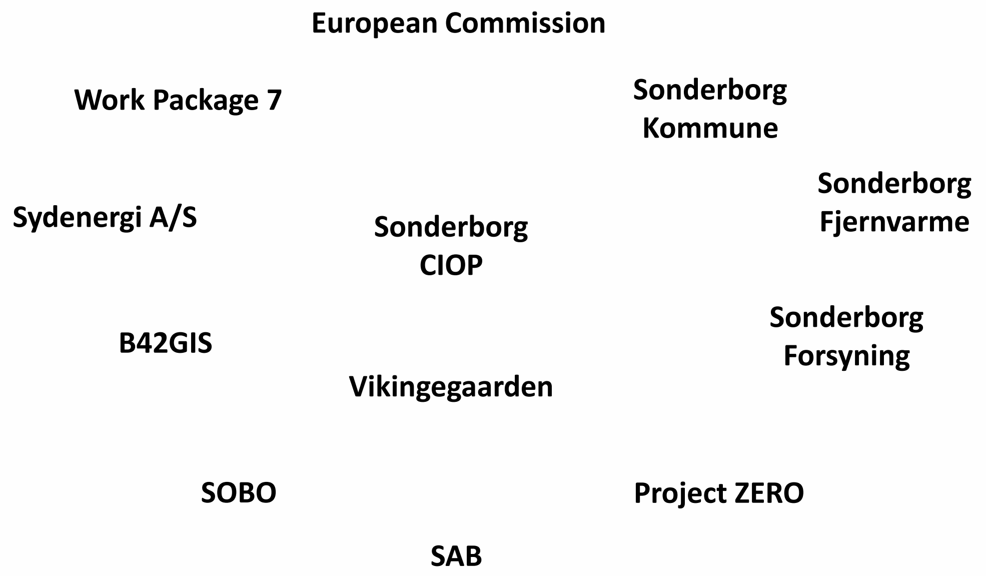


Figure 32 Main stakeholders for the Sonderbørg lighthouse city

4.1.3 Tartu

The proposed ICT solution has several stakeholders with various interests. For the case of Tartu the following figure shows the list of main stakeholders identified concerned with the CIOP solution.

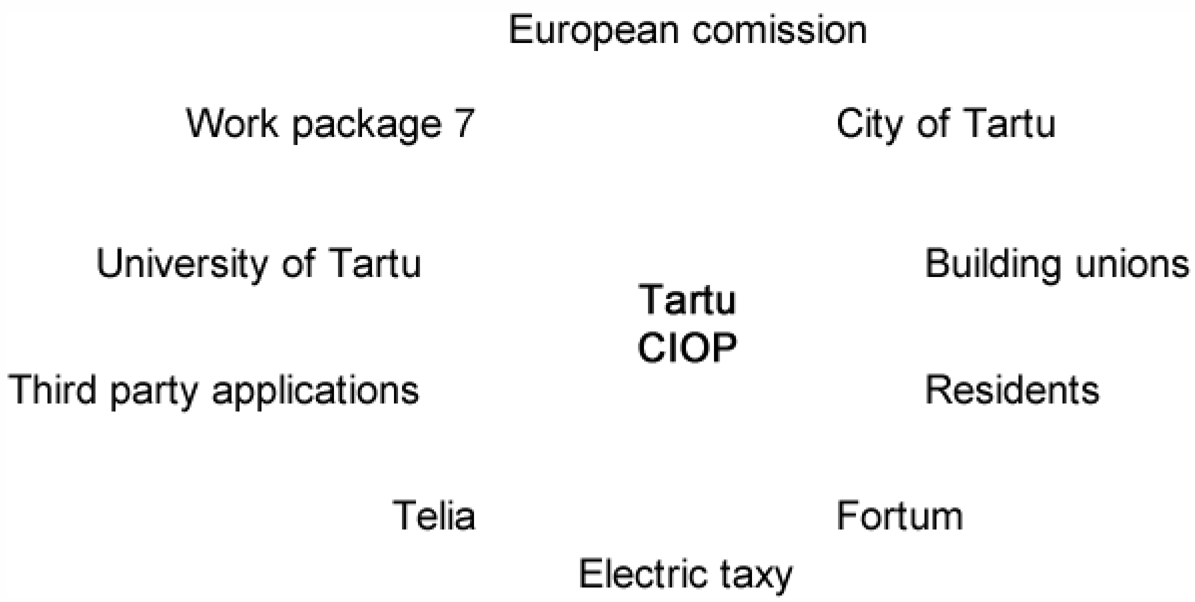


Figure 33 Main stakeholders for the Tartu lighthouse city

4.2 Questionnaire

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

1. Your Profile

Contact Details

• Name	
• Country	
• Email-address	
• Entity / Company	
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	
Building retrofitting	
District heating networks	
Integrated Infrastructures (RES integration and management)	
Sustainable Mobility	
Electrical Vehicles	
Public Transportation and Logistics	
Sharing facilities	
Social Engagement	

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality		
Public Company		
Energy Service Company (ESCO)		
Citizens		
Building Owner		
Solution provider (Company willing to provide services based on the CIOP)		
Investor / Promoter		
Grant Manager		
Energy Network manager		
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns		
	Detecting weaknesses to be corrected and strengths to be replicated		
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)		
	Detection of buildings with poor performance		
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)		
	Identification of vulnerable areas or buildings		
	Identification of viability for the implementation of a district heating network		
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)		
	Integrated electrical and thermal network energy management systems (at home, building and district level)		
	Smart public lighting management		
Sustainable Mobility	Information about the availability of EVs recharging points		
	Information about the availability of shared green vehicles		
	Information about the availability of bikesharing		
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.		
	Management of granting EVs acquisition		

	Management of the dimension and capacity of the EVs recharging network.		
	Optimization of public transportation routes		
	Optimization of last mile logistic		
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours		
	Providing information about success stories in building retrofitting		
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)		
	Information about schedules and routes of public transportation		

3. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

4. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures

5. **Citizen engagement**

5.1. Do you have an online citizen participation portal? YES NO

If yes, describe the main functionalities

1.	
2.	
3.	
4.	

5.2. What is the main added value that the CIOP platform can provide to the citizen?

6. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Electrical readings**	**All the apartments are sending their consumption to a central data base**	**JSON/XML**	**Yes – Electrical grid owner grants the access to apartment owner and electricity company**

7. **List of new data sources planned within SmartEnCity project** (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Availability of EV recharging posts	The EV posts provide data about the status that is pushed to a monitoring system	XML	YES – Opendata

8. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

4.3 Analysis of questionnaires for each Lighthouse City

A total of 15 questionnaires were received from the stakeholders for the three lighthouse cities (VITORIA-GASTEIZ, SONDERBØRG and TARTU) and two follower cities (LECCE and ASENOVGRAD). Completed questionnaires are included as annex to this deliverable (See Section 8.2) The questionnaires were tailored to three different types of stakeholders, i.e. a questionnaire was targeted to Service Providers, ESCOs and Energy Network Managers, another questionnaire was defined for Municipalities and Public Companies, and the last type of questionnaire was addressed to Citizen Owners, Promoters and Grant Managers. The elaboration of different versions of a base questionnaire allowed us to adapt the questions to the respondents' profiles in order to obtain quality contributions from them. For each of the lighthouse cities, at least one questionnaire for each type of stakeholder has been collected for the analysis. Through the questionnaires, information connected to the relevance of services, main users of the platform, visualization of results and existing and data sources was collected and analyzed. The conclusions, which will serve for the definition of user functional and non-functional requirements, are highlighted in the next subchapters.

4.3.1 Relevance of Services

The summary of the answers received by the stakeholders in this category is shown in the table below (**Table 17**). The services that appear in blue color (in **Table 17**) are new services identified by the stakeholders themselves. For this reason, these services have a lower relevance score since they have been evaluated only by the stakeholders that identified them.

Generally speaking, the services connected with the energy assessment have obtained a good score compared to the rest of categories since this is the category that is more aligned with a greater number of stakeholders' profiles. The most relevant services that the CIOP platform should feature are the next ones:

- **Energy Assessment**
  - Monitoring of most relevant KPIs at different levels (dwelling, building, district)
  - Identification of energy consumption patterns
  - Integrated electrical and thermal network energy management systems (at home, building and district level)
  - Detecting weaknesses to be corrected and strengths to be replicated
  - Detection of buildings with poor performance
  - Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)
- **Sustainable mobility**
  - Information about the availability of shared green vehicles
  - Management of the dimension and capacity of the EVs recharging network
  - Information about the availability of EVs recharging points
  - Management of granting EVs acquisition
  - Optimization of public transportation routes
  - Optimization of last mile logistic
- **Citizen engagement**
  - Providing information about success stories in building retrofitting

- Launching surveys in the district about the building retrofitting preferences of the neighbors
- Feedback about failures in the services (e.g. EVs charging points, public transportation, bike sharing)
- Information about schedules and routes of public transportation
- Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding, etc.)
- Live CO_2 measurements / Renewables information

The complete analysis of the relevance of the services for each stakeholder of the lighthouse cities and follower cities are included as an appendix (See Section 8.3).

CATEGORY	SERVICE	RELEVANCE
Energy Assessment	Aligned with your activity?	
	Identification of energy consumption patterns	34
	Detecting weaknesses to be corrected and strengths to be replicated	34
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	36
	Detection of buildings with poor performance	30
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	32
	Identification of vulnerable areas or buildings	24
	Identification of viability for the implementation of a district heating network	25
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	28
	Integrated electrical and thermal network energy management systems (at home, building and district level)	33
	Smart public lighting management	24
	Data collection (heat, electricity, inside climate)	3
Sustainable Mobility	Aligned with your activity?	
	Information about the availability of EVs recharging points	25
	Information about the availability of shared green vehicles	25
	Information about the availability of bikesharing	21
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	22
	Management of granting EVs acquisition	23
	Management of the dimension and capacity of the EVs recharging network.	25
	Optimization of public transportation routes	22
	Optimization of last mile logistic	22

	Information about the feasibility of exploitation of new social transport and vehicle sharing buisness models, based on electro mobility	3
	Information about the feasibility of exploitation of new goods transports business models, based on electro mobility	3
Citizen Engagement	Aligned with your activity?	
	Launching surveys in the district about the building retrofitting preferences of the neighbours	34,5
	Providing information about success stories in building retrofitting	36
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	30
	Information about schedules and routes of public transportation	27
	Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding , etc)	6
	City News	3
	Innovation models	3
	Live CO2/renewables information	3

Table 17 Relevance of Services

4.3.2 Main users of the platform

Regarding who should be the main users of the platform according to the respondents, the main identified users are the municipalities, followed by the building owners, citizens and, finally, the ESCOs, public companies, solution providers and energy network managers. The rest of proposed users were not identified as relevant potential users. Regarding the solution providers, these were not considered to be main users since their number of votes is very low. This could be explained by the fact that the "main users" concept could have been understood as final users of the platform and not as third parties that build services with the information provided by the CIOP platform. Thus, the service providers can be considered to be third party actors that leverage the aggregated, filtered and curated data provided by the CIOP to generate added value services for the end users of the platform.

The complete analysis of the users identified by the stakeholders can be found in the appendix of this document (See Section 8.3).

USER	VOTES
Municipality	10
Public Company	5
Energy Service Company (ESCO)	4

Citizens	7
Building Owner	8
Solution provider	5
Investor / Promoter	1
Grant Manager	0
Energy Network manager	4
Others (specify)	2

Table 18: Main users of the platform

4.3.3 Visualization of results

The visualization format that best fits the envisaged services results are the following, considering the analysis of the results from the questionnaires:

- Comparison tables
- Bar charts with figures

In some occasions, the leverage of 2D maps for the localization of geospatial information is considered to be useful. On the other hand, the 3D visualization of results is not considered relevant and the use of information panels could be useful under certain circumstances.

A deeper analysis is necessary in this issue and a specific task will be dedicated for HMI mechanisms (Task 6.5) in WP6. Depending on the data to be shown different dashboards and reports might be necessary.

A more complete analysis is included in this document Appendix (See Section 8.3).

4.3.4 Existing Data Sources and Services

Currently, there is not a great number of significant data sources and services within the lighthouse cities. Some of the main existing services are related to weather forecasting and the management of the mobility of public transportation vehicles. These services provide data that could be accessible for its integration into the CIOP platform.

Other data sources, relevant for the project, which were identified, are data coming from the energy consumption devices (electricity, gas, etc.) and water. In this case, data is not normally available in a reusable format and, when the information scope is restricted to the level of a dwelling, this information will be accessible only by the dwelling proprietary. A way to aggregate these atomic measures at building and city level should be leveraged by the CIOP platform.

In the case of Vitoria-Gazteiz the city hall has recently released the Open data web portal[118], as the central access point for a great variety of data elaborated by the institution in order to be accessible and usable without any restriction.

The complete analysis is included as an appendix at the end of the deliverable(See Section 8.3).

4.3.5 New Data Sources generated in SmartEnCity

The main data sources that are to be leveraged in SmartEnCity project are related to the monitoring of energy consumption and energy generation at different levels of aggregation (apartment, building, district, city, etc.). It is also considered relevant the monitoring of the different KPIs identified during the project.

The geo-localization capabilities to support the management of Green vehicles (public transportation, logistics and private use) are considered to be relevant. These capabilities connected with alternative and shared transportation means, such as bicycles, can provide data about their localization and use.

On the other hand, the information coming from surveys, real-time feeds or comments provided by the citizens, could be a relevant data source that could be leveraged to improve the added value services, e.g. to transmit best retrofitting practices and shortages, irregularities and quality of the services offered to the citizen.

The complete analysis is included as an appendix (See Section 8.3).

4.4 Identification of services and high level added value services

SmartEnCity project must contribute to achieve a common city management platform which interacts with the different services from the smart cities. Such services must be designed according to the expectative of cities and partners from the consortium. Hence, the definition of services and added value services must be coordinated in order to achieve the target from each agent.

In this deliverable, we start to describe the possible ICT solutions that can be deployed in the framework of the project and the first impressions received from cities and partners working in the project. As a result, we can have a general idea about the most interesting solutions by each of these groups.

This section compiles the potential services and added value services to be incorporated in the CIOP, the relevance of these services for stakeholders and for project partners as well as the requirements needed to be considered in the design of the platform design.

4.4.1 Services and added value services

Services and added value services in the context of SmartEnCity are ICT solutions that can be constructed from data available in the platform or from the usage of the solutions provided within the project which can support decision making on new activities.

118 www.vitoria-gasteiz.org/opendata

These ICT solutions can be grouped into following categories:

- Services consist of ICT solutions that can offer suitable information and recommendations to empower citizens on decision making (e.g. in relation to home energy consumption and mobility) but also can boost the use of Urban Platforms through the connection of platform with social networks, contributing to raise the awareness about energy consumption and launching awareness campaigns.
- Added value services consist of ICT solutions that also include machine learning, big data or business intelligent techniques with the aim of dealing with complex data analysis and user behaviour.

Both types of services will take part of the Urban Platforms to be deployed in each LH city and will correspond with following types of services:

- Energy assessment services in order to identify energy consumption patterns of different actors.
- Sustainable mobility services in order to manage public charge points and shared green vehicles.
- Citizens' engagement services in order to agile communication channel among the citizens, the municipality and the operators of the energy and sustainable transport services.

4.4.2 Potential services and added value services to be deployed in SmartEnCity

Table below compiles potential ICT solutions that could be deployed in the framework of the SmartEnCity project. Such list is the result of compiling information from the Description of the Action (DoA) as well as proposals made by partners.

Category of ICT solution	Type of ICT solution	Description
Energy Assessment	***Added value services***	**<u>Energy use forecast</u>** Estimation of the energy needs at district level for assuring the comfort values and the supply into all the dwellings. In this way, weather forecast would help to estimate the individual dwelling energy needs which will lie in an estimation of the required energy to fulfill the energy demand. Then, a set of recommendations could be emitted to the ESCo with the aim at managing energy in an efficient way.
		<u>Dwelling energy</u> Similar to before, but in this case at dwelling level. The service aims at providing useful guidelines to the end-user according to the management of the energy parameters. Then, having into account the weather forecast, the energy demand could be estimated according to certain comfort parameters in order to give recommendation to the end-user at time of establishing the thermostat set-point.
		<u>Identification of energy consumption patterns</u>

		Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)
	Services	Home Energy Consumption Monitoring: This service will monitor electrical energy consumption on dwellings. It will collect electrical consumption information from metering devices installed in the dwellings and store them in a central location. This service will provide an HMI for the residents to let them know about their energy consumption patterns, set consumption goals and thresholds, receive advice on how to reduce their consumption, and will allow comparing their consumption with other residents in their area. The goal of the services is to empower the resident to engage in energy consumption reduction.
		Monitoring of most relevant Key Performance Indicators: Indoor KPIs (e.g. temperature, humidity, energy) at different levels (dwelling, building, district). Outdoors KPIs (e.g. street lights, temperature, speed of wind, humidity, waste collection
		Detecting weaknesses in buildings from the energy consumption patterns to be corrected and strengths to be replicated
		Detection of buildings with poor performance
		Identification of vulnerable areas or buildings
		Identification of viability for the implementation of a district heating network
		Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)
		Integrated electrical and thermal network energy management systems (at home, building and district level)
		Smart public lighting management
Sustainable mobility	***Added value service***	**Calculation of Total Cost of Ownership for EVs** Calculation of the total cost of ownership for a taxi or last mile vehicle along the project lifetime. Generally, there will be a point in time when the EV will have been the right choice from the economic point of view. Drivers/vehicle owners will be asked to provide information on every expense related to the EV (energy required for the charging process, maintenance related expenses, taxes if any, etc). They will be getting total related costs on a regular basis. Info on equivalent ICEs may be provided based on estimations. This analysis can also be complemented with profits made by the owner, and other considerations and additional studies can end in a business model.
		CO2 emissions reduction An analysis of the CO2 emissions that will be avoided can be made on the basis of km driven and the equivalent fuel consumption.
	Services	Geolocation of rental cars and bikes: Geolocation tracking for billing purposes and KPI calculations
		Geolocation of public transport
		Information about the availability of EVs recharging points
		Information about the availability of shared green vehicles

		Information about the availability of bike-sharing
		Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.
		Management of granting EVs acquisition
		Management of the dimension and capacity of the EVs recharging network
		Optimization of public transportation routes
		Optimization of last mile logistic
Citizen engagement	***Added value service***	**<u>Citizen information system</u>** The service will allow to broadcast any kind of information to the residents in the form of a digital TV channel. By installing the appropriate hardware at the existing TV header equipment in each building, the service will allow the municipality (or any other interested stakeholder) to display any kind of information to the residents. The service would allow to target all or part of the buildings (i.e., to segment it into different citizen groups) and to schedule different information for different time periods.
	Services	Launching surveys in the district about the building retrofitting preferences of the neighbors
		Providing information about success stories in building retrofitting
		Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)
		Information about schedules and routes of public transportation

Table 19 List of potential services and added value services

4.4.2.1 Relevance of ICT solutions

The most promising ICT solutions to be deployed in the SmartEnCity project are the result of two steps:

- The valuation made by the stakeholders identified in each city (section 4.3: user requirements)
- The valuation made by companies/research organisations interesting in using or deploying these services (section 4.4)

As a result, we have obtained a first evaluation about the most interesting services for final users and for future providers of such services in order to focus the future activity to be deployed in the project as well as for predicting the possible requirement of these services for the architectural design of the CIOP.

The relevance of ICT services has been analysed in the analysis of the questionnaires distributed within the main stakeholders of each lighthouse city (See section 4.3).

The evaluation process for the case of companies has consisted on the selection of the relevance of each added value services described in table (Table 19) according to this rating scale: low, medium and high. Then, it has applied scoring values to each category: Low = 1; Medium = 2; High = 3 and has summed up all the values. As a result, taking into account that 6 entities have replied the questionnaire, it has considered that:

- Added Value Services with values less than 7 are services with low relevance for companies/research organizations. They are represented in red colour in table below.
- Added Value Services with values among 8-13 are services with medium relevance for companies/research organizations. They are represented in orange colour in table below.
- Added Value Services with values higher than 14 are services with high relevance for companies/research organizations. They are represented in green colour in table below.

Table below (Table 20) shows the list of added value services with values from highest to lowest score. In the annex (See Section 8.4) it can be found the valuation made by the partners who fulfilled the questionnaire.

Type of service	Description	RESULT
Energy Assessment	Dwelling energy	17
	Energy use forecast	14
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures	14
Sustainable mobility	Calculation of Total Cost of Ownership for EVs	14
	CO_2 emissions reduction	14
Citizen engagement	Citizen information system	14
Energy Assessment	Identification of energy consumption patterns	13

Table 20 Relevance of added value services

Main conclusions obtained from partners aimed to use or exploit ICT solutions are:

- This analysis allows concluding that this list of added value services seems interesting for providers companies or research organizations which will be the responsible for their future implementation as well as for the municipalities that have participated in the valuation of these services.
- None of the added value services has been scored as low relevance by partners participating in the questionnaire. Consequently, all the ICT solutions seem useful for partners aimed to exploit or use these services.
- Most solutions are in the same range of valuation (5 of 7 added value services), being the most and less interesting ICT solutions related to energy assessment services.

- For the case of Vitoria, all partners find relevant those services focused on providing useful guidelines to ESCO and end-users with the aim to manage the energy in an efficient way. Sustainable mobility or citizen engagement ICT solutions have not been selected as priority services. In the case of Tartu, all added value services have been considered relevant with the only exception of one ICT solution related to energy service. For the case of Sonderbørg, any valuation has been obtained.
- The analysis needs to be done in the further future but for the case of Vitoria we have obtained a first good approach after the participation of 6 partners in the evaluation process. Therefore, it can be said that this supposes a good sample since it covers partners with different roles in the project (district retrofitting, integrated infrastructures and sustainable mobility) and belong to different types of organisms (private companies, public companies and research entities).

In a further step, it will be required to know if all these ICT solutions can be deployed in each city participating in the project, requiring to design a strategy for involving the technical partners working in T6.6, T3.7, T4.7 and T5.7 in order to decide which added value services will be deployed and the partner in charge. Moreover, other possibilities will be evaluated for making use of the available data in the platforms.

4.4.3 Added value services/services as tools for evaluating KPIs

Figure below represents the scheme for evaluating the interventions from a holistic point of view in order to assess the energy and CO_2 savings after interventions in districts and mobility actions but also to evaluate the social acceptance, the economic performance and the environmental impact of each of these actions.

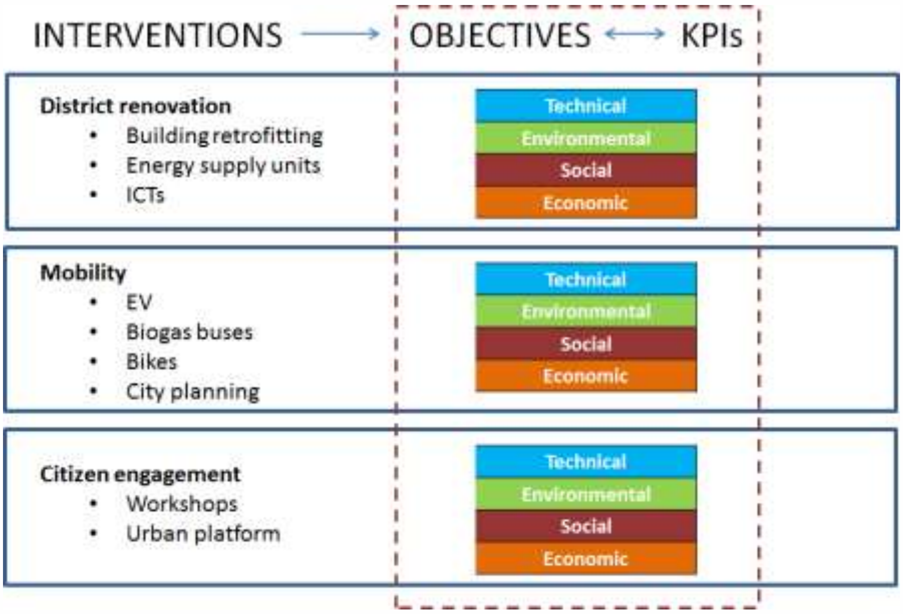


Figure 34 Evaluation of Interventions

ICT infrastructure will be deployed with the goal of managing the generation and distribution systems in order to assure that they are working in an appropriate manner, to monitor the energy and CO2 savings as well as other parameters and calculate KPIs. Concerning added value services and services will be used for assessing specifically this objective pursued in the project: change the user behaviour related to energy consumption which will be evaluated according to the number of final users of these ICT solutions, number of active users or people who acquired capacity for managing the energy consumption of their homes or vehicles. Therefore, these services must offer this information in order to help to evaluate this information.

On the other hand, as part of the social acceptance of the project, it will evaluate the satisfaction of ICT tools among benefits of the project using these services. It will deliver surveys to residents and drivers in order to analyse these issues.

5 Functional and Non-Functional requirements

This section aims to structure the user requirements obtained in the previous section into a formal specification of requirements for the architectural design of the CIOP. In addition to our own ideas, the requirements section is based on a number of articles and public opinions[119,120,121,122]. The list of functional requirements presented in this section represents a wish-list collected from feedback provided by stakeholders, not all these features are going to be implemented in SmartEnCity project.

Formal requirements are split into functional (the functionality that has to be offered to end users) and non-functional (e.g. scalability, privacy, availability, etc.). Functional requirements can still be split into more detailed categories related to specific aspects:

- Use case requirements for the development of CIOP added value services (i.e. Energy Assessment, Sustainable Mobility and Citizen Engagement)
- Technical infrastructure requirements (e.g. user interfaces, data and business logic) derived from the use case requirements

Each category of requirements is provided in a table format which defines the following data for each requirement:

- Requirement ID: a unique identifier for the requirement, so that it can be properly referenced and helps to design test and validation cases based on that
- Requirement description

5.1 Functional Requirements

In the next table (Table 21), the requirements for the development of added value services are shown according to the project thee vertical categories.

Requirement ID	Vertical	Description Applicable to different levels; dwelling, building, district
FR_EA_01	Energy Assessment	The system should provide a way to monitor relevant KPIs
FR_EA_02	Energy Assessment	The system should provide means of identifying energy consumption patterns
FR_EA_03	Energy Assessment	The system should provide means of detecting buildings and districts with poor energy performance

119 https://dzone.com/articles/iot-software-platform-comparison

120https://www.progress.com/docs/default-source/default-document-library/progress/documents/papers/ iot_surveyreport.pdf

121 https://www.mapr.com/blog/key-requirements-iot-data-platform

122 http://www.iot-a.eu/public/requirements/copy_of_requirements

FR_EA_04	Energy Assessment	The system should provide decision making capabilities to guide stakeholders on the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)
FR_EA_05	Energy Assessment	The system should support an integrated electrical and thermal network energy management
FR_EA_06	Energy Assessment	The system should have access to specific information from dwellings and buildings through sensors or meters to be installed (e.g. temperature, humidity, electricity consumption, gas, water), through a weather forecast station (exterior temperature, wind speed, sunshine) or through a simulation model (energy demand)
FR_EA_07	Energy Assessment	The system should provide an energy use forecast at dwelling and district level by means of incorporating weather forecasts. A set of recommendations could be emitted to the end-users and ESCOs with the aim at managing the energy use in an efficient way
FR_SM_01	Sustainable Mobility	The system should provide services that inform the users about the availability of shared green vehicles
FR_SM_02	Sustainable Mobility	The system should provide services that allow the management of the dimension and capacity of the EVs recharging network
FR_SM_03	Sustainable Mobility	The system should provide services that inform the users about the availability of EVs recharging points
FR_SM_04	Sustainable Mobility	The system should provide services allow the management of granting EVs acquisition
FR_SM_05	Sustainable Mobility	The system should provide services that allow the optimization of public transportation routes and the last mile logistic
FR_SM_06	Sustainable Mobility	The system should have access to specific information from vehicles through meters to be installed (e.g. distances travelled, geolocation) or provided by vehicle users (e.g. costs, investment, operation costs)
FR_SM_07	Sustainable Mobility	The system should provide citizens with resources to calculate the total cost of ownership of EV
FR_SM_08	Sustainable Mobility	The system should provide analysis results of CO2 emissions based on the efficient use of mobility resources
FR_CE_01	Citizen Engagement	The system should provide citizens with information about success stories in building retrofitting

FR_CE_02	Citizen Engagement	The system should allow launching surveys in the district about the building retrofitting preferences of the neighbors
FR_CE_03	Citizen Engagement	The system should enable the citizens to provide feedback about failures in the services (e.g. EVs charging points, public transportation, bike sharing)
FR_CE_04	Citizen Engagement	The system should provide information about schedules and routes of public transportation
FR_CE_05	Citizen Engagement	The system should enable the answering of questions regarding building refurbishment (technical, regulatory, process, funding, etc.)
FR_CE_06	Citizen Engagement	The system should have suitable data to offer citizens and a direct connection among platform and buildings converters. This could be solved by placing information displays in the most concurred city places or deploying a mobile app instead of TV broadcasting
FR_CE_07	Citizen Engagement	The system should allow to broadcast any type of information to the residents in the form of a digital TV channel

Table 21 Functional requirements for the verticals

Table 22 shows the technical requirements derived from the functional requirements for the verticals.

Requirement ID	Category	Description
FR_DM_01	Device management	The system should provide a way to manage connected devices. Management activities include adding and removing devices, managing ownership and hierarchy, relations to other assets
FR_DM_02	Device management	The system should provide means of defining and reusing the data model profiles for various devices
FR_DM_03	Device management	Devices should be able to advertise which services they provide (service discovery)
FR_UM_01	User management	The system should enable several users to access the system using their own username and password.
FR_UM_02	User management	Based on authorization level, existing users can add new users
FR_UM_03	User management	Users only have access to data of their own assets and to assets they have been given permissions to
FR_DE_01	Decision Engine	The system should provide a way to apply automatic

		business rules (for example turn on a light when motion in the room is detected). This may be either internal to the platform or using external callbacks.
FR_RA_01	Remote Actions	The system should allow for certain actions to be triggered remotely, sending commands to the devices
FR_DA_01	Data Analysis	The system should provide a way to gather historical device measurements data
FR_DA_02	Data Analysis	The platform should support storing all communication with any device or component in an external data analytics platform
FR_DA_03	Data Analysis	It should be possible to export the data to be analysed in 3rd party systems (for example big data analysis systems).
FR_GEO_01	Geolocation	The system should enable storing the physical coordinates of devices
FR_GEO_02	Geolocation	The system should provide means of querying for devices by their coordinates

Table 22: CIOP Technical requirements

5.2 Non-Functional Requirements

Non-functional requirements are shown below in Table 23.

Requirement ID	Category	Description
NFR_SEC_01	Security	The system should provide a secure environment protected from common attack vectors
NFR_SEC_02	Security	The system components should be updateable to protect against known vulnerabilities
NFR_SEC_03	Security	User data should be protected from unauthorized access
NFR_SEC_04	Security	The system should make it difficult to spy on messages communicated in the system (use HTTPS etc)
NFR_SEC_05	Security	The security and privacy mechanism should sufficient to be trustworthy for the clients
NFR_IPR_01	Privacy	The system should respect user’s privacy, preventing unauthorized access
NFR_IPR_02	Privacy	The system should not be configured to collect more

		data than it needs for its functionality
NFR_IPR_03	Privacy	User should be able to define and monitor who can use their data
NFR_IPR_04	Privacy	It is ok to publicly share aggregated user data (data combined for a number of users for some prolonged period of time)
NFR_IPR_05	Privacy	In case of aggregated data, it should not be determinable exactly from whom was this data gathered from
NFR_IPR_06	Privacy	When relocating existing devices, the new owner should not be able to view the history of previous device owner
NFR_IPR_07	Privacy	The system should prevent tracking of devices by unauthorized entities
NFR_IPR_08	Privacy	Users without applicable permissions should not be able to track what other users are doing in the system
NFR_IPR_09	Privacy	The physical location of users should not be made accessible to other parties without the required permissions
NFR_NET_01	Networking	The platform should be able to operate over different networks (wired and wireless internet, GSM etc).
NFR_NET_02	Networking	Support for IPv6 is a benefit.
NFR_NET_03	Networking	The system should be able to handle heterogeneous lossy networks such as wireless internet and data over mobile networks
NFR_NET_04	Networking	The system should be able to run on distributed networks and locations
NFR_NET_05	Networking	The platform should be able to operate over VPN if required
NFR_NET_06	Networking	It's a benefit if the system uses standard HTTP communication, not requiring special firewall configurations
NFR_NET_07	Networking	When using networks such as mobile network, the system should be able to gracefully handle roaming

		between different cell towers
NFR_DEV_01	Constrained devices	The platform should enable communication for low power resource (CPU, memory, etc.) limited devices
NFR_DEV_02	Constrained devices	Constrained devices can communicate using a less restricted gateway talking to the actual platform
NFR_DEV_03	Constrained devices	The system could include ways of prioritizing communication between devices so the more safety or security critical devices can use more of the limited networking or processing capabilities
NFR_AUD_01	Auditing	All changes made to the system should leave an automatic and permanent audit trail showing who and when made which changes
NFR_BAC_01	Backup	The system should provide means or ways to back up the data periodically
NFR_BAC_02	Backup	The system should provide means to restore to a backed up version
NFR_HOS_01	Hosting	It's a benefit if it's possible to host the platform on the operator's infrastructure
NFR_HOS_02	Hosting	The data stored and generated in the system should belong to the clients and operators and be subject to laws of the deployed country
NFR_AVA_01	Availability	The system should take measures to provide high availability (SLA)
NFR_AVA_02	Availability	The system should provide high Quality of Service (QoS)
NFR_EXT_01	Extensibility	The system should be extensible with new functionality either through modifying its source code or by utilizing the API interfaces to build external 3rd party modules
NFR_EXT_02	Extensibility	Being open source or at least having access to the source code is a benefit
NFR_COM_01	Community	Strong community and extensive deployment of the platform is a benefit
NFR_COM_02	Community	Lots of public internet know-how and troubleshooting is a benefit

NFR_INT_01	Interoperability	The system should provide ways for different external 3rd party systems to communicate with the platform
NFR_INT_02	Interoperability	If the system has its own administration interface, the provided API should allow performing all the same functions by 3rd party application given sufficient privileges
NFR_DOC_01	Documentation	The platform and its functions should be sufficiently documented so new people could be included to work on it without dependence on original developers
NFR_DOC_02	Documentation	The public API interface should be extensively documented
NFR_FAU_01	Fault tolerance	The system should be able to handle faulty or compromised devices sending invalid data or at high rates
NFR_FAU_02	Fault tolerance	The system should be able to detect and notify about devices not reporting expected data
NFR_MAI_01	Maintainability	The system should be designed to be operated and maintained for a prolonged period of time
NFR_MAI_02	Maintainability	The components and dependencies should be updateable
NFR_MAI_03	Maintainability	The system should not lock the client into a certain vendor
NFR_MAI_04	Maintainability	Open source software not depending on proprietary technologies is a benefit

Table 23: CIOP Non-functional requirements

6 Conclusions, deviations and outputs for other WPs

Deliverable D6.1 presents a collection of functional and non-functional requirements to be addressed by the CIOP reference model to be implemented in following tasks in WP6.

The review of the most representative existing frameworks and platforms in the field of Smart cities leads us to the conclusion that there already exists a huge list of frameworks and architectures for the deployment of ICT solutions for Smart Cities. An initial analysis and a first elimination round has been performed during the development of this task and a final list of 11 IoT platforms have been selected for a deeper analysis in the following task in WP6.

The use of standards for the representation and modelling of the relevant information in Smart cities is a key issue of SmartEnCity and many other initiatives in the field. The analysis performed in the task 6.1 focuses on the different levels of a city (i.e. urban, building, sensor) as well as the different vertical domains of the project (i.e. energy, mobility, citizen engagement). It can be concluded that the most relevant standards for SmartEnCity project for data modelling are: CityGML for the representation of urban areas in 3D; KML for visualization purposes; SHP or OSM as input data; IFC for the detailed representation of buildings; and the set of standards included in the SWE Framework the most well defined standard way to make accessible via Web the sensors data.

There is also a huge list of projects and initiatives of Smart cities relevant for SmartEnCity. From the huge list an analysis has been carried out in order to select a manageable list according mainly to two criteria: Smart city projects or initiatives focused on the development of ICT tools and the openness of the implementation carried out, including tools and standards for data collection or representation. SmartEnCity, as emerging project, is improving the current SmartCity platforms based on the existing results and lessons learnt in order to increase the services provided and stakeholders involved. It is very important this feedback because it facilitates the growth of the scientific community and knowledge, as well as sustainability awareness. In counterpart, in spite of having service-oriented platforms, it is sometimes difficult to reuse the methodologies due to lack of information which complicates the analysis

The identification of stakeholders and the questionnaire generated within this task allow us to stablish the basis for the development of the CIOP in SmartEnCity. Main focus of each of the lighthouse city as well as the different interests of stakeholders lead us to the conclusion that CIOP to be developed in SmartEnCity will be a reference framework which will be tailored according to the smart city strategy of each lighthouse city in order to implement SmartEnCity project. Main relevant services identified are related in general to energy assessment and especially those related to KPIs monitoring and improvement of energy performance. They are also very much linked to the identification of successful stories and transparency for citizen engagement. Main users of the platform are the municipalities, the building owners and citizens. The way the information should be presented to the users will depend on the information type but tables and figures are mainly requested. In general, the currently existing services and data sources is quite poor at the moment, but a large set of data sources are expected to be generated within the project in order to develop the services for each lighthouse city.

Formal requirements are split into functional (the functionality that has to be offered to end users) and non-functional (e.g. scalability, privacy, availability, etc.). Functional requirements can still be split into more detailed categories related to specific aspects. The final list of requirements is a wish-list, and it does not mean that all these features are going to be implemented in SmartEnCity project. They represent a reference framework for the implementation of SmartEnCity in each lighthouse city.

No deviations have been produced according to the dates and content of the deliverable with respect to the proposed plan.

The outputs produced in this deliverable will have effects mainly on other activities of the WP6 and on activities related with the deployment of the CIOP platform in the three lighthouse cities (Vitoria-Gasteiz WP3, Tartu WP4 and Sonderbørg WP5)

7 References

Ross, L. (2010), “Virtual 3D City Models in Urban Land Management Technologies and Applications”, Master thesis, the University of Berlin, Germany, 2010

Kolbe T. H. (2009) Representing and Exchanging 3D City Models with CityGML.. Proceedings of the 3rd International Workshop on 3D Geo-Information, Lecture Notes in Geoinformation & Cartography, page 20. Seoul, Korea, Springer Verlag.

Kolbe, T. H., Groger, G., Nagel, C. & Hafele, K.-H. (2012). OGC City Geography Markup Language (CityGML) Encoding Standard, Open Geospatial Consortium. Category: OpenGIS Implementation Specification, GC Document: OGC 12-019.

INSPIRE Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

Goodwin C., Russomanno D.J. (2006) An Ontology-Based Sensor Network Prototype Environment. Proceedings of the Fifth International Conference on Information Processing in Sensor Networks; Nashville, TN, USA. 19–21 April 2006.

Neuhaus H., Compton M. (2009) The Semantic Sensor Network Ontology: A Generic Language to Describe Sensor Assets. Proceedings of 12th AGILE International Conference on Geographic Information Science, Workshop on Challenges in Geospatial Data Harmonisation; Hannover, Germany. June 2009; pp. 1–33.

8 ANNEX

8.1 IoT Frameworks Review

Detail of the review of analysed IoT framework is provided as an annex to this deliverable.

Company	Product	Type	Archidecture	Can be hosted by Telia?	Who owns the customer?	Scalability	Open source	REST	Device management	Data mining	Dashboard	Automated business rules	End to end security
FiWare	FIWARE	Paas / Saas	Cloud-based	Yes	Telia	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
IBM	Watson IoT Platform	Paas	Cloud-based	No	?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Tieto Industrial Internet	Connect by Cumulocity	Paas / Saas	Cloud-based	Yes	Telia	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Cumulocity	Cumulocity	Saas	Cloud-based	Yes	Telia	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
PTC	ThingWorx IoT Platform	Paas / Saas	Cloud-based	Yes	Telia	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
~~Google~~	Brillo	OS, Core pltform + SDK		No	-	-	-	-	-	-	-	-	-

Company	Product	Multiple languages	Geolocation	List of supported devices	New device provisioning	Device/client specific authorization	Telco References	In what applications	Integration	Protocols supported	Millions of devices?	Time to market	Free trial	Future-proof?	Price	Others
FiWare	FIWARE	No	Yes	Link			Telefonica	Smart city but not specific	REST API	UL2.0/HTTP, MQTT, OMA LWM2M/CoAP, ThinkingThings Protocol and SIGFOX protocol	Yes	Medium	Free	Yes	Free	Backed by EU
IBM	Watson IoT Platform	?	Yes				AT&T	Almoust everywhere	REST and Real-time API's	HTTPS, MQTT	Yes	Fast	Yes	Yes	#of devices, traffic and storage	
Tieto Industrial Internet	Connect by Cumulocity	?	Yes				TeliaSonera	Tracking, metering	?	?	?	?	?	?	?	?
Cumulocity	Cumulocity	?	Yes	Link	Link		TeliaSonera, DT	Tracking, smart metering, Vending, Telematics, remote maintenance	REST API	REST HTTP, MQTT	Yes	Fast	Yes	Yes	number of connected devices	
PTC	ThingWorx IoT Platform	?	Yes	Link			Elisa	Aerospace, Automotive, Consumer products, Electronics and HighTech, Industrial equipment, Medical devices, Smart cities and all other Smart initiatives	REST API	MQTT, AMQP, XMPP, CoAP, DDS, WebSockets	Yes	Fast	Yes	Yes		
~~Google~~	Brillo	-	-				-	-	-	-	-	-	-	-	-	-

Company	Product	Type	Archidecture	Can be hosted by Telia?	Who owns the customer?	Scalability	Open source	REST	Device management	Data mining	Dashboard	Automated business rules	End to end security
~~Apple~~	HomeKit	Apple prop	Cloud-based	No	-	-	-	-	-	-	-	-	-
Microsoft	Azure IoT	Paas	Cloud-based	No	?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Amazon	AWS IoT	Iaas	Cloud-based	No	?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Cisco	IoT Cloud Connect	see Jasper	-	-	-	-	-	-	-	-	-	-	-
Jasper + Cisco	Jasper	SaaS	Cloud-based	Yes	Telia	Yes	No	?	Yes	Yes	Yes	Yes	Yes
~~Samsung~~	ARTIK	Hardware	-	No	-	-	-	-	-	-	-	-	-
Ericsson	DCP	Saas	Cloud-based	Yes	Telia	Yes	No	?	Yes	Yes	Yes	?	Yes
Oracle	Oracle Internet of Things	Paas	Cloud-based	Yes	?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Company	Product	Multiple languages	Geolocation	List of supported devices	New device provisioning	Device/client specific authorization	Telco References	In what applications	Integration	Protocols supported	Millions of devices?	Time to market	Free trial	Future-proof?	Price	Others
~~Apple~~	HomeKit	-	-				-	-	-	-	-	-	-	-	-	-
Microsoft	Azure IoT	Yes	Yes				SK Telecom	Energy, Transportation, Smart cities, Manufacturing and Healthcare	REST, SDK	HTTP, AMQP, MQTT	Yes	Fast	Yes	Yes	#of devices and messages per day	
Amazon	AWS IoT	Yes	Yes				Netflix, Tadiran Telecom	Almoust everywhere	REST API	MQTT, HTTP1.1	Yes	Medium	Yes	Yes	$5 per million messages	
Cisco	IoT Cloud Connect	-	-				-	-	-	-	-	-	-	-	-	-
Jasper + Cisco	Jasper	No	Yes	Cars, vending, robots etc			AT&T, O2, Tele2	Connected car, Industrial, Retail, Home automation, Transport and Logistics	?	?	Yes	Fast	?	Yes	Contact for a quote	2015 GSMA Global Mobile Awards Winner: Best Mobile Innovation for the 'Internet of Things
~~Samsung~~	ARTIK	-	-				-	-	-	-	-	-	-	-	-	-
Ericsson	DCP	?	Yes				AT&T	Smart city, Telecommunication, Smart metering	REST API	CoAP	Yes	Medium				
Oracle	Oracle Internet of Things	?	Yes								Yes					

Company	Product	Type	Archidecture	Can be hosted by Telia?	Who owns the customer?	Scalability	Open source	REST	Device management	Data mining	Dashboard	Automated business rules	End to end security
HP	HPE IoT Platform	Saas	Cloud-based	Yes	Telia	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Intel	Mix of HW and SW	?	?	?	?	Yes	No	?	?	Yes	?	?	Yes
Xively	Xively	Paas / Saas	Cloud-based	?	?	Yes	No	Yes	Yes	Yes	Yes	Yes	?
Sap IoT platform	HANA Cloud Platform												
Exosite	Exosite	Paas	Cloud-based	No	?	Yes	No	Yes	Yes	Yes	Yes	Yes	?
Carriots	Carriots	Paas	Cloud-based	No									
Verizon	ThingSpace	Paas	Cloud-based	No									
Octoblu/Citrix	Octoblu	Saas / Private		Yes			80%	Yes	Yes	Yes			?
ThingSpeak	ThingSpeak	Saas / Private	Centralized	Yes	Telia	?	Yes	Yes	Yes	Yes (Matlab)	Yes	Yes	?
Evrythng	Evrythng	Paas / Saas	Cloud-based	?	Telia	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
CyberVision, Inc	Kaa	Private	On-premises, cloud, or mixed	Yes	Telia	?	Yes	Yes	Yes			Yes	Yes
Scada	B-Scada												

Company	Product	Multiple languages	Geolocation	List of supported devices	New device provisioning	Device/client specific authorization	Telco References	In what applications	Integration	Protocols supported	Millions of devices?	Time to market	Free trial	Future-proof?	Price	Others
HP	HPE IoT Platform		Yes								Yes		Yes	Yes		
Intel	Mix of HW and SW	?	?				?	?	?	?	?	?	?	?	?	
Xively	Xively	?	Yes				No		REST API	WebSockets, MQTT	Yes	?	No	?	?	
Sap IoT platform	HANA Cloud Platform															
Exosite	Exosite	?	Yes						REST API	COAP						
Carriots	Carriots															
Verizon	ThingSpace															
Octoblu/Citrix	Octoblu							IP and non-IP devices	REST API	HTTP, WebSockets, MQTT, and CoAP						
ThingSpeak	ThingSpeak	Yes	Yes				No	For Arduino, Raspberry Pi, BeagleBone etc	REST API	HTTP	Yes	?	Yes	?	GPLv3	
Evrythng	Evrythng	?	Yes				DT		REST API	MQTT, CoAP and WebSockets.	Yes	?	?			
CyberVision, Inc	Kaa	?	Yes	Link				Smart City, Agri, Indust, CE, Wear, Health	REST API	Zigbee, mqtt, CoAP, XMPP, TCP, HTTP	Yes	Fast	Yes	?		
Scada	B-Scada															

8.2 Collected Questionnaires

All questionnaires collected form the stakeholders are provided as an annex to this deliverable.

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Service Providers, ESCOs and Energy Network Managers)

1. Your Profile

Contact Details

• Name	Inhar
• Country	Spain
• Email-address	Inhar.muruaga@veolia.com
• Entity / Company	Giroa
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

ESCO	Main Profile
Energy Network manager	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Its main role in the project will be the deployment and

operation of the new district heating in Vitoria-Gasteiz

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	yes
Building retrofitting	yes
District heating networks	yes
Integrated Infrastructures (RES integration and management)	yes
Sustainable Mobility	no
Electrical Vehicles	no
Public Transportation and Logistics	no
Sharing facilities	no
Social Engagement	no

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	yes	Feedback of use of suitable mobility and energy consumptions.
Public Company	no	
Energy Service Company (ESCO)	yes	Identify energy consumption patterns to detect weaknesses and failures. Compare
Citizens	yes	To know suitable mobility and energy consumptions for adopting energy efficient behaviours
Building Owner	yes	Feedback of energy consumptions for adopt energy efficient behaviours
Solution provider (Company willing to provide services based on the CIOP)	no	
Investor / Promoter	no	
Grant Manager	no	
Energy Network manager	yes	
Others (specify)		Identify energy consumption patterns to detect weaknesses and failures.

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	High	
	Detecting weaknesses to be corrected and strengths to be replicated	High	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	High	
	Detection of buildings with poor performance	High	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	Low	
	Identification of vulnerable areas or buildings	Low	
	Identification of viability for the implementation of a district heating network	High	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	Low	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	Low	
	Smart public lighting management		
Sustainable Mobility	Information about the availability of EVs recharging points		
	Information about the availability of shared green vehicles		

	Information about the availability of bikesharing		
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.		
	Management of granting EVs acquisition		
	Management of the dimension and capacity of the EVs recharging network.		
	Optimization of public transportation routes		
	Optimization of last mile logistic		
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours		
	Providing information about success stories in building retrofitting		
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)		
	Information about schedules and routes of public transportation		

3. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)	http://www.euskalmet.euskadi.net http://www.tutiempo.net/	Weather forecast services.
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

4. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Electrical readings	All the apartments are sending their consumption to a central data base	JSON/XML	Yes – Electrical grid owner grants the access to apartment owner and electricity company

5. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Availability of EV recharging posts	The EV posts provide data about the status that is pushed to a monitoring system	XML	YES – Opendata
Energy Assessment	Availability of Buildings consumption	All the Buildings will send their consumption to a central data base	XML	YES – Opendata
Energy Assessment	Availability of heating production	The heating central production will send their production to a central data base	XML	YES – Opendata
Energy Assessment	Availability of External temperature	A Buildings will send the external temperature to a central data base	XML	YES – Opendata
Energy Assessment	Availability of apartments consumption	All the apartments will send their consumption to a central data base	XML	No, is private information

6. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Service Providers, ESCOs and Energy Network Managers)

1. Your Profile

Contact Details

• Name	Alvaro Arroyo Díaz
• Country	Spain
• Email-address	aarroyo@estudiosgis.com
• Entity / Company	Estudios GIS S.L.
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Service Provider	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

We provide technologic products and services oriented to assets management in the city. Our applications have geographical component, and allow management, georeferenced representation, monitoring, analyse, generation of charts and reports, as well as remote management of several assets such as street lights and irrigation networks.

We have skills and extended experience on two verticals related to SmartEnCity project.

Energy Efficiency

Our technology allows monitoring from a lot of type of sensors:

consumption, power, waste collection, temperature, speed of wind, precipitation, network data, etcetera.

Movility

Our technology is used by Vitoria-Gasteiz Council for control and management of fleet of waste collection. Also we are from Basque Association of Mobility and Logistic.

We aim to build a city model that allow monitoring, consulting and managing data related to mobility, energy efficiency and process of urban planning through ICTs (City Information Open Platform).

We maintain Vitoria-Gasteiz City Council's Geographic Information System, eleven years ago. Therefore we know perfectly Vitoria-Gasteiz City Council's Technologies.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	
Building retrofitting	YES
District heating networks	YES
Integrated Infrastructures (RES integration and management)	YES
Sustainable Mobility	
Electrical Vehicles	YES
Public Transportation and Logistics	YES
Sharing facilities	YES
Social Engagement	NO

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	YES	Monitoring and analysis of the district consumptions, consulting and exploitation of data mobility (Traffic, emission C02, …) and environmental data (temperature, speed of the wind, humidity, waste collection).
Public Company	YES	Recommendation to save energy and efficient use of transport (people and goods).
Energy Service Company (ESCO)		
Citizens	YES	Access and consulting of data mobility, availability of public services and recommendation systems for adopting energy efficient behaviours
Building Owner		
Solution provider (Company willing to provide services based on the CIOP)	YES	Treatment of data and generation of added value services
Investor / Promoter		
Grant Manager		
Energy Network manager		
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns		
	Detecting weaknesses to be corrected and strengths to be replicated		
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	High	
	Detection of buildings with poor performance		
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)		
	Identification of vulnerable areas or buildings		
	Identification of viability for the implementation of a district heating network		
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	High	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	Medium	
	Smart public lighting management	Medium	
Sustainable Mobility	Information about the availability of EVs		

	recharging points		
	Information about the availability of shared green vehicles	Medium	
	Information about the availability of bikesharing		
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.		
	Management of granting EVs acquisition		
	Management of the dimension and capacity of the EVs recharging network.		
	Optimization of public transportation routes	High	
	Optimization of last mile logistic	High	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours		
	Providing information about success stories in building retrofitting		
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	High	
	Information about schedules and routes of public transportation	High	

3. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine	http://www.vitoria-gasteiz.org/we001/was/we001Action.do?idioma=es&aplicacion=j16-02&tabla=inicio	Geovitoria, provides public API for calculation of routes
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		
weather stations and sensors installed on the European project Irrigestlife	http://www.irrigestlife.eu	There are five weather stations that contain several type of sensors

4. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Electrical readings**	**All the apartments are sending their consumption to a central data base**	**JSON/XML**	**Yes – Electrical grid owner grants the access to apartment owner and electricity company**
Sustainable Mobility	Traffic density on real-time	Traffic density on real-time	JSON	Yes
Sustainable Mobility	Works in the streets	Works in the streets	XML	Yes
Sustainable Mobility	Traffic Incidences	Incidences because of traffic	JSON	Yes
Sustainable Mobility	Geolocation public bus	Geolocation public bus	JSON	Yes
	Environment data	Environment data from sensors; temperature, speed of the wind, humidity.		NO
	Waste collection	Department of Environment has data about daily waste collection		NO

5. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Availability of EV recharging posts**	**The EV posts provide data about the status that is pushed to a monitoring system**	**XML**	**YES – Opendata**
	Monitoring of most relevant KPIs (indoor)	Monitoring of most relevant KPIs at different levels (dwelling, building, district)	JSON	
	Monitoring of most relevant KPIs (District Heating)	Monitoring of most relevant KPIs at network disctrict heating	JSON	
	Geolocation of rental cars and bikes	Geolocation traking for billing purposes and KPI calculations	JSON	
	Monitoring of most relevant KPIs (outdoor)	Monitoring of most relevant KPIs at Street lights	JSON	

6. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnair

(For Service Providers, ESCOs and Energy Network Managers)

1. Your Profile

Contact Details

• Name	Javier de Rivas
• Country	Spain
• Email-address	j.derivas@fagorederlan.es
• Entity / Company	Fagor Ederlan Group
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Public Company	Main Profile
Solution Provider	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Design and implementation of new business models of mobility services for persons and goods with electric vehicles.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	NO
Building retrofitting	NO
District heating networks	NO
Integrated Infrastructures (RES integration and management)	NO
Sustainable Mobility	YES
Electrical Vehicles	YES
Public Transportation and Logistics	YES
Sharing facilities	YES
Social Engagement	NO

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	YES	City monitorization and control
Public Company	YES	Services optimization
Energy Service Company (ESCO)		
Citizens		
Building Owner		
Solution provider (Company willing to provide services based on the CIOP)		
Investor / Promoter		
Grant Manager		
Energy Network manager		
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns		
	Detecting weaknesses to be corrected and strengths to be replicated		
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)		
	Detection of buildings with poor performance		
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)		
	Identification of vulnerable areas or buildings		
	Identification of viability for the implementation of a district heating network		
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)		
	Integrated electrical and thermal network energy management systems (at home, building and district level)		
	Smart public lighting management		
Sustainable Mobility	Information about the availability of EVs recharging points	LOW	
	Information about the availability of shared green vehicles	LOW	

	Information about the availability of bikesharing		
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	LOW	
	Management of granting EVs acquisition	Medium	
	Management of the dimension and capacity of the EVs recharging network.	Medium	
	Optimization of public transportation routes	Medium	
	Optimization of last mile logistic	HIGH	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours		
	Providing information about success stories in building retrofitting		
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)		
	Information about schedules and routes of public transportation		
Sustainable Mobility	Information about the feasilibility of exploitation of new social transport and vehicle sharing business models, based on electro mobility.	HIGH	
	Information about the feasilibility of exploitation of new goods transports business models, based on electro mobility.	HIGH	

3. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

4. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Electrical readings	All the apartments are sending their consumption to a central data base	JSON/XML	Yes – Electrical grid owner grants the access to apartment owner and electricity company

5. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Availability of EV recharging posts**	**The EV posts provide data about the status that is pushed to a monitoring system**	**XML**	**YES – Opendata**
Sustainable Mobility	Vehicle data	Kms, energy consumption, geolocalization, activity time…	XML	NO

6. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Municipalities and Public Companies)

1. Your Profile

Contact Details

• Name	Patxi Hernández
• Country	Spain
• Email-address	Patxi.h@visesa.eus
• Entity / Company	VISESA
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Public company (Housing)	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

VISESA is a public company of the Housing Department of the Basque Government, whose main objective is to promote high quality subsidized housing in the Basque Region, thus contributing to the effort by the Regional Government to make real the right of housing in all social sectors. VISESA plays a key role on urban transformation as a developer of energy efficiency new housing and promoting energy efficient building refurbishment.

Within SmartEnCity project, VISESA is the Vitoria-Gasteiz Lighthouse project coordinator, and responsible of the renovation of 750 dwellings (60.000m2) in the Coronation district, including their connection to the new biomass fueled district heating.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	
Building retrofitting	YES (Main focus)
District heating networks	YES
Integrated Infrastructures (RES integration and management)	YES
Sustainable Mobility	
Electrical Vehicles	NO
Public Transportation and Logistics	NO
Sharing facilities	NO
Social Engagement	NO

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	YES	Access to monitoring data for evaluation of the real performance of the projects.
Public Company	YES	Access to monitoring data for evaluation of the real performance of the projects.
Energy Service Company (ESCO)	YES	Access to real data for potential replication of projects
Citizens	NO	
Building Owner	NO	
Solution provider (Company willing to provide services based on the CIOP)	YES	Will depend on the quality of data accessible through the CIOP
Investor / Promoter	NO	
Grant Manager	NO	
Energy Network manager	YES	Study of system performance, viability of new projects and replication.
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

3. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	HIGH	
	Detecting weaknesses to be corrected and strengths to be replicated	HIGH	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	HIGH	
	Detection of buildings with poor performance	HIGH	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	HIGH	
	Identification of vulnerable areas or buildings	HIGH	
	Identification of viability for the implementation of a district heating network	HIGH	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	Medium	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	Medium	
	Smart public lighting management	Low	
Sustainable Mobility	Information about the availability of EVs recharging points	Low	

	Information about the availability of shared green vehicles	Low	
	Information about the availability of bikesharing	Low	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	Low	
	Management of granting EVs acquisition	Low	
	Management of the dimension and capacity of the EVs recharging network.	Low	
	Optimization of public transportation routes	Low	
	Optimization of last mile logistic	Low	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	High	
	Providing information about success stories in building retrofitting	High	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	Low	
	Information about schedules and routes of public transportation	Low	
	Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding , etc)	HIGH	

4. Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		
EuskoREGITE	www.euskoregite.com	Repository on technical building inspections

5. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Visualization of building energy ratings	2D maps
Visualization of solar potential in roofs	2D maps

6. **Citizen engagement**
   6.1. Do you have an online citizen participation portal? NO

If yes, describe the main functionalities

1.	**2.**
3.	**4.**
5.	**6.**
7.	**8.**

6.2. What is the main added value that the CIOP platform can provide to the citizen?

Direct communication and information about procedures to follow , funding opportunities, technical details, etc.

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

7. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Electrical readings	All the apartments are sending their consumption to a central data base	JSON/XML	Yes – Electrical grid owner grants the access to apartment owner and electricity company

8. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Availability of EV recharging posts	The EV posts provide data about the status that is pushed to a monitoring system	XML	YES – Opendata

9. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Cost of electricity	If user has contracted a variable cost tariff, the hourly cost of electricity is an interesting input to allow optimizing the use and reduce the energy costs.	JSON/XML	Yes – https://www.esios.ree.es/es/pvpc

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Citizen, Owners, Promoters and Grant Managers)

1. Your Profile

Contact Details

• Name	Tõnis Eelma
• Country	Estonia
• Email-address	toni@ise.ee
• Entity / Company	Smart City Lab
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Building manager	Main Profile
Inhabitant	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Representing inhabitants / building owners of pilot area in Tartu. Testing smart home solutions for pilot area buildings.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	Y
Building retrofitting	Y
District heating networks	N
Integrated Infrastructures (RES integration and management)	N
Sustainable Mobility	N
Electrical Vehicles	N
Public Transportation and Logistics	N
Sharing facilities	N
Social Engagement	Y

2. CIOP Features

Please answer the following questions:

1. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

2. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	H	
	Detecting weaknesses to be corrected and strengths to be replicated	M	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	L	
	Detection of buildings with poor performance	M	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	L	
	Identification of vulnerable areas or buildings	M	
	Identification of viability for the implementation of a district heating network	L	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	L	
	Integrated electrical and thermal network	H	

	energy management systems (at home, building and district level)		
	Smart public lighting management	M	
Sustainable Mobility	Information about the availability of EVs recharging points	M	
	Information about the availability of shared green vehicles	M	
	Information about the availability of bikesharing	M	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	M	
	Management of granting EVs acquisition	M	
	Management of the dimension and capacity of the EVs recharging network.	L	
	Optimization of public transportation routes	L	
	Optimization of last mile logistic	L	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	H	
	Providing information about success stories in building retrofitting	H	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	M	
	Information about schedules and routes of public transportation	H	

	Personal additions:		
Other (Building management)	Collecting energy consumption data from apartments		
Energy assessment	Buildings energy consumption monitoring		
Citizen engagement	District information distribution		
Citizen engagement	Influencing on people energy consumption habits		
Sustainable mobility	Input for city transport planning		

3. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Smart home solution	Overview of energy and resources consumption
Smart home solution	Real time energy and resources consumption with expected costs
Smart home solution	Video stream from front door and outdoor area
Smart home solution	Messages from house cooperative and municipality

4. **Citizen engagement**

6.1- Do you have an online citizen participation portal? YES NO

If yes, describe the main functionalities

1.	
2.	
3.	
4.	

6.2- What is the main added value that the CIOP platform can provide to the citizen?

To see online information about transportation, electrical vehicles, building retrofitting efficiency

1. From questionnaire ver0.8:

2. List of existing data sources available (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
Energy	Electrical reading	All the apartments are sending their consumption to a central data base (accessible to …)		Yes – Electrical grid owner grants the access to apart. Owner and electricity company

3. List of new data sources planned within SmartEnCity project (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
Energy	Thermostats	Metering heating energy		Yes – for owner and building manager
Energy	Gas meter	Metering gas consumption		Yes – for owner and building manager
Resources	Water meters	Metering water consumption		Yes – for owner and building manager
Energy	Temperature meters	Metering indoor temperature		Yes – for owner and building manager
Security	Smoke detectors	Smoke and fire alarms		Yes – for owner and building manager

4. **List of new data sources in the future (list all your wildest ideas)**(complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
Security	Video stream and recordings	Streaming and recording video in building public areas + indoor cameras for personal use		Yes – for owner and building manager
Security	Location indicators	Possibility to track objects (personal belongings) movement and location		Yes – citizen
			o	

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Municipalities and Public Companies)

1. Your Profile

Contact Details

• Name	Raimond Tamm
• Country	Estonia
• Email-address	raimond.tamm@raad.tartu.ee
• Entity / Company	Tartu City Government
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Municipality	Main Profile
Grant Manager	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Tartu Lighthouse coordinator in SmartEnCity project, member of Tartu City Council. Participate in the discussions and decision making regarding the master plans, which show the way to energy efficient development of the city technical infrastructure. To guarantee the heating of the houses with renewable energy the rules of using the solar panels, wind generators and ground heat will be set in the new master plan (probably will be approved in 2017).

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	Y
Building retrofitting	Y
District heating networks	Y
Integrated Infrastructures (RES integration and management)	Y
Sustainable Mobility	Y
Electrical Vehicles	Y
Public Transportation and Logistics	Y
Sharing facilities	Y
Social Engagement	Y

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality		Online and on-time readings of (energy)consumptions (building level); online on-time readings of PV panels energy production; online real-time information and on-time readings from street lighting sensors network and EV rental points; online on-time readings of public transportation (gas buses); online on-time readings of supported private EVs (incl taxis); online on-time readings of bike sharing , EV chargers, results from polling environment
Public Company		
Energy Service Company (ESCO)		
Citizens		Online and on-time readings of (energy)consumptions (building and apartement level); online real-time information from street lighting sensors network and EV rental points, EV chargers
Building Owner		Online and on-time readings of all types of (energy)consumptions (building level); online on-time readings of PV panels energy production
Solution provider (Company willing to provide services based on the CIOP)		Online real-time information and on-time readings from street lighting sensors network and EV rental points; online on-time readings of bike sharing, EV chargers
Investor / Promoter		
Grant Manager		
Energy Network manager		
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

3. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	H	
	Detecting weaknesses to be corrected and strengths to be replicated	H	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	H	
	Detection of buildings with poor performance	H	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	H	
	Identification of vulnerable areas or buildings	H	
	Identification of viability for the implementation of a district heating network	M	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	H	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	H	
	Smart public lighting management	H	
Sustainable Mobility	Information about the availability of EVs recharging points	H	

	Information about the availability of shared green vehicles	M	
	Information about the availability of bikesharing	M	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	M	
	Management of granting EVs acquisition	H	
	Management of the dimension and capacity of the EVs recharging network.	H	
	Optimization of public transportation routes	H	
	Optimization of last mile logistic	H	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	H	
	Providing information about success stories in building retrofitting	H	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	H	
	Information about schedules and routes of public transportation	H	

	Personal additional information:		
Municipality	Street lighting network sensor data analysis reports – might be comparison tables, 2D interactive maps, pie/bar charts with figures etc		
Municipality	EV and e-bikes (incl rental points) data analysis reports - might be comparison tables, pie/bar charts with figures etc		
Municipality	Bike sharing data analysis reports - might be comparison tables, pie/bar charts with figures etc		
Service provider	Smart energy (heating, power) management in apartement buildings (based on current market prices etc) - might be comparison tables, pie/bar charts with figures etc		
Municipality	EV chargers data analysis reports - might be comparison tables, pie/bar charts with figures etc		
Municipality	Results from polling		
Municipality	Report of suggestions from public transport planning tool		
Service provider	Distric cooling station and reusing its heat energy in distric heating system		

4. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

5. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Street lighting network sensor data analysis reports	might be comparison tables, 2D interactive maps, pie/bar charts with figures etc
EV and e-bikes (incl rental points) data analysis reports	might be comparison tables, pie/bar charts with figures etc
Bike sharing data analysis reports	might be comparison tables, pie/bar charts with figures etc
Smart energy (heating, power) management in apartement buildings (based on current market prices etc)	might be comparison tables, pie/bar charts with figures etc
EV chargers data analysis reports	might be comparison tables, pie/bar charts with figures etc
Results from polling	
Report of suggestions from public transport planning tool	
Distric cooling station and reusing its heat energy in distric heating system	

6. **Citizen engagement**
   6.1. Do you have an online citizen participation portal? **YES** **NO**

If yes, describe the main functionalities

1.	**Possibility to prepare and conduct various polls**
2.	
3.	
4.	

6.2. What is the main added value that the CIOP platform can provide to the citizen?

Real-time info, on-time readings, engagement

7. **List of existing data sources available** (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Electrical readings	All the apartments are sending their consumption to a central data base	JSON/XML	Yes – Electrical grid owner grants the access to apartment owner and electricity company
Energy	Electrical reading	All the apartments are sending their consumption to a central data base (accessible to …)		Yes – Electrical grid owner grants the access to apart. Owner and electricity company
Mobility	GPS	GPS information (position, mileage, working hours) from real-time bus info system	XML	Yes

8. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Availability of EV recharging posts**	**The EV posts provide data about the status that is pushed to a monitoring system**	**XML**	**YES – Opendata**
Energy		Energy (heat, power, water) consumptions data from apartements and buildings		
Energy		Energy production data from PV panels system		
Infrastucture		Street lighting network sensors data		
Mobility		EV rental points data		
Mobility		Public transportation data		
Mobility		Private EV (inc taxis) data		
Mobility		Bike-sharing system data		
Mobility		EV chargers data		
Infrastructure		Street lighting energy consumption data		
Mobility		Public transport planning tool data		
Energy		Energy re-use information from the central cooling		

		station		
Engagement		Polling environment data		

9. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Service Providers, ESCOs and Energy Network Managers)

1. Your Profile

Contact Details

• Name	Martin KIKAS
• Country	Estonia
• Email-address	Martin.kikas@trea.ee
• Entity / Company	TREA
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	Martin Kikas

Type of Stakeholder

Other, Energy Agency	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Advising and consulting organization providing consulting services for energy end users like households, local administration, SME-s on field of energy efficiency and using renewable energy sources. Consultancy of sustainable renovation.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	Y
Building retrofitting	Y
District heating networks	Y
Integrated Infrastructures (RES integration and management)	Y
Sustainable Mobility	N
Electrical Vehicles	N
Public Transportation and Logistics	N
Sharing facilities	N
Social Engagement	N

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality		District or city level – data readings
Public Company		
Energy Service Company (ESCO)		Data readings (by inhabitant mandate) Assessment of energy consumption,
Citizens		Inside climate control, apartment level data readings and control
Building Owner		Online and on-time readings of all types of (energy)consumptions
Solution provider (Company willing to provide services based on the CIOP)		
Investor / Promoter		
Grant Manager		
Energy Network manager		
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	H	
	Detecting weaknesses to be corrected and strengths to be replicated	H	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	H	
	Detection of buildings with poor performance	H	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	H	
	Identification of vulnerable areas or buildings	H	
	Identification of viability for the implementation of a district heating network	H	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	H	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	H	
	Smart public lighting management	M	
Sustainable Mobility	Information about the availability of EVs	M	

	recharging points		
	Information about the availability of shared green vehicles	L	
	Information about the availability of bikesharing	L	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	L	
	Management of granting EVs acquisition	L	
	Management of the dimension and capacity of the EVs recharging network.	M	
	Optimization of public transportation routes	L	
	Optimization of last mile logistic	L	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	H	
	Providing information about success stories in building retrofitting	H	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	M	
	Information about schedules and routes of public transportation	L	

	Personal additional input:		
Energy assessment	Data collection (heat, electricity, inside climate)		
Energy assessment	Energy consumption (inside climate) control (management)		
Energy assessment	Energy assessment on building and city level		

3. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS

4. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Electrical readings	All the apartments are sending their consumption to a central data base	JSON/XML	Yes – Electrical grid owner grants the access to apartment owner and electricity company
Energy	Electrical reading	All the apartments are sending their consumption to a central data base accessible to consumer		Yes – Electrical grid owner grants the access to apart. Owner and electricity company
Energy	Heating reading	Building level consumption data will be sent to a central data base accessible to Appartment association. Consumption data will be sent from service provider to apartment association.		Yes?
Energy	Water reading	All apartment owners provide data to service provider monthly.		no
Energy	Gas reading	All the apartments are sending their consumption to a central data base accessible to consumer		no

5. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Availability of EV recharging posts	The EV posts provide data about the status that is pushed to a monitoring system	XML	YES – Opendata
Energy	Electrical energy readings	Apartment level, aggregated data building level and district level. Consumption data, peak loads, ?		Yes
Energy	Electrical energy readings	Produced energy by PV panels reading on building level and district level, production, own consumption, peaks, sold to grid		Yes
Energy	Heating energy readings	Apartment level and building level. On building level heating and for domestic hot water. Consumption, peaks,		yes
Energy	Water (cold) consumption readings	Apartment level and aggregated data on building level Consumption, peaks		yes
Energy	CO2 readings	CO2 readings on apartment level and management,		Yes?
Energy	temperature	Temperature management on apartment level		No ?

6. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
Energy	Electrical energy	On building level, Benchmarking with regulations (energy performance levels, with average, with other buildings)		
Energy	Electrical energy	On apartment level with others apartments?		
Energy	heating	Data and control on room level (temp set).		
Energy	ventilation	Ventilation control by user		

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Municipalities and Public Companies)

1. Your Profile

Contact Details

• Name	Rein Ahas
• Country	Estonia
• Email-address	Rein.ahas@ut.ee
• Entity / Company	University of Tartu
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

University	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Studying social innovation models for better using sensor data and engagement.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	N
Building retrofitting	N
District heating networks	N
Integrated Infrastructures (RES integration and management)	N
Sustainable Mobility	Y
Electrical Vehicles	N
Public Transportation and Logistics	Y
Sharing facilities	Y
Social Engagement	Y

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality		
Public Company		
Energy Service Company (ESCO)		
Citizens		Saving energy and money
Building Owner		Online and on-time readings of all types of (energy)consumptions
Solution provider (Company willing to provide services based on the CIOP)		
Investor / Promoter		
Grant Manager		
Energy Network manager		
Others (specify) – University		Developing data models

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

3. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	L	
	Detecting weaknesses to be corrected and strengths to be replicated	L	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	M	
	Detection of buildings with poor performance	L	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	M	
	Identification of vulnerable areas or buildings	L	
	Identification of viability for the implementation of a district heating network	L	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	L	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	M	
	Smart public lighting management	M	
Sustainable Mobility	Information about the availability of EVs recharging points	M	

	Information about the availability of shared green vehicles	M	
	Information about the availability of bikesharing	M	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	M	
	Management of granting EVs acquisition	L	
	Management of the dimension and capacity of the EVs recharging network.	M	
	Optimization of public transportation routes	M	
	Optimization of last mile logistic	M	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	H	
	Providing information about success stories in building retrofitting	M	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	M	
	Information about schedules and routes of public transportation	H	

	Personal additional information:		
	Citizen engagement		
	Innovation models		

4. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

5. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Municipality	**Comparison tables**
Energy provider	**2d maps**
Persons living in smart house	**Visual analytics toolkit**

6. **Citizen engagement**
   6.1. Do you have an online citizen participation portal? **YES** **NO**

If yes, describe the main functionalities

Analyses of energy use and money saving
1. Yes, we have portal for distributing information and getting feedback
2.
3.

6.2. What is the main added value that the CIOP platform can provide to the citizen?

7. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Electrical readings	All the apartments are sending their consumption to a central data base	JSON/XML	Yes – Electrical grid owner grants the access to apartment owner and electricity company
Energy	Electrical reading	All the apartments are sending their consumption to a central data base (accessible to …)		Yes – Electrical grid owner grants the access to apart. Owner and electricity company

8. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	Availability of EV recharging posts	The EV posts provide data about the status that is pushed to a monitoring system	XML	YES – Opendata
House	All smart meters: electricity, heating, water consumption	Smart meters	Machine reading potential	Yes, but limited with privacy
Mobility	Electric car GPS log	Car use by person		Yes

9. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
Persons living in	**Personal CO footprint tracker in smartphone**	**App for tracking and questionning**	**digital**	**Yes, privacy concerns**

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Citizen, Owners, Promoters and Grant Managers)

1. Your Profile

Contact Details

• Name	Mathias Rasmussen
• Country	Denmark
• Email-address	mara@sonfor.dk
• Entity / Company	Sønderborg Forsyning A/S
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	
Building retrofitting	No
District heating networks	No
Integrated Infrastructures (RES integration and management)	Yes
Sustainable Mobility	
Electrical Vehicles	No
Public Transportation and Logistics	No
Sharing facilities	No
Social Engagement	

2. CIOP Features

Please answer the following questions:

1. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

2. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	High	
	Detecting weaknesses to be corrected and strengths to be replicated	Medium	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	Low	
	Detection of buildings with poor performance	Medium	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	High	
	Identification of vulnerable areas or buildings	High	
	Identification of viability for the implementation of a district heating network	Medium	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	High	
	Integrated electrical and thermal network	High	

	energy management systems (at home, building and district level)		
	Smart public lighting management	Medium	
Sustainable Mobility	Information about the availability of EVs recharging points	Low	
	Information about the availability of shared green vehicles	Low	
	Information about the availability of bikesharing	Low	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	Medium	
	Management of granting EVs acquisition	High	
	Management of the dimension and capacity of the EVs recharging network.	High	
	Optimization of public transportation routes	Medium	
	Optimization of last mile logistic	Medium	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	Low	
	Providing information about success stories in building retrofitting	Medium	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	Low	
	Information about schedules and routes of public transportation	High	

3. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures

4. **Citizen engagement**

6.1- Do you have an online citizen participation portal? YES NO

If yes, describe the main functionalities

1.
2.
3.
4.

6.2- What is the main added value that the CIOP platform can provide to the citizen?

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Citizen, Owners, Promoters and Grant Managers)

1. Your Profile

Contact Details

• Name	Hans Peter Hollænder
• Country	Denmark
• Email-address	hph@soebo.dk
• Entity / Company	Housing Association Soebo
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Housing Association	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Our district heating company aims to be CO2 neutral in 2029 by burning waste, using geothermal heating from the underground and PVs. Our buildings will produce electricity from PVs. Beside that we will reduce heating costs by installing new energy efficient windows etc.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assessment	
Building retrofitting	yes
District heating networks	yes
Integrated Infrastructures (RES integration and management)	don't understand the question
Sustainable Mobility	
Electrical Vehicles	Maybe
Public Transportation and Logistics	no
Sharing facilities	no
Social Engagement	

2. CIOP Features

Please answer the following questions:

1. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

2. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns		
	Detecting weaknesses to be corrected and strengths to be replicated		
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)		
	Detection of buildings with poor performance		
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)		
	Identification of vulnerable areas or buildings		
	Identification of viability for the implementation of a district heating network		
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)		
	Integrated electrical and thermal network		

	energy management systems (at home, building and district level)		
	Smart public lighting management		
Sustainable Mobility	Information about the availability of EVs recharging points		
	Information about the availability of shared green vehicles		
	Information about the availability of bikesharing		
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.		
	Management of granting EVs acquisition		
	Management of the dimension and capacity of the EVs recharging network.		
	Optimization of public transportation routes		
	Optimization of last mile logistic		
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	Yes	
	Providing information about success stories in building retrofitting	Yes	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)		
	Information about schedules and routes of public transportation		

3. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures

4. **Citizen engagement**

6.1- Do you have an online citizen participation portal? YES NO

If yes, describe the main functionalities

1.
2.
3.
4.

6.2- What is the main added value that the CIOP platform can provide to the citizen?

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Citizen, Owners, Promoters and Grant Managers)

1. Your Profile

Contact Details

• Name	Nicolas
• Country	Bernhardi
• Email-address	Nicolas.Bernhardi@projectzero.dk
• Entity / Company	ProjectZero
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Other (public-private-partnership, none profit organisation)	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager

- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

ProjectZero is Sonderborgs vision to become CO2-neutral by 2029 - 20 years ahead of Denmark. ProjectZero is also a PPP company that drive the implementation of the ProjectZero-vision. Through different initiatives addressing the citizens, companies and institutions, ProjectZero aims to facilitate more energy efficient solutions, energy retrofitting of buildings, green transportation, to reduce CO2 emissions and creating green jobs, demonstrating that a ZEROcarbon community is doable.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	
Building retrofitting	Yes
District heating networks	Yes
Integrated Infrastructures (RES integration and management)	Yes
Sustainable Mobility	YES
Electrical Vehicles	Yes
Public Transportation and Logistics	Yes

Sharing facilities	No
Social Engagement	Yes

2. CIOP Features

Please answer the following questions:

1. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

2. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	Medium	Could be interesting in order to see if there is a possibility for load shifting and demand-side management.
	Detecting weaknesses to be corrected and strengths to be replicated	High	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	High	
	Detection of buildings with poor performance	High	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	High	
	Identification of vulnerable areas or buildings	?	Vulnerable to what?
	Identification of viability for the implementation of a district heating network	Low	The district heating plan of the Sonderborg municipality took care of this last year (2015)

	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	Low	There is already detailed planning on RES in the Sonderborg municipality
	Integrated electrical and thermal network energy management systems (at home, building and district level)	High	Very interesting
	Smart public lighting management	Medium	From a perspective of energy savings the potential seems rather low, as almost everywhere LED is the choice for public lightning. Though this topic can have a big effect in terms of citizen engagement, as this would be a result of SmartEnCity that would be very visible to everyone in the city.
Sustainable Mobility	Information about the availability of EVs recharging points	Low	http://www.ladekort.danskelbilalliance.dk/
	Information about the availability of shared green vehicles	High	N/A
	Information about the availability of bikesharing	High	N/A
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	High	N/A
	Management of granting EVs acquisition	High	N/A
	Management of the dimension and capacity of the EVs recharging network.	High	In Sonderborg there will be installed smart EV chargers from www.evergreen.dk. Probably this function is already included. If not, this could be interesting.

	Optimization of public transportation routes	Low	Is constantly optimized
	Optimization of last mile logistic	Medium	Could be interesting but only if easy to implement, as it does not seem to be that important.
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	Low/medium	Depends on the frequency and type of survey.
	Providing information about success stories in building retrofitting	High	Already done on ProjectZero website and in ZEROnyt
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	High	N/A
	Information about schedules and routes of public transportation	Low	Is already in place but could probably be included here as well.
	Live CO2/renewables information	High	Showing some real time data, so citizens begin to think about their energy consumption more frequently.

3. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Interactive displaying of information	Citizens should actively be informed via information on city displays/screens
Benchmarking of housing association	The citizens of the housing ascensions should be constantly informed about their own energy performance and should benchmarked to each other. This can be done through different KPI's graphs and charts.
Smart charging of EV's	The current free capacity and charging status of the EV fleet should be displayed (as sum for all cars).

4. **Citizen engagement**

6.1- Do you have an online citizen participation portal? **NO**

If yes, describe the main functionalities

1.
2.
3.
4.

6.2- What is the main added value that the CIOP platform can provide to the citizen?

The citizens will be updated about opportunities, participatory choices and progress of the project. Appears to be very much like the www.projectzero.dk website, but maybe more interactive …

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Municipalities and Public Companies)

1. Your Profile

Contact Details

• Name	Iben Nielsen
• Country	Denmark
• Email-address	ibni@sonfor.dk
• Entity / Company	Sønderborg Forsyning
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

I am the project manager responsible for SONF whom is WP5 leader. SONF is a utilities company in Sønderborg and is responsible for water, waste water, some district heating and waste collection and recycling. SONF strives to continuously improve efficiency in operations to reduce the environmental impact of our work at the lowest cost to our customers. We have acquired EVs, trucks have been converted to run partly on electricity, PVs have been installed on the roofs of the HQ and several recycling locations, data loggers have been installed to track energy, heat and water consumption and PV production in real time. For example; to ensure quality services in the future our new water facilities use stainless steel and have two separate lines in case of contamination of one the other can still run.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assessment	
Building retrofitting	No
District heating networks	Yes
Integrated Infrastructures (RES integration and management)	YES
Sustainable Mobility	
Electrical Vehicles	YES
Public Transportation and Logistics	No
Sharing facilities	No
Social Engagement	No

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	Yes	Data collection and factual feedback on implemented changes
Public Company	Yes	Data collection and factual feedback on implemented changes
Energy Service Company (ESCO)	Possibly	
Citizens	Yes	Interaction and feedback between service provider and customer
Building Owner	Yes	Specific actions can be taken due to building feedback from data loggers
Solution provider (Company willing to provide services based on the CIOP)	Possibly	
Investor / Promoter	Possibly	
Grant Manager	Possibly	
Energy Network manager	Yes	
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

3. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	High	
	Detecting weaknesses to be corrected and strengths to be replicated	High	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	High	
	Detection of buildings with poor performance	Medium	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	Medium	
	Identification of vulnerable areas or buildings	Low	
	Identification of viability for the implementation of a district heating network	Low	The majority of the municipality is already marked as dristrict heating area.
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	Low	RES is more influenced by politics than by potential benefits
	Integrated electrical and thermal network energy management systems (at home, building and district level)	Medium	
	Smart public lighting management	Low	All public lights are currently being converted to new LEDs.

Sustainable Mobility	Information about the availability of EVs recharging points	High	
	Information about the availability of shared green vehicles	Medium	
	Information about the availability of bikesharing	Medium	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	High	
	Management of granting EVs acquisition	Low	
	Management of the dimension and capacity of the EVs recharging network.	Medium	
	Optimization of public transportation routes	Low	Denmark as a country has apps for this and they work very well already.
	Optimization of last mile logistic		
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	Medium	
	Providing information about success stories in building retrofitting	Medium	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	High	
	Information about schedules and routes of public transportation	Low	Denmark as a country has apps for this and they work very well already.

4. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine	www.rejseplanen.dk	
Weather forecast service (e.g. Accuweather, weatherforecast)	www.yr.no	
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

5. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures

6. **Citizen engagement**
   6.1. Do you have an online citizen participation portal? **<u>NO</u>**

If yes, describe the main functionalities

1.
2.
3.
4.

6.2. What is the main added value that the CIOP platform can provide to the citizen?

Feedback and dialogue instead of one-way communication.

7. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Electrical readings**	**All the apartments are sending their consumption to a central data base**	**JSON/XML**	**Yes – Electrical grid owner grants the access to apartment owner and electricity company**
Energy assessment	Electrical/heat/water	Apartments may have individual meters (water, electricity, but also they may have only one meter for the building and share the cost evenly between the apartments.		

8. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Availability of EV recharging posts**	**The EV posts provide data about the status that is pushed to a monitoring system**	**XML**	**YES – Opendata**
Assessment	Electrical/heat	Real time data logging of retrofitted buildings		

9. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Citizen, Owners, Promoters and Grant Managers)

1. Your Profile

Contact Details

• Name	Anelia Ognianova Lesova
• Country	Bulgaria
• Email-address	a.lesova@abv.bg
• Entity / Company	Municipality Asenovgrad
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

SmartEnCity
Vitoria-Gasteiz – Tartu – Sonderborg

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

I am a citizen who lives in the municipality of Asenovgrad.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	Yes
Building retrofitting	Yes
District heating networks	No
Integrated Infrastructures (RES integration and management)	No
Sustainable Mobility	No
Electrical Vehicles	Yes
Public Transportation and Logistics	Yes
Sharing facilities	No
Social Engagement	Yes

2. CIOP Features

Please answer the following questions:

1. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

2. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	High	
	Detecting weaknesses to be corrected and strengths to be replicated	High	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	Medium	
	Detection of buildings with poor performance	Medium	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	High	
	Identification of vulnerable areas or buildings	High	
	Identification of viability for the implementation of a district heating network	Medium	
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	High	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	High	
	Smart public lighting management	High	

Sustainable Mobility	Information about the availability of EVs recharging points	High	
	Information about the availability of shared green vehicles	Medium	
	Information about the availability of bikesharing	Medium	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	Medium	
	Management of granting EVs acquisition	Medium	
	Management of the dimension and capacity of the EVs recharging network.	High	
	Optimization of public transportation routes	High	
	Optimization of last mile logistic	High	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	High	
	Providing information about success stories in building retrofitting	High	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	High	
	Information about schedules and routes of public transportation	High	

3. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Identification of possible energy savings	3D map
Potential areas of impact	2D maps
Identify potential buildings	comparison tables

4. **Citizen engagement**

6.1- Do you have an online citizen participation portal? **YES** **<u>NO</u>**

If yes, describe the main functionalities

1.
2.
3.
4.

6.2- What is the main added value that the CIOP platform can provide to the citizen?

Date information on energy consumption. A strategy to reduce energy consumption.

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Municipalities and Public Companies)

1. Your Profile

Contact Details

• Name	Georgi Angelov
• Country	Bulgaria
• Email-address	smartencitybg@abv.bg
• Entity / Company	Asenovgrad Municipality
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Municipality	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager
- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

Municipality of Asenovgrad is a Signatory of Covenant of Mayors and has developed and submitted already approved Sustainable Energy Action Plan with an overall CO_2 emission reduction target of 28 % by 2020. The main priority areas are: reduction of energy consumption by 30 % in buildings through building refurbishment – both public municipal and private residential; street lighting refurbishment; energy efficiency in public transport; energy efficiency in local industries; utilization of available wind and solar potential; introducing energy management systems.

Asenovgrad has also developed an Integrated Plan for Urban Regeneration and Development. At present there are three zones of intervention identified: social intervention zone, zone of public functions with high public importance and zone of high economic development potential. The Integrated Plan has been supplemented with concrete projects and measures to be implemented according the potential for interventions in the identified zones.

Concrete sectors of activities to support the above policies are:

- Management of buildings, owned by Asenovgrad Municipality;

-Street lighting refurbishment and control;

-Partner of National energy efficiency program for multifamily residential buildings;

-Beneficiary under the operational programs of the European Union introducing energy efficiency measures;

-others.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	YES

Building retrofitting	YES
District heating networks	
Integrated Infrastructures (RES integration and management)	
Sustainable Mobility	
Electrical Vehicles	YES
Public Transportation and Logistics	YES
Sharing facilities	
Social Engagement	YES

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	Yes	Monitoring and analysis of the district consumptions; Online and real-time readings of all types of energy consumptions
Public Company	Yes	Online and real-time readings of all types of energy consumptions
Energy Service Company (ESCO)	Yes	Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies
Citizens	Yes	engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing
Building Owner	Yes	engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing
Solution provider (Company willing to provide services based on the CIOP)	Yes	providing information on how to improve energy efficiency and best practice examples
Investor / Promoter	Yes	Investment activities
Grant Manager		
Energy Network manager		
Others (specify)		

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

3. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	High	
	Detecting weaknesses to be corrected and strengths to be replicated	High	
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	Medium	
	Detection of buildings with poor performance	High	
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	High	
	Identification of vulnerable areas or buildings	Medium	
	Identification of viability for the implementation of a district heating network	Low	There are only few buildings with central heating systems. The city has a gas distribution network with individual heating facilities at each consumer (apartment or multi-family building)
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	High	
	Integrated electrical and thermal network energy management systems (at home, building and district level)	Medium	
	Smart public lighting management	High	

Sustainable Mobility	Information about the availability of EVs recharging points	High	
	Information about the availability of shared green vehicles	Medium	At the moment Asenovgrad is not planning to introduce shared green vehicles
	Information about the availability of bikesharing	Medium	At the moment Asenovgrad is not planning to introduce bikesharing
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	Medium	
	Management of granting EVs acquisition	Medium	
	Management of the dimension and capacity of the EVs recharging network.	Medium	
	Optimization of public transportation routes	Low	
	Optimization of last mile logistic	Low	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	High	
	Providing information about success stories in building retrofitting	High	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	High	
	Information about schedules and routes of public transportation	Medium	

4. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine		
Weather forecast service (e.g. Accuweather, weatherforecast)		
Survey services (e.g. surveyMonkey, surveyGizmo)		
Social networks (e.g. facebook, twiter)		

5. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures
Identification of areas with high RES potential (e.g. solar, wind)	2D maps and 3D maps with energy potential
Comparison between different energy sources: solar, wind, biomass, geothermal.	Comparison tables.
Comparison between investments needed for different energy sources: solar, wind, biomass, geothermal.	Comparison tables in euro/kWh.

6. **Citizen engagement**

6.1. Do you have an online citizen participation portal? **YES** **NO**

If yes, describe the main functionalities

1.	
2.	
3.	
4.	

6.2. What is the main added value that the CIOP platform can provide to the citizen?

The platform will provide the necessary information for citizens to compare different energy sources, energy efficiency measures, methods of energy management and others to build their own opinion and planning their opportunities to introduce energy efficiency and RES measures.

7. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Electrical readings**	**All the apartments are sending their consumption to a central data base**	**JSON/XML**	**Yes – Electrical grid owner grants the access to apartment owner and electricity company**
Buildings, municipal property	Asenovgrad Municipality has data on energy consumption in buildings, municipal property.	Not applicable	No	Not applicable
Street lighting management	Asenovgrad Municipality has data on the energy consumption of street lighting.	Not applicable	No	Not applicable
Social institutions	Asenovgrad Municipality has data on the energy consumption of social institutions.	Not applicable	No	Not applicable
Schools and kindergartens	Asenovgrad Municipality may request and receive data on the energy consumption of schools and kindergartens on its territory.	Not applicable	No	Not applicable

8. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Availability of EV recharging posts**	**The EV posts provide data about the status that is pushed to a monitoring system**	**XML**	**YES – Opendata**
Buildings, municipal property	Asenovgrad Municipality has data on energy consumption in buildings, municipal property.	Asenovgrad Municipality has data on energy consumption in buildings, municipal property.	Word and/or Excel	No
Street lighting management	Asenovgrad Municipality has data on the energy consumption of street lighting.	Asenovgrad Municipality has data on energy consumption in buildings, municipal property.	Word and/or Excel	No
Social institutions	Asenovgrad Municipality has data on the energy consumption of social institutions.	Asenovgrad Municipality has data on the energy consumption of social institutions.	Word and/or Excel	No
Schools and kindergartens	Asenovgrad Municipality may request and receive data on the energy consumption of schools and kindergartens on its territory.	Asenovgrad Municipality may request and receive data on the energy consumption of schools and kindergartens on its territory.	Word and/or Excel	No

RES utilisation	Installing masts with anemometers for measuring wind speed and direction on municipal territory	The anemometers provide all-year-round data that is fed to a database that will be used to assess the feasibility ofo wind turbines application on the site.	n.a.	No

9. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

ICT System

(CIOP – City Information Open Platform)

User Requirements Questionnaire

(For Municipalities and Public Companies)

1. Your Profile

Contact Details

• Name	ENERGY MANAGER: ING. IVAN VERNICH CONTACT PERSON: DOTT. RAFFAELE PARLANGELI
• Country	Italy
• Email-address	ivan.vernich@comune.lecce.it raffaele.parlangeli@comune.lecce.it
• Entity / Company	Municipality of Lecce
• If you are not a partner of **SmartEnCity** project, the name and company of your contact person in the project.	

Type of Stakeholder

Municipality	Main Profile
	Additional profile 1 (if applicable)
	Additional profile 2 (if applicable)
	Additional profile 2 (if applicable)

Set of possible Stakeholders:

- Municipality
- Public Company
- Energy Service Company (ESCO)
- Citizens' Association
- Building Owner (Not individual)
- Solution provider (Company willing to provide services based on the CIOP)
- Investor / Promoter
- Grant Manager
- Energy Network manager

- Other Local/Regional/National Authority (Describe)
- Other (Describe)

Main Role

Please, provide a brief description of your role in the urban transformation into sustainable, smart and resource-efficient urban environment of your city.

With Deliberation of Town Junta n° 1220 of 15.12.2015 the office Energy has been founded - Renewable Energies and Energetic Saving - (inserted in the CDR XX) with the purpose to effect a census of all the uses and the contracts in to be near all the structures of town ownership and subsequently to predispose special projects for the containment of the energetic consumptions, giving the responsibility to the Coordinator Ing. Ivan Vernich, with Managerial provision N°. 8065 of 19.11.2016;

The same Coordinator graduated in Civil Engineering to participated, in Bologna near the Center Congresses in the street of the Arcoveggio n.49, from February 29 th 2016 to March 4 th 2016, to the "Raced of formation and professional updating for Energy Managers (E.M.) and for Experienced in Management of the energy" (E.G.E.) organized by the ENEA - with center in Rome, achieving the certificate and becoming at the same time Energy Manager of it on behalf of the Town administration of Lecce.

The Energy Manager has the assignment to manage what he concerns the energy inside a' Public Corporate body, verifying the consumptions, optimizing them and promoting interventions contemplated to the energetic efficiency and the use of renewable sources.

Insofar. reporting himself/herself/itself to the typical actions, the following list can be considered:

" Taking of contact with the organization and individualization of the figures of reference for the carrying out of his/her own activities (decisions, office purchases, experienced technicians in management of the energy, maintenances, responsible of lines of trial, administrative and bookkeeping functions, financial functions, etc.);

" Harvest of the energetic bills, evaluation of the monthly and annual consumptions, verification; Individualization of the daily curves of load electric and thermal;

" Verification of the existing contracts connected to the energetic services (both to make sure himself some disbursed performances, both to plan in opportune way the proposals of investment);

" Creation of a database of the areas of consumption, with greater details for those more meaningful (characteristics, busy powers and of plate, energy times of operation, give of installation, etc.);

" Individualization of a set of indicators of energetic performances to compare the consumptions among the different centers and with the literature;

" Realization of energetic diagnosis and studies of feasibility (in first person or with the aid of third subjects);

" Proposals of intervention and studies of feasibility (reduction wastes, programs of sensitization to the employees, investments in efficiency and renewable);

" Accessed the incentives;

" Verification of the achieved results and programs of communication of the same.

Which of the following domains (verticals) are more aligned with your activity?

VERTICAL	YES/NO
Energy Assesment	YES
Building retrofitting	NO
District heating networks	YES
Integrated Infrastructures (RES integration and management)	YES
Sustainable Mobility	NO
Electrical Vehicles	NO
Public Transportation and Logistics	NO
Sharing facilities	NO
Social Engagement	NO

2. CIOP Features

Please answer the following questions:

1. **Who do you consider the main user(s) of the CIOP platform?** (Select the key users and the main value added by the platform to each one) (e.g: Building Owner: Online and real-time readings of all types of energy consumptions; Citizens: engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing; ESCO: Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies; Municipality: Monitoring and analysis of the district consumptions)

USER	YES/NO	MAIN VALUE
Municipality	YES	to verify Analysis energetic consumption
Public Company	NO	
Energy Service Company (ESCO)	NO	
Citizens	YES	Through official site Municipality of Lecce, possible realization of a profile devoted Manager to the activities of the Energy
Building Owner	NO	
Solution provider (Company willing to provide services based on the CIOP)	YES	Only functional to the specific services on the base, for the management and the activities of the Energy Manager or his staff
Investor / Promoter	NO	
Grant Manager	NO	
Energy Network manager	YES	Manager of the data to Be communicated, to analyze and to share with other corporate bod
Others (specify)	NO	

2. **Please write a list of the added value services you expect from the CIOP of the SmartEnCity project** (A list of examples of services is provided, please select the relevance of each one in your case and complete with additional services you consider of relevance in you case. Please classify the services into the following three categories: Energy assessment, Sustainable mobility, Citizen engagement, other (please specify)).

3. CATEGORY	ADDED VALUE SERVICE	RELEVANCE (High/Medium/Low)	COMMENTS
Energy Assessment	Identification of energy consumption patterns	H	To know all the data and the situation
	Detecting weaknesses to be corrected and strengths to be replicated	H	To reach the preset objectives
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	L	They serve indicative auto-built, to share with other corporate body
	Detection of buildings with poor performance	L	Data coming from E.G.E.
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	H	Management of the priorities (Curve of Pareto)
	Identification of vulnerable areas or buildings	L	Not Remarkable
	Identification of viability for the implementation of a district heating network	M	To verify feasibility (schools or neighboring offices)
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	M	Through map to individualize aerial to be realized new interventions
	Integrated electrical and thermal network energy management systems (at home, building and district level)	H	Management of the electric energy, thermal on all the buildings of town ownership
	Smart public lighting management	L	To know all the data and the situation of the Public Illumination
Sustainable Mobility	Information about the availability of EVs recharging points	NO	
	Information about the availability of shared green vehicles	NO	

	Information about the availability of bikesharing	NO	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	NO	
	Management of granting EVs acquisition	NO	
	Management of the dimension and capacity of the EVs recharging network.	NO	
	Optimization of public transportation routes	NO	
	Optimization of last mile logistic	NO	
Citizen Engagement	Launching surveys in the district about the building retrofitting preferences of the neighbours	NO	
	Providing information about success stories in building retrofitting	NO	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	NO	
	Information about schedules and routes of public transportation	NO	

4. **Please write a list of the current services that could be integrated with the CIOP of the SmartEnCity project** (please include the URL of the services if known. Several examples are provided)

CURRENT SERVICE	SERVICE URL	COMMENTS
Multimodal transport search engine	NOT AVAILABLE	You see on the site of the commune: SCHEDULES OF BUS - TRAINS - AIRPLANES
Weather forecast service (e.g. Accuweather, weatherforecast)	NOT AVAILABLE	You see on the site of the Municipality: FORECASTS OF THE TIME
Survey services (e.g. surveyMonkey, surveyGizmo)	NO	NO
Social networks (e.g. facebook, twiter)	WWW.COMUNE.LECCE.IT	To also see the linkses on the social pointed out on site of the Municipality

5. **Please identify the list of expected outputs to be provided by the added value services** (e.g. comparison tables, 2D maps, 3D map, pie/bar charts with figures, etc. An example is shown in the table)

SERVICE TYPE	OUTPUT
Identification of energy consumption patterns	Pie/Bar charts with figures

6. **Citizen engagement**

6.1. Do you have an online citizen participation portal? **NO**

If yes, describe the main functionalities

1.
2.
3.
4.

6.2. What is the main added value that the CIOP platform can provide to the citizen?

7. List of existing data sources available (complete the following table, use the proposed one as an example)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?
ENERGY	TO DO	MANAGEMENT OF THE TEMPERATURE: IDEA AND' NOT TO MANAGE THE FUEL OR GAS FOR THE WINTER E/O L' ELECTRIC ENERGY FOR THE COOLING IN SUMMER, MA ON THE CONTRARY' TO USE OF FIRMS OR CORPORATE BODY THAT MANAGE THE TEMPERATURE IN TERMS CONTRACTUAL EXAMPLE: MI you Sell The 20° Degrees (you See Scheme Of the Temperature)	**TBD**	YES
ENERGETIC SAVING AND CREATION ENERGY	TO DO	INTELLIGENT WINDOWS (TO REPLACE WITH THOSE EXISTING) TO GUARANTEE A PRODUCTION OF ENERGY WITH INTEGRATED SOLAR PANELS IN THE WINDOWS E/O IN THE PARAPETS OF THE BALCONIES	**TBD**	YES
INTELLIGENT ROAD X LA CREATION OF ELECTRIC ENERGY	TO DO	TO REALIZE A ROLL ON THE ROAD CENTER THAT PRODUCES ELECTRIC ENERGY TO SEE BREVET,	**TBD**	YES
INTELLIGENT PIPES FOR THE TRANSPORT OF THE LIGHT	TO DO	TUBULAR STRUCTURES WITH MIRROR WITH "GUIDE OF LIGHT" TO ILLUMINATE THE PLACES WITHOUT LIGHT, STAIRCASES OF ENTRY, GARAGE, FILES, ETC. SUCH TECHNOLOGY TAKES THE LIGHT FROM	**TBD**	YES

		THE ROOF IT IS IT TRANSPORTS IN THE LUOGIS DOVE AND' NECESSARY, WITH ENERGETIC IMPACT = ZERO		
I PLAN TABLE	TO DO	SYSTEM OF SUPERVISION IS CONTROL OF ALL THE SOURCES OF DATA, INTUITIVE SYSTEM, MULTITOUCH, FOR THE STAFF DI THE ENERGY MANAGER IS FOR THE DIRECTIVE FIGURES OF THE FITTINGSES. IT ALLOWS TO CREATE DIFFERENT LAYER E WITH THE POSSIBILITY' TO MANAGE ALGORITHMS IS RULES FOR IMMEDIATE DECISIONS AND PROJECTIONS OF FORECASTS. THE INFORMATION CAN BE ALSO SHARED ON MORE' UNITED', THE SYSTEM FORESEES TO TALK WITH OTHERS DEVICES WHAT SMARTPHONE, TABLET, ETCC	**TBD**	YES
SENSORY	TO DO	IDEA CONSISTS IN THE USE OF TECHNOLOGIES IOT PER TO HAVE A LOWER PART COST AND A LOW ENVIRONMENTAL IMPACT, AND' POSSIBLE TO USE TECHNOLOGIES WIRELESS CON FREQUENCIES OF EXERCISE NOT Á. PAGAMENTO AND THEY USE PROTOCOLS OF TRANSMISSION CODIFIED IN CIRCLE INTERNET	**TBD**	YES
GROUP OF JOB	TO DO	TO CREATE A NETWORK DI COMPETENCES WITH THE UNIVERSITY, DHITECH, CETMA, CNR ENEA, ETC. TO GIVE THE POSSIBILITY' Á. THE ENERGY MANAGER TO EFFECT NEW PROJECTS E/O FARE EXPERIMENTATION. SUCH GROUP WILL ALLOW' TO HAVE COMPETENCES DEVOTED ON THE PROJECTS IS ON THE IMPLEMENTATIONS FUTURE FIT Á. THE	**TBD**	YES

		ATTAINMENT OF THE OBJECTIVES OF THE SAME ENERGY MANGER		
TO INDIVIDUALIZE THE SOCIAL	TO DO	SYSTEM TO INDIVIDUALIZE OF THE "SPOKEN" ON THE SOCIAL, VERIFICATION OF THE " FEELING" OF THE ACTIONS IT UNDERTOOK FROM THE ENERGY MANGER	TBD	YES

8. List of new data sources planned within SmartEnCity project (complete the following table, use the proposed one as an example)

Area	Data source Name	Description	Data Format	Accessible through web service?
Energy Assessment	**Availability of EV recharging posts**	**The EV posts provide data about the status that is pushed to a monitoring system**	**XML**	**YES – Opendata**

9. List of new data sources in the future (list all your wildest ideas) (complete the following table)

Area or Vertical to with below	Data source Name	Description	Data Format	Accessible through web service?

8.3 Questionnaires review

Detailed information in the different aspects analysed during the review of the questionnaires is included as annex to this deliverable.

		VITORIA-GASTEIZ									
		ServiceProviders_ESCOs&EnergyNetworkManagers					Municipalities&PublicCompanies			Citizen_Owners_Promoters&GrantManagers	
CATEGORY	SERVICE	GIROA-VEOLIA	FAGOR EDERLAN	ESTUDIOS GIS	CORPORACIÓN MONDRAGON	TECNALIA	AVG+CEA (TIC)	AVG+CEA (Citizen)	VISESA	Errota Zaharra	VISESA
Energy Assessment	Aligned with your activity?	YES	NO	YES	YES	YES			YES		
	Identification of energy consumption patterns	3			1				3		3
	Detecting weaknesses to be corrected and strengths to be replicated	3			2				3		3
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	3		3	2	3			3		3
	Detection of buildings with poor performance	3			1				3		3
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	1			2				3		3
	Identification of vulnerable areas or buildings	1			1				3		3
	Identification of viability for the implementation of a district heating network	3			2				3		3
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	1		3	2				2		2
	Integrated electrical and thermal network energy management systems (at home, building and district level)	1		2	2				2		2
	Smart public lighting management			2	2				1		1
	Data collection (heat, electricity, inside climate)										
Sustainable Mobility	Aligned with your activity?	NO	YES	YES	NO	YES			NO		
	Information about the availability of EVs recharging points		1		2	3			1		1
	Information about the availability of shared green vehicles		1	2	2	3			1		1
	Information about the availability of bikesharing				1	3			1		1
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.		1		2				1		1
	Management of granting EVs acquisition		2		3				1		1
	Management of the dimension and capacity of the EVs recharging network.		2		3				1		1
	Optimization of public transportation routes		2	3	3				1		1
	Optimization of last mile logistic		3	3	2				1		1
	Information about the feasibility of exploitation of new social transport and vehicle sharing buisness models, based on electro mobility		3								
	Information about the feasibility of exploitation of new goods transports business models, based on electro mobility		3								
Citizen Engagement	Aligned with your activity?	NO	NO	NO	YES	NO			NO		
	Launching surveys in the district about the building retrofitting preferences of the neighbours				3	3			3		3
	Providing information about success stories in building retrofitting				3	3			3		3
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)			3	3	3			1		1
	Information about schedules and routes of public transportation			3	2	3			1		1
	Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding , etc)								3		3
	City News										
	Innovation models										
	Live CO2/renewables information										

		TARTU						
		ServiceProviders_ESCOs&EnergyNetworkManagers			Municipalities&PublicCompanies			Citizen_Owners_Promoters&GrantManagers
CATEGORY	SERVICE	Fortumo	Cityntel	Elektritakso	Tartu City	University of Tartu	Tartu Energiaagentuur	Smart City Lab
Energy Assessment	Aligned with your activity?				YES	NO	YES	YES
	Identification of energy consumption patterns				3	1	3	3
	Detecting weaknesses to be corrected and strengths to be replicated				3	1	3	2
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)				3	2	3	1
	Detection of buildings with poor performance				3	1	3	2
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)				3	2	3	1
	Identification of vulnerable areas or buildings				3	1	3	2
	Identification of viability for the implementation of a district heating network				2	1	3	1
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)				3	1	3	1
	Integrated electrical and thermal network energy management systems (at home, building and district level)				3	2	3	3
	Smart public lighting management				3	2	2	2
	Data collection (heat, electricity, inside climate)						3	
Sustainable Mobility	Aligned with your activity?				YES	YES	NO	NO
	Information about the availability of EVs recharging points				3	2	2	2
	Information about the availability of shared green vehicles				2	2	1	2
	Information about the availability of bikesharing				2	2	1	2
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.				2	2	1	2
	Management of granting EVs acquisition				3	1	1	2
	Management of the dimension and capacity of the EVs recharging network.				3	2	2	1
	Optimization of public transportation routes				3	2	1	1
	Optimization of last mile logistic				3	2	1	1
	Information about the feasibility of exploitation of new social transport and vehicle sharing buisness models, based on electro mobility							
	Information about the feasibility of exploitation of new goods transports business models, based on electro mobility							
Citizen Engagement	Aligned with your activity?				YES	YES	NO	YES
	Launching surveys in the district about the building retrofitting preferences of the neighbours				3	3	3	3
	Providing information about success stories in building retrofitting				3	2	3	3
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)				3	2	2	2
	Information about schedules and routes of public transportation				3	3	1	3

		SONDERBORG						
		ServiceProviders_ESCOs&EnergyNetworkManagers		Municipalities&PublicCompanies	Citizen_Owners_Promoters&GrantManagers			
CATEGORY	SERVICE	Sønderborg Fjernvarme Sønderborg Forsyning	Sydenergi A/S	Sønderborg Kommune	Project ZERO	SAB	SOBO	B42
Energy Assessment	Aligned with your activity?	YES			YES	YES	YES	
	Identification of energy consumption patterns	3			2	3		
	Detecting weaknesses to be corrected and strengths to be replicated	3			3	2		
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	3			3	1		
	Detection of buildings with poor performance	2			3	2		
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	2			3	3		
	Identification of vulnerable areas or buildings	1				3		
	Identification of viability for the implementation of a district heating network	1			1	2		
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	1			1	3		
	Integrated electrical and thermal network energy management systems (at home, building and district level)	2			3	3		
	Smart public lighting management	1			2	2		
	Data collection (heat, electricity, inside climate)							
Sustainable Mobility	Aligned with your activity?	YES			YES	NO	NO	
	Information about the availability of EVs recharging points	3			1	1		
	Information about the availability of shared green vehicles	2			3	1		
	Information about the availability of bikesharing	2			3	1		
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	3			3	2		
	Management of granting EVs acquisition	1			3	3		
	Management of the dimension and capacity of the EVs recharging network.	2			3	3		
	Optimization of public transportation routes	1			1	2		
	Optimization of last mile logistic				2	2		
	Information about the feasibility of exploitation of new social transport and vehicle sharing buisness models, based on electro mobility							
	Information about the feasibility of exploitation of new goods transports business models, based on electro mobility							
Citizen Engagement	Aligned with your activity?	NO			YES	YES	YES	
	Launching surveys in the district about the building retrofitting preferences of the neighbours	2			1,5	1	3	
	Providing information about success stories in building retrofitting	2			3	2	3	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	3			3	1		
	Information about schedules and routes of public transportation	1			1	3		
	Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding , etc)							
	City News							
	Innovation models							
	Live CO2/renewables information				3			

		ASENOVGRAD	
		Municipalities&PublicCompanies	Citizen_Owners_Promoters&GrantManagers
CATEGORY	SERVICE	Municipality of Asenovgrad	Citizen
Energy Assessment	Aligned with your activity?	YES	YES
	Identification of energy consumption patterns	3	3
	Detecting weaknesses to be corrected and strengths to be replicated	3	3
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	2	2
	Detection of buildings with poor performance	3	2
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	3	3
	Identification of vulnerable areas or buildings	2	3
	Identification of viability for the implementation of a district heating network	1	2
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	3	3
	Integrated electrical and thermal network energy management systems (at home, building and district level)	2	3
	Smart public lighting management	3	3
	Data collection (heat, electricity, inside climate)		
Sustainable Mobility	Aligned with your activity?	YES	YES
	Information about the availability of EVs recharging points	3	3
	Information about the availability of shared green vehicles	2	2
	Information about the availability of bikesharing	2	2
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	2	2
	Management of granting EVs acquisition	2	2
	Management of the dimension and capacity of the EVs recharging network.	2	3
	Optimization of public transportation routes	1	3
	Optimization of last mile logistic	1	3
	Information about the feasibility of exploitation of new social transport and vehicle sharing buisness models, based on electro mobility		
	Information about the feasibility of exploitation of new goods transports business models, based on electro mobility		
Citizen Engagement	Aligned with your activity?	YES	YES
	Launching surveys in the district about the building retrofitting preferences of the neighbours	3	3
	Providing information about success stories in building retrofitting	3	3
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	3	3
	Information about schedules and routes of public transportation	2	3
	Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding , etc)		
	City News		
	Innovation models		
	Live CO2/renewables information		

		LECCE
		Municipalities&PublicCompanies
CATEGORY	SERVICE	Municipality of Lecce
Energy Assessment	Aligned with your activity?	YES
	Identification of energy consumption patterns	3
	Detecting weaknesses to be corrected and strengths to be replicated	3
	Monitoring of most relevant KPIs (Key Performance Indicators) at different levels (dwelling, building, district)	1
	Detection of buildings with poor performance	1
	Decision making capabilities to guide stakeholders the implementation of energy efficiency measures (e.g. Identification of priorities for intervention)	3
	Identification of vulnerable areas or buildings	1
	Identification of viability for the implementation of a district heating network	2
	Identification of areas with high RES potential (e.g. solar, wind, biomass, geothermal)	2
	Integrated electrical and thermal network energy management systems (at home, building and district level)	3
	Smart public lighting management	1
	Data collection (heat, electricity, inside climate)	
Sustainable Mobility	Aligned with your activity?	NO
	Information about the availability of EVs recharging points	
	Information about the availability of shared green vehicles	
	Information about the availability of bikesharing	
	Management of the booking of EVs recharging points, shared green vehicles, parking lots, etc.	
	Management of granting EVs acquisition	
	Management of the dimension and capacity of the EVs recharging network.	
	Optimization of public transportation routes	
	Optimization of last mile logistic	
	Information about the feasibility of exploitation of new social transport and vehicle sharing buisness models, based on electro mobility	
	Information about the feasibility of exploitation of new goods transports business models, based on electro mobility	
Citizen Engagement	Aligned with your activity?	NO
	Launching surveys in the district about the building retrofitting preferences of the neighbours	
	Providing information about success stories in building retrofitting	
	Feedback about failures in the services (e.g. EVs charging points, public transportation, bikesharing)	
	Information about schedules and routes of public transportation	
	Providing information and attending questions regarding building refurbishment (technical, regulatory, process, funding , etc)	
	City News	
	Innovation models	
	Live CO2/renewables information	

USER	VOTES	STAKEHOLDER	MAIN VALUE
Municipality	10	GIS	Monitoring and analysis of the district consumptions, consulting and exploitation of data mobility (Traffic, emission C02, ...) and environmental data (temperature, speed of the wind, humidity, waste collection).
		FED	City Monitoring and Control
		SONF	Data collection and factual feedback on implemented changes
		TAR	Online and on-time readings of (energy) consumptions (building level); online on-time readings of PV panels energy production; online real-time information and on-time readings from street lighting sensors network and EV reantal points; online on-time readings of public transportation (gas buses); online on-time readings of supported private EVs (incl taxis); online on-time readings of bike sharing, EV chargers, results from polling environment.
		TREA	District or city level - data readings
		SCL	Urban planning, policy making
		VIS	Access to monitoring data for evaluation of the real performance of the projects.
		GIR	Feedback of use of suitable mobility and energy consumptions.
t		LECCE	To verify Analysis energetic consumption
		ASENOV	Monitoring and analysis of the district consumptions; Online and real-time readings of all types of energy consumptions
Public Company	5	GIS	Recommendation to save energy and efficient use of transport (people and goods).
		FED	Services optimization
		SONF	Data collection and factual feedback on implemented changes
		VIS	Access to monitoring data for evaluation of the real performance of the projects.
		ASENOV	Online and real-time readings of all types of energy consumptions
Energy Service Company (ESCO)	4	VIS	Access to real data for potential replication of projects
		GIR	Identify energy consumption patterns to detect weaknesses and failures.
		TREA	Data readings (by inhabitant mandate) Assessment of energy consumption
		ASENOV	Identify energy consumption patterns to detect weaknesses and identify retrofitting strategies
Citizens	7	GIS	Access and consulting of data mobility, availability of public services and recommendation systems for adopting energy efficient behaviours
		SONF	Interaction and feedback between service provider and customer
		TAR	Online and on-time readings of (energy) consumptions (building and apartmente level); online on-time information from street lighting sensors network and EV rental points, EV chargers
		TREA	Inside climate control, apartment leval data readings and control
		UTAR	Saving energy and money
		GIR	To know suitable mobility and energy consumptions for adopting energy efficient behaviours
		ASENOV	Engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing
Building Owner	8	SONF	Specific actions can be taken due to building feedback from data loggers
		TAR	Online and on-time readings of all types of (energy) consumptions (building level); online on-time readings of PV panels energy production
		TREA	Online and on-time readings of all types of (energy) consumptions.
		UTAR	Online and on-time readings of all types of (energy) consumptions.
		SCL	Online and on-time readings of all types of (energy) consumptions.
		GIR	Feedback of energy consumptions for adopt energy efficient behaviours
		LECCE	Through official site Municipality of Lecce, possible realization of a profile devoted Manager to the activities of the Energy
		ASENOV	Engagement services, recommendation systems for adopting energy efficient behaviours, feedback provision to municipalities, best practice sharing
Solution provider	5	GIS	Treatment of data and generation of added value services
		TAR	Online real-time information and on-time readings from street lighting sensors network and EV rental points; online on-time readings of bike sharing, EV chargers
		VIS	Will depend on the quality of data accessible through the CIOP
		LECCE	Only functional to the specific services on the base, for the management and the activities of the Energy Manager or his staff
		ASENOV	Providing information on how to improve energy efficiency and best practice examples
Investor / Promoter	1	ASENOV	Investment activities
Grant Manager			
Energy Network manager	4	SONF	
		VIS	Study of system performance, viability of new projects and replication.
		GIR	Identify energy consumption patterns to detect weaknesses and failures.
		LECCE	Manager of the data to Be communicated, to analyze and to share with other corporate bodies
Others (specify)	2	TREA	ENERGY AGENCY: Data readings (by inhabitant mandate) Assessment of energy consumption
		UTAR	UNIVERSITIES: Developing data models

MAIN OUTPUT TYPE	SERVICE TYPE
Comparison Tables	Benchmarking of housing association Smart charging of EV's Comparison of energy (water) consumption building level Street lighting network sensor data analysis reports EV and e-bikes (incl rental points) data analysis reports Bike sharing data analysis reports Smart energy (heating, power) management in apartement buildings (based on current market prices etc)
2D Maps	Visualization of building energy ratings Visualization of solar potential in roofs Street lighting network sensor data analysis reports
3D Maps	
Pie / Bar charts with figures	Benchmarking of housing association Smart charging of EV's Street lighting network sensor data analysis reports EV and e-bikes (incl rental points) data analysis reports Bike sharing data analysis reports Smart energy (heating, power) management in apartement buildings (based on current market prices etc)
Citizens should actively be informed via information on city	Interactive displaying of information

LIGHTHOUSE CITY	SERVICE	COMMENT
VITORIA-GASTEIZ	Multimodal transport search engine	Geovitoria, provides public API for calculation of routes
	Weather stations and sensors installed on the European project Irrigestlife	There are five weather stations that contain several type of sensors
	EuskoREGITE	Repository on technical building inspections. www.euskoregite.com
	Weather forecast services.	http://www.euskalmet.euskadi.net http://www.tutiempo.net/
SONDERBORG	Multimodal transport search engine	www.rejseplanen.dk
	Weather forecast service	www.yr.no
TARTU		
LECCE	Social networks to also see the links on the social pointed out on site of the Municipality	WWW.COMUNE.LECCE.IT

LIGHTHOUSE CITY	VERTICAL	DATA SOURCE	DESCRIPTION	WHO?	FORMAT	ACCESIBLE THROUGH WEB SERVICE?
VITORIA-GASTEIZ	ENERGY	Climate data	Environment data from sensors; temperature, speed of the wind, humidity.	GIS		No
	MOBILITY	Traffic density on real-time	Traffic density on real-time	GIS	JSON	Yes
		Works in the streets	Works in the streets	GIS	XML	Yes
		Traffic Incidences	Incidences because of traffic	GIS	JSON	Yes
		Geolocation public bus	Geolocation public bus	GIS	JSON	Yes
	CITIZEN					
	OTHER	Waste collection	Department of Environment has data about daily waste collection	GIS		No
SONDERBORG	ENERGY	Electrical/Heat/Water	Apartments may have individual meters (water, electricity, but also they may have only one meter for the building and share the cost evenly between the apartments.	SONF		
	MOBILITY					
	CITIZEN					
	OTHER					
TARTU	ENERGY	Electrical reading	All the apartments are sending their consumption to a central data base accessible to consumer	TREA		YES
		Heating reading	Building level consumption data will be sent to a central data base accessible to Apartment association. Consumption data will be sent from service provider to apartment association.	TREA		
		Water reading	All apartment owners provide data to service provider monthly	TREA		NO
		Gas reading	All apartments are sending their consumption to a central data base accessible to consumer	TREA		NO
		Electrical reading	All the apartments are sending their consumption to a central data base (accessible to …)	TAR		YES
		Electrical reading	All the apartments are sending their consumption to a central data base (accessible to …)	UTAR		YES
	MOBILITY	GPS	GPS information (position, mileage, working hours) from real-time bus info system	TAR	XML	YES
	CITIZEN					
	OTHER					

LIGHTHOUSE CITY	VERTICAL	DATA SOURCE	DESCRIPTION	WHO?	FORMAT	ACCESIBLE THROUGH WEB SERVICE?
VITORIA-GASTEIZ	ENERGY	Monitoring of most relevant KPIs (indoor)	Monitoring of most relevant KPIs at different levels (dwelling, building, district)	GIS	JSON	
		Monitoring of most relevant KPIs (District Heating)	Monitoring of most relevant KPIs at network disctrict heating	GIS	JSON	
		Monitoring of most relevant KPIs (outdoor)	Monitoring of most relevant KPIs at Street lights	GIS	JSON	
		Cost of electricity	If user has contracted a variable cost tariff, the hourly cost of electricity is an interesting input to allow optimizing the use and reduce the energy costs.	VIS	JSON/XML	YES
		Availability of Buildings consumption	All the Buildings will send their consumption to a central data base	GIR	XML	YES
		Availability of heating production	The heating central production will send their production to a central data base	GIR	XML	YES
		Availability of External temperature	A Buildings will send the external temperature to a central data base	GIR	XML	YES
		Availability of apartments consumption	All the apartments will send their consumption to a central data base	GIR	XML	NO
	MOBILITY	Geolocation of rental cars and bikes	Geolocation traking for billing purposes and KPI calculations	GIS	JSON	
		Vehicle data	kms, energy consumption, geolocalization, activity time, etc	FED	XML	NO
	CITIZEN					
	OTHER					
SONDERBORG	ENERGY	Electrical / Heat	Real time data logging of retrofitted buildings			
	MOBILITY					
	CITIZEN					
	OTHER					
TARTU	ENERGY	Energy (heat, power, water) consumtions data from apartments and buildings	Energy (heat, power, water) consumtions data from apartments and buildings	TAR		
		Energy production data from PV panels system	Energy production data from PV panels system	TAR		
		Energy re-use information from the central cooling station	Energy re-use information from the central cooling station	TAR		
		Street lighting network sensors data	Street lighting network sensors data	TAR		
		Street lighting energy consumption data	Street lighting energy consumption data	TAR		
		Electrical energy readings (consumed)	Apartment level, aggregated data building level and district level. Consumption data, peak loads, etc.	TREA		
		Electrical energy readings (produced)	Produced energy by PV panels reading on building level and district level, production, own consumption, peaks, sold to grid	TREA		
		Heating energy readings	Apartment level and building level. On building level heating and for domestic hot water. Consumption, peaks, etc.	TREA		
		Water (cold) consumption readings	Apartment level and aggregated data on building level. Consumption, peaks.	TREA		
		CO2 readings	CO2 readings on apartment level and management.	TREA		
		Temperature	Temperature management on apartment level	TREA		
		Electrical energy (building level)	On building level, Benchmarking with regulations (energy performance levels, with average, with other buildings)	TREA		
		Electrical energy (apartment level)	On apartment level with other apartments	TREA		
		Heating	Data and control on room level (temp set)	TREA		
		Ventilation	Ventilation control by user	TREA		
		Smart meters	All smart meters: electricity, heating, water consumption	UTAR	Machine reading potential	
		Thermostats	Metering heating energy	SCL		YES
		Gas meters	Metering gas consumption	SCL		YES
		Water meters	Metering water consumption	SCL		YES
		Temperature meters	Metering indoor temperature	SCL		YES
	MOBILITY	EV rental points data	EV rental points data	TAR		
		Public transportation data	Public transportation data	TAR		
		Private EV (including taxis) data	Private EV (including taxis) data	TAR		
		Bike sharing system data	Bike sharing system data	TAR		
		EV chargers data	EV chargers data	TAR		
		Public transport planning tool data	Public transport planning tool data	TAR		
		Electric car GPS log	Car use by person	UTAR		YES
	CITIZEN	Polling environmental data	Polling environmental data	TAR		
		Personal CO footprint tracker in smartphone	App for tracking and questionning	UTAR		
	OTHER	Smoke detectors	Smoke and fire alarms	SCL		YES
		Video stream and recordings	Streaming and recording video in building public areas + indoor cameras for personal use	SCL		YES
		Location indicators	Possibility to track objects (personal belognings) movement and location	SCL		YES

8.4 Analysis of added value services

Detailed results of the relevance of identified added value services for the partners who fulfilled the questionnaire are included in this annex.

Type of service	Description	RELEVANCE (High/Medium/Low) *Research company working in ICT tools for city management: TEC*	RELEVANCE (High/Medium/Low) *Private company working in energy management systems: MON*	RELEVANCE (High/Medium/Low) *Public company working in residential districts: VIS*	RELEVANCE (High/Medium/Low) *Technological centre working in sustainable urban development and sustainable mobility: CAR*	RELEVANCE (High/Medium/Low) *Private company working in residential districts and sustainable urban development: ACC*	RELEVANCE (High/Medium/Low) *Municipality: TAR*	RESULT
Energy Assessment	Energy use forecast	HIGH	MEDIUM	MEDIUM	HIGH	HIGH	LOW	14
	Dwelling energy	HIGH	HIGH	MEDIUM	HIGH	HIGH	HIGH	17
	Identification of energy consumption patterns	NA	LOW	HIGH	HIGH	HIGH	HIGH	13
	Decision support system for measures implementation	NA	MEDIUM	HIGH	HIGH	HIGH	HIGH	14
Sustainable mobility	Calculation of Total Cost of Ownership for EVs	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	14
	CO_2 emissions reduction	MEDIUM	MEDIUM	LOW	HIGH	HIGH	HIGH	14
Citizen engagement	Citizen information system	MEDIUM	LOW	MEDIUM	HIGH	HIGH	HIGH	14