Nantes | Hamburg | Helsinki

Ref. Ares(2019)7391370 - 01/12/2019

Deliverable due date: M36 – November 2019

D2.8 Improved Services in Nantes Urban Platform

WP2, Task 2.5: ICT and Urban Platform Developments

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

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

Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30th November 2021 (60 Months)
Deliverable	D2.8 Improved Services in Nantes Urban Platform
Diss. Level	PU
Status	☐ Working
	☐ Verified by other WPs
	■ Final version
Due date	30/11/2019
Work Package	WP2
Lead beneficiary	ENG
Contributing beneficiary(ies)	NAN
Task description	This document presents the services provided by the urban platform in the context of mySMARTLife Nantes demosite actions. It focuses on the requirements of mySMARTLife ICT actions regarding the proposed solution, the use cases implementations and the experience learned.

Date	Version	Author	Comment
06/04/2019	0.1	ENG	Table of contents and responsibilities
07/18/2019	0.2	ENG	Initial draft (partial).
09/06/2019	0.3	ENG	Updates (partial).
10/09/2019	0.4	NAN	Part 4 writing & part 5 contribution on the usage side.
10/14/2019	0.5	ENG	Updates. Partial review.
10/16/2019	0.6	NAN	Updates following to NAN/ENG review & feedbacks.
10/21/2019	0.7	ENG	Final updates.
10/29/2019	0.8	NAN	Adding ESPRESSO paragraph + ESPRESSO sheets
10/30/2019	0.9	ENG	Final review and complements
10/31/2019	1.0	ENG	Final version for peer review
11/22/2019	1.1	ARM	Peer review
11/27/2019	2.0	ENG	Updates following peer review. **FINAL VERSION for SUBMISSION**.

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

Table of Content

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

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

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

Table of Figures

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

Table of Tables

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

Abbreviations and Acronyms

Acronym	Description
AENOR	Asociación Española de Normalización y Certificación (Spanish Association for Normalization and Certification)
API	Application Programming Interface
CityGML	City Geography Markup Language
CKAN	Comprehensive Knowledge Archive Network
CSV	Comma Separated Values
CSW	Catalogue Service Web
EIP	European Innovation Partnership
EJB	Enterprise JavaBean
ESPRESSO	systemic Standardisation approach to Empower Smart citieS and cOmmunities
ETL	Extract, Transform and Load
FCP	Field Component Platforms
FTP	File Transfer Protocol
FTPS	FTP SSL (Secure Socket Layer)
GDPR	General Data Protection Regulation
GIS	Geographic Information System
HMDK	Hamburger Metadatenkatalog (Hamburg Metadata Catalogue)
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technologies
ID	IDentifier
IoT	Internet of Things
IR	Intermodal Routing
ISO	International Organization for Standardization
IT	Information Technologies
ITU-T	International Telegraph Union - Telecommunication Standardization Sector
JSON	JavaScript Object Notation
JSON-LD	JSON for Linking Data
KPI	Key Performance Indicator

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

Acronym	Description
LGV	Landesbetrieb Geoinformation und Vermessung (Agency for Geoinformation and Surveying)
LPWAN	Low Power Low Range Wide Area network
M2M	Machine to Machine
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
OGC	Open Geospatial Consortium
OUP	Open Urban Platform
PEP	Policy Enforcement Point
QUDT	Quantity, Unit, Dimension, Type
REST	Representational State Transfer
SCC	Smart Cities and Communities
SDK	Software Development Kit
SFTP	Secure FTP
SGFC	Smart Grid Field Component Platform
SOAP	Simple Object Access Protocol
SSFC	Smart Streetlight Field Component Platform
TLS	Transport Layer Security
UNE	Una Normal Española (A Spanish Norm)
XML	eXtensible Markup Language
WFS	Web Feature Service
WMS	Warehouse Management System
WP	Work Package
WS	Work Stream

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

1. Executive Summary

This document presents the work achieved on the Urban Platform of the Nantes Demosite to process and carry out the ICT actions of the mySMARTLife project.

mySMARTLife actions produce data and must be evaluated. The three lighthouse cities have similar constraints and planning regarding mySMARTLife: they have already existing IT systems, the actions producing data are undertaken by partners which come up with their own solutions, the work carried out by the lighthouse cities should beneficiate to the follower cities.

One of the key aspects of the mySMARTLife project regarding ICT actions is to adapt to each specific situation (existing assets, planned action) and build up a common knowledge so that results can be compared, and actions replicated.

In a first step, the grounds on which the ICT works were based are presented: the objectives, the constraints and the proposed solution in terms of overall design leading to the upgrades and re-engineering of the solution at the core of the Urban Platform extensions. Secondly, the process of searching and designing the proposed use cases is detailed. Then the implementations of the planned use cases are presented with a focus on interoperability matters. Finally, the first returns of experience are presented.

2. Introduction

2.1 Purpose and target group

Deliverable 2.8 “Improved services in Nantes Urban Platform” is aimed at an ICT audience, which must be familiar with the process of ICT requirement design, Systems Integration, Interoperability, Technical implementation and Deployment.

It mainly describes “Action 42. Urban Platform and Open APIs” but is also linked to other actions producing or using data to and from the new services of the Urban Platform, such as “Action 44. Smart data on mobility”, “Action 45. Energy data lab initiative”, or “Action 46. Decision making tool”. Deliverable D2.8 should also be considered in the continuity of deliverable D2.16, which sets up the design process and requirements and in view of D2.17, with respect to the interoperability aspects.

This report is organised to present these different aspects of the project:

- **Part 2**: Requirements identification
- **Part 3**: Technical implementation
- **Part 4**: Designing new use cases
- **Part 5**: Implementing use cases in the Urban Platform
- **Part 6**: Feedback, lessons learnt developing the Urban Platform

2.2 Contributions of partners

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

Table 1: Contribution of partners

Participant short name	Contributions
ENGIE (ENG)	Urban platform requirements, architecture and data integration concepts, contribution to the mySMARTLife framework, use case implementation as urban platform extensions (modelling, drivers and calculation implementations, dashboards), leader on D2.8 deliverable.
NANTES METROPOLE (NAN)	Use case exploration and experimentation, specification at functional level, definition of the Nantes architecture and content.

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

2.3 Relation to other activities in the project

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

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D2.16	Open Specifications Framework
D2.17	Interoperability Plan
D2.11	Energy data lab initiative
D2.10	Heating network optimisation
D2.9	Decision aiding tool
D2.13	Monitoring solutions for EV uptake
D2.15	Design and implementation of public lighting concept
D2.12	Cross-modal mobility observatory
D1.4	Delivery of Workshops for citizen engagement
D2.7	Smart Energy Supply and Demand with RES

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

3. Requirements identification

3.1 What is an Urban Platform?

Definition (cf. D2.16):

> It is "the implemented realization of a logical architecture/content/design that brings together (integrates) data flows within and across city systems and exploits modern technologies (sensors, cloud services, mobile devices, analytics, social media etc.)" [4].
>
> It provides "the building blocks that enable cities to rapidly shift from fragmented operations to include predictive effective operations, and novel ways of engaging and serving city stakeholders in order to transform, in a way that is tangible and measurable, outcomes at local level (e.g. increase energy efficiency, reduce traffic congestion and emissions, create (digital) innovation ecosystems)". [4]
>
> An urban platform integrates various verticals and enables data exchange between verticals and data analytics regarding the combination of services. It forms a system of systems.

In the context of mySMARTLife actions of Nantes demosite, the "Urban Platform" designate the ICT subsystem which undertakes the following roles:

- To gather observation data from various "**publishers**";
- To allow "**service providers**" to perform transformations on the data to create new ones;
- To provide querying tools to "**data consumers**" to consult the data;
- To apply data access regulations decided by the "**platform provider**".

On the constraints side, open specifications and APIs apply to how data are exchanged (inbound and outbound). The interoperability schema binds those constraints together and is a key aspect of the development of new services.

As a result, mySMARTLife defined an architecture framework to bring the urban platforms to share common concepts even if the implementations differ. Further, a research at data level was undertaken to choose a technical specification of the data and API: the three demosite agreed on OGC's Sensorthings API. Practically speaking, the new services on the Nantes Urban platform are developed to process data produced by mySMARTLife actions, integrated by means of open and interoperable APIs, used to build KPIs comparable to those calculated in other demosites and made available by means of interoperable APIs.

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

3.2 Open specifications and APIs

Definition (cf. D2.16):

The documents fully describing the functional perimeter and the integration details (including the service contract) are free for access.

"*An open API, also known as a public API, is an application programming interface that allows the owner of a network-accessible service to give universal access to consumers of that service, such as developers. An API is a software intermediary that makes it possible for application programs to interact with each other and share data."* [3]

The API is available to any user for free. Authentication may be required, depending on the Platform Provider policy.

Aiming at building a network of knowledge across Europe requires to come up with solutions which must be free of any proprietary constraint. This applies to both the technical way the knowledge is provided (open API) and the documents describing how to use it (open specifications). At the early stages of mobile phones, each brand and sometimes each model had its specific charger, leading to people's and EU concern about the environment[1], as opposed to today's three standards. Similarly, the three demosites worked to use a common standard for digital data.

Sharing a common standard is not only a matter of choosing the best standard to describe data but mostly to weight the gain and evaluate the cost of adapting to the existing Information Systems on one hand and to the planned systems due to be installed as mySMARTLife actions on the other hand. Indeed, there is currently no widely-adopted IoT standard in the sensor industry.

This matter was dealt with in a practical way using the following approach:

- Data already in the Urban Platform are not remodelled and the workflows remain unchanged.
- Data publisher's IT system providing new data should do so with the adopted standard.
- If the above is not feasible (existing solution), then an adapter is developed.
- The adapters must be considered as not part of the core of the urban platform and not be necessary for its operating.
- When the data publisher upgrades its publisher's system to embrace the standard, the adapter is removed.

[1] *"Harmonisation of a charging capability of common charger for mobile phones - frequently asked questions" European Commission. 29 th June 2009. Read 17 th July 2019.*

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

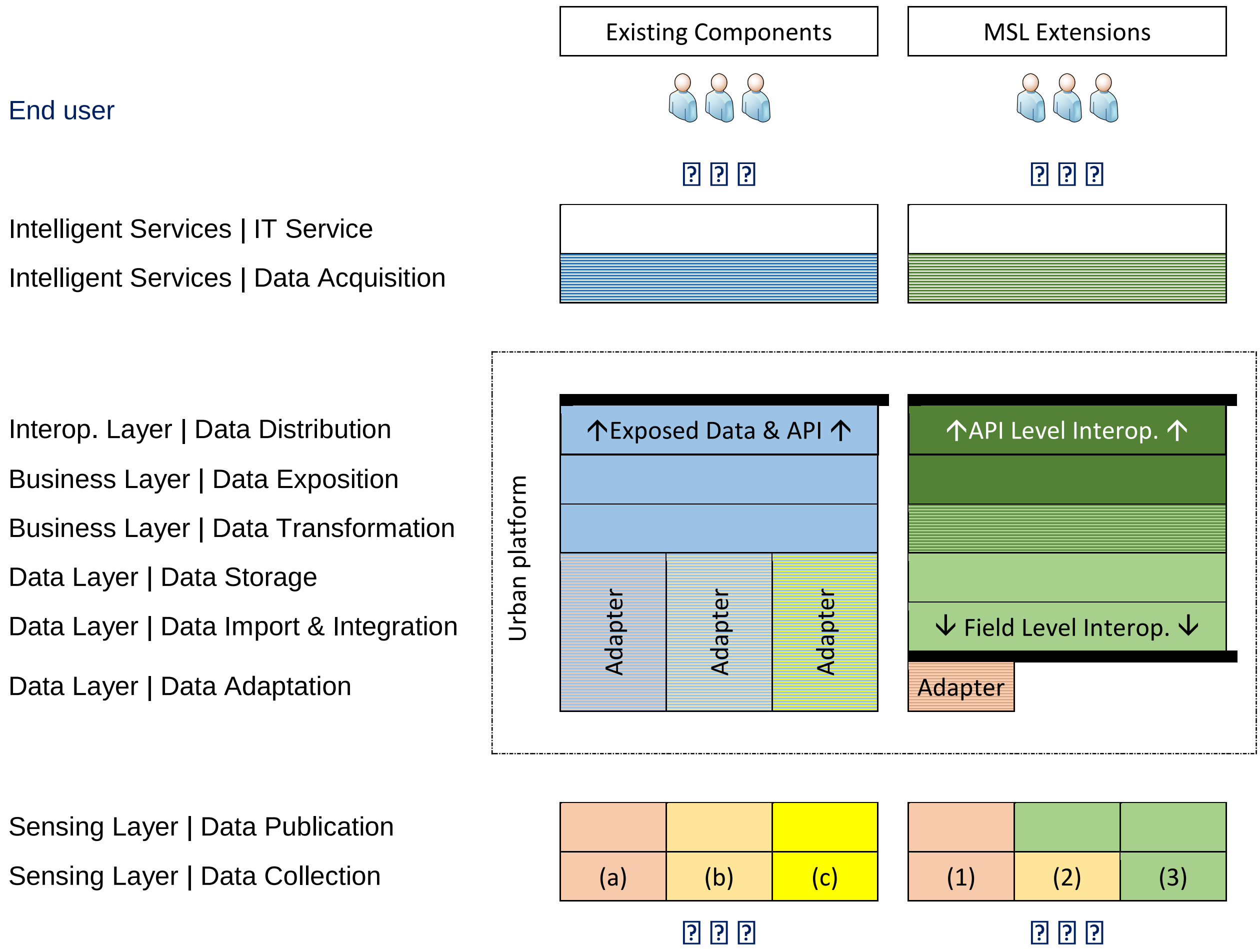


Figure 1: Principle regarding existing standards and adapters

The three demosites agreed on the use of OGC's Sensorthings API[2] at data integration/field-level and KPI restitution/API-level. This standard provides a conceptual model, an open API specification and several open source implementations: FROST by Fraunhofer Institute, GOST by GEODAN, Mozilla STA by Mozilla.

[2] http://docs.opengeospatial.org/is/15-078r6/15-078r6.html Read 16 th June 2017

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

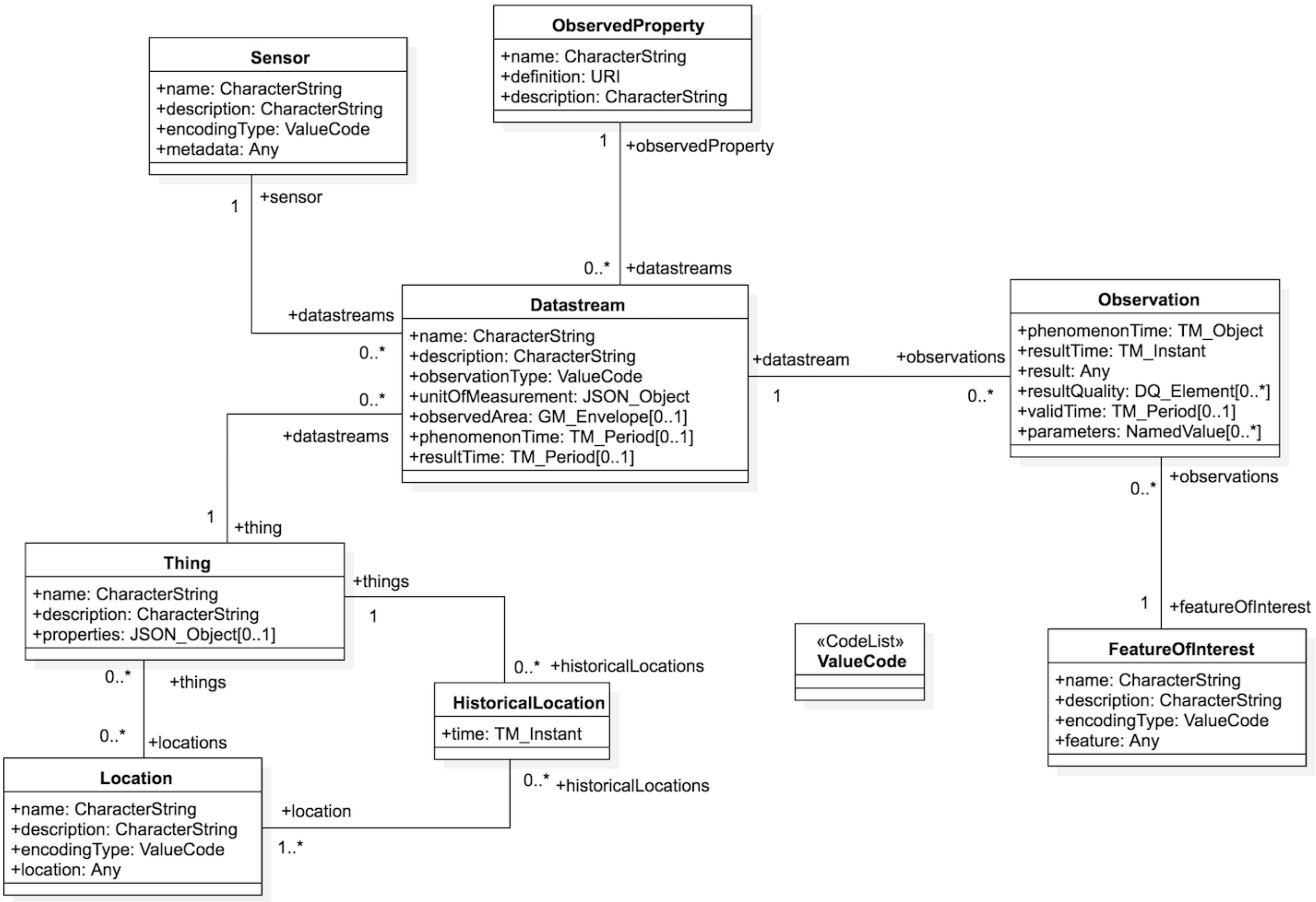


Figure 2: Sensorthings API Sensing conceptual model

3.3 Interoperabilities

Now that a common standard was adopted among the demosites, does it mean that interoperability if fully achieved? Interoperability is the "*Ability for products/services/systems to exchange data with other products/services/systems in an harmonized and homogeneous way by using open and standard formats and/or protocols.*" [13] Different levels of interoperability must be considered.

3.3.1 Syntactic interoperability

The first level of interoperability is <u>syntactic</u>: the API signatures are shared. It involves the method, parameters and attribute names. As per the phone charger comparison it is equivalent to the plug shape.

By adopting the same standard, the urban platform extensions are syntactically interoperable. In the example hereafter, the API request is agnostic to Nantes demosite (apart from the host address) and thus should be <u>applicable to the other demosites</u>.

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

Example of data query to retrieve the 2rd observation data using the standard API:

```
http://stout.msl.31.172.234.197.nip.io/Observations?$top=1&$skip=1
```

3.3.2 Semantic interoperability

However, the syntactic level is not enough to ensure that the demosites Urban Platforms use the same “dialect”. For instance, the above bloc “parameters” is correct at syntax level but not mandatory and most of all the content of this bloc is not fixed by the specification. This is the semantic level of interoperability.

Agreeing at semantic level was discussed between the demosite teams and too many differences at detail level prevented to define such grammar. Documenting the dialect is therefore all the more necessary to share the specificity of each urban platform service implementation.

For instance, the following set of “types” is used for Nantes Demosite for the electromobility KPIs:

KPI	Technical value used for Datastream Name
MO12 Annual energy delivered by each charging point	EMOB_ENERGY_DELIVERED_PER_YEAR
MO16 Total number of charges per year in charging points	EMOB_CHARGES_PER_YEAR

Example of query to retrieve the first MO12 KPI available, using the Nantes Métropole “dialect” (bold characters on grey background) to designate the KPI:

```
https://stin.msl.31.172.234.197.nip.io/Observations?$top=1&$skip=0&$filter=Datastream/name eq
'EMOB_ENERGY_DELIVERED_PER_YEAR'
```

3.3.3 Ontologies

The means to achieve semantic interoperability is to define a common set of definitions and terms thus describing a subset of reality: an “ontology”. The work package 5 defines the KPI ontology at expertise level, the technical ICT-level ontology using IT codes is yet to be defined. The first step in defining such ontology is to share the needs and preliminary solutions, which is what is done periodically between the demosite ICT teams. To achieve this goal is on good tracks with the multiplication of cities urban platforms and the experience gained by doing so but still requires a fully dedicated knowledge management project.

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

Pillar	:tions (Categorie	Objective of evaluation	Code	Indicator	Primary Secondary	Description	Formula	Unit	Reference *(Original document where indicator is collected)*
	District/Building: New buildings, RES buildings, Storage in Buildings, Domotics & Smart Controls	Energy consumption and CO2 savings for thermal and electrical uses	EN01	Thermal energy consumption	P	The energy demand/consumption corresponds to the energy entering the system in order to keep operation parameters (e.g. comfort levels). To consider the whole savings, the energy consumption may be calculated separately determined for thermal energy and electricity.	equipment	kWh/(m^2.month); kWh/(m^2.year)	SCIS, CITYKEYS
			EN02	Electrical energy consumption	P		equipment	kWh/(m^2.month); kWh/(m^2.year)	
			EN03	Lighting energy consumption	P		equipment	kWh/(m^2.month); kWh/(m^2.year)	
			EN04	Annual energy consumption	S		E.1 + E.2 + E.3	kWh/(m^2.month); kWh/(m^2.year)	
			EN05	Reduction in annual energy consumption	S	This KPI determines the reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	100 - [(E.4 after project) * 100 / (E.4 before proje	% in kWh	SCIS, CITYKEYS
			EN06	Energy use for heating	P	For BEST TABLES. Energy demand per m2 of total used conditioned floor area incl. system losses	equipment	kWh/(m^2.year)	mySMARTLife
			EN07	Energy use for DHW	P		equipment	kWh/(m^2.year)	
			EN08	Energy use for lighting	P		equipment	kWh/(m^2.year)	
			EN09	Energy use for cooling	P		equipment	kWh/(m^2.year)	
			EN10	Reduction in annual heating energy use ambitious compared to national regulation for new or retrofit building	S		100 - [(E.6 * 100) / (national regulation energy u	kWh/(m^2.year)	
			EN11	Reduction in annual DHW energy use ambitious compared to national regulation for new or retrofit building	S		100 - [(E.7 * 100) / (national regulation energy u	kWh/(m^2.year)	
			EN12	Reduction in annual lighting energy use compared to national regulation	S		100 - [(E.8 * 100) / (national regulation energy u	kWh/(m^2.year)	
			EN13	Reduction in annual lighting energy use compared to initial situation	S		100 - [(E.8 after project * 100) / (E.8 before proje	kWh/year	
			EN14A	Recovery	P	DHW energy recovered	equipment	kWh/year	
			EN14B	Saved energy for server cooling	S	Energy not consumed for the cooling of the c	E.14.a * factor	kWh/year	
			EN15	Primary thermal energy consumption	S	The primary energy demand/consumption of a system encompasses all the naturally available energy that is consumed in the supply chains of the used energy carriers. To enable the comparability between systems, the total primary energy demand/consumption can be related to the		kWh/(m^2.year)	SCIS
			EN16	Primary electrical energy consumption	S			kWh/(m^2.year)	
			EN17	Total primary energy consumption (thermal + electrical)	S		E.15 + E.16	kWh/(m^2.year)	
			EN18	Total primary energy consumption related to heating delivered	S			kWh/(m^2.year)	
			EN19	Reduction of total primary energy consumption	S	This KPI determines the reduction of the primary energy consumption after the interventions, taking into consideration the	100 - [(E.17 after project * 100) / (E.17 before pr	% change in kWh/(m^2.year)	

Figure 3: Extract of the KPI ontology provided by WP5

OBJECT	FIELD	VALUE	CONTEXT
DATASTREAM	name	charging_session	Electromobility
		charging_station_user	Electromobility
		EMOB_AVERAGE_OCCUPANCY	Electromobility KPI
		EMOB_CHARGES_PER_YEAR	Electromobility KPI
		EMOB_CHARGING_CAPACITY	Electromobility KPI
		EMOB_ENERGY_DELIVERED_PER_YEAR	Electromobility KPI
		EMOB_OCCUPANCY_PER_YEAR	Electromobility KPI
		EMOB_OPERATING_TIME_RATIO	Electromobility KPI
		EMOB_OPERATING_TIME_YEAR	Electromobility KPI
		EMOB_USERS_PER_YEAR	Electromobility KPI
		lamp_level	Street lighting
	u.o.m.	{ "name" : "Hour", " symbol": "hr", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Hour" }	Electromobility KPI
		{ "name" : "Kilowatthour", " symbol": "kW-hr", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Kilowatt" }	Electromobility KPI
		{ "name" : "Kilowatthour", " symbol": "kW-hr", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Kilowatthour" }	Electricity consumption
			Electromobility
			Electromobility KPI
		{ "name" : "Number", " symbol": "#", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Number" }	Electromobility KPI
		{ "name" : "Percent", " symbol": "%", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Percent" }	Electricity consumption
			Electromobility KPI
			Street lighting
		{ "name" : "Person", " symbol": "person", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Person" }	Electromobility
		{ "name" : "Watt", " symbol": "W", "definition": "http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Watt" }	Electricity consumption
OBSERVED_PROPERTY	definition	"http://www.qudt.org/qudt/owl/1.0.0/quantity/Instances.html#Time	Electromobility KPI
		http://www.qudt.org/qudt/owl/1.0.0/quantity/Instances.html#Dimensionless	Electromobility

Figure 4: Extract of Nantes demosite Urban Platform observation data ontology

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

4. Technical implementation

4.1 Processing steps

The design of the Urban Platform Extensions is based on the following processing tasks breakdown (Figure 5).

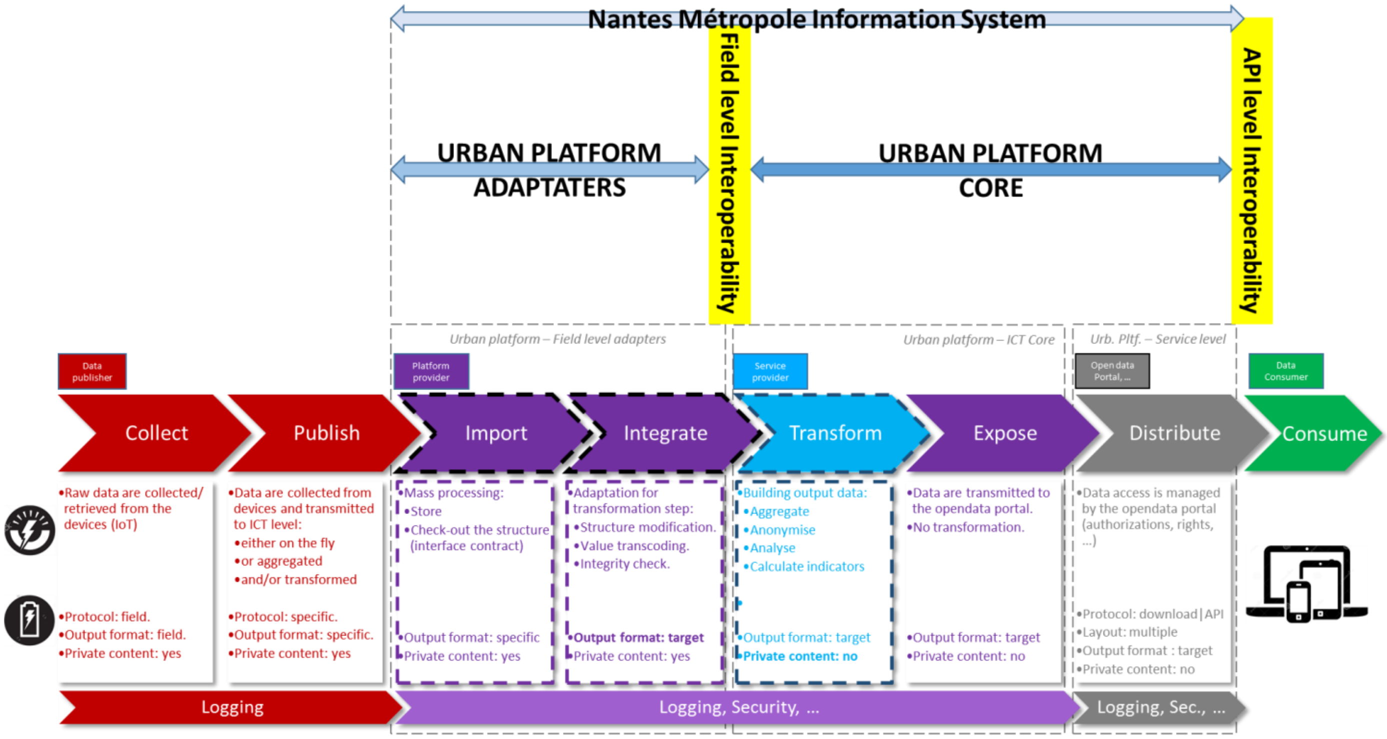


Figure 5: Nantes Urban Platform extensions processing steps

Collect, Publish: These steps are carried out by the Data publisher and are out of the scope of the Urban Platform. They consist in creating the digital information from on-site measurements (sensors) and sending or making it available to the urban Platform. This step is achieved by a simple device or more likely by a proper management system.

Import, Integrate: These steps are relevant only when the Data Publisher cannot meet the Field Interoperability requirement (e.g. existing IS). If not, an "adapter" becomes necessary.

Transform: This step represents the activities within the business (knowledge) layer such as analysis, cross-reference with other data, KPI calculation, aggregation, anonymization, etc. It is at the end of this step when data not produced directly by Data Publishers can be created, especially with regards to privacy issues.

Expose: This step consists in choosing which data, or rather which data type, should be made available to the Data Consumers. It is essential with regards to privacy issues and

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

aggregation matters. For instance, home energy consumptions are private sensitive data since they can reflect living habits [10] and therefore should not be exposed.

Distribute: This step consists in interacting directly with the Data Consumers and the way the data – only those which were chosen to be "exposed" – are made available and accessible to the Data Consumers (persons or systems). Typically, this is where the open data portal plays its role: formats, access rights…

4.2 Architecture

The Urban Platform extensions consist in four sub-systems:

STAGGING	[Specific] Adapters and staging storage area for incoming data.
WORK	[Specific] Transformation services, referential tables and calculated data.
	[Generic] API and storage area for incoming and calculated data.
EXPO	[Generic] API and storage area for data due to be exposed to the existing portal.
MANAGER	[Generic] Logs, dashboards, access control
	[Specific] Use case specific dashboards

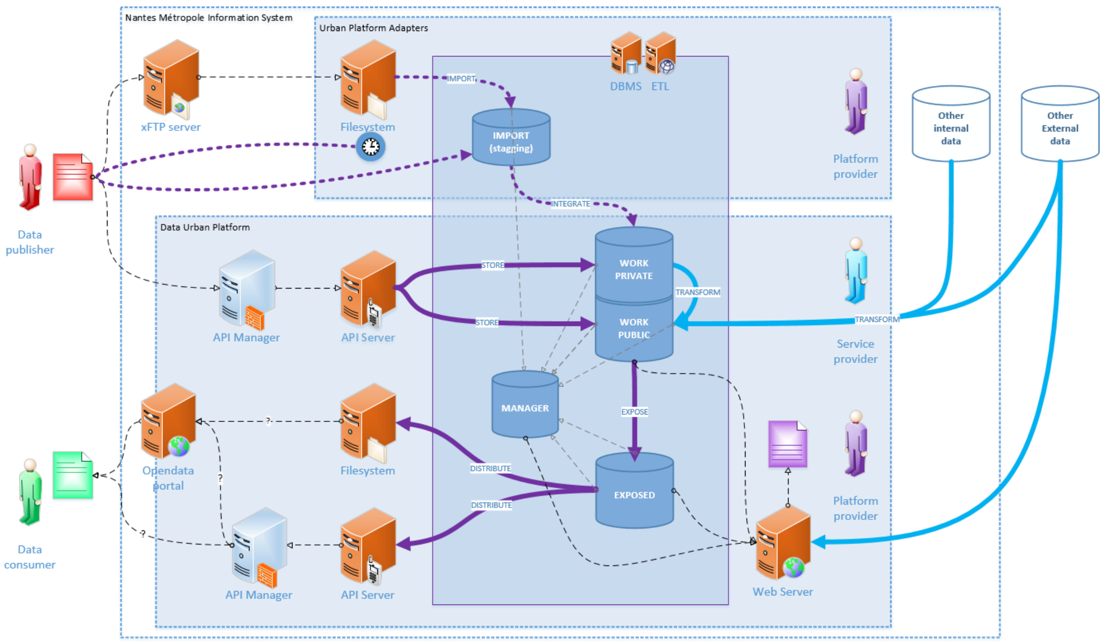


Figure 6: Urban platform extensions architecture principle (full picture: see 10.1)

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

The Urban Platform extensions integrate with the existing systems by sharing the exposition portal and referential asset dictionary.

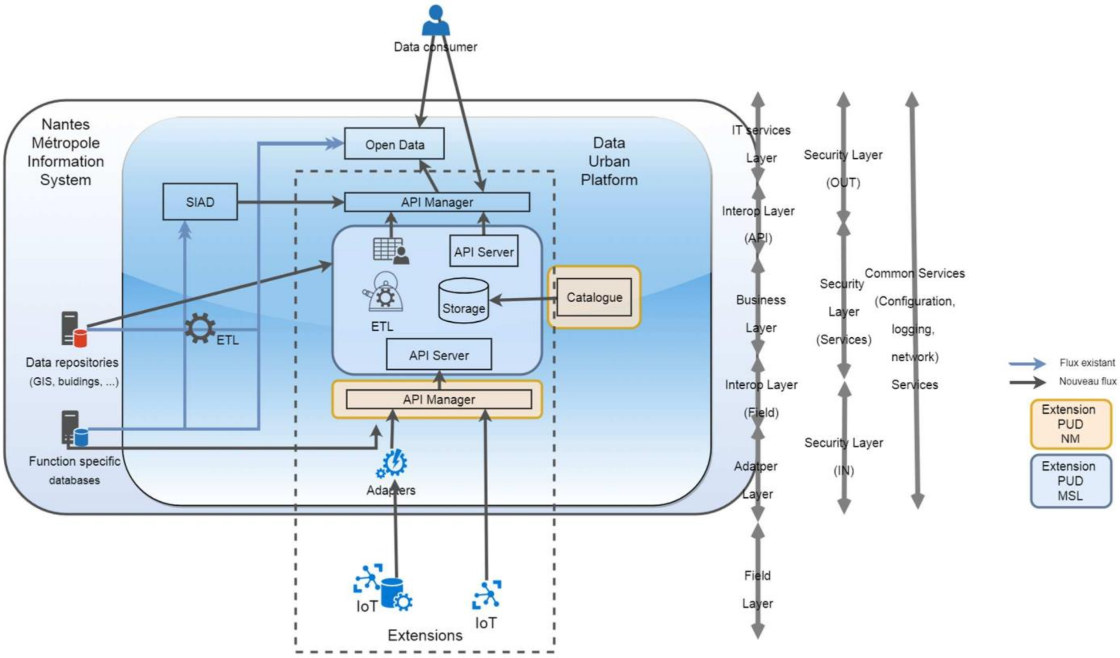


Figure 7: Nantes Métropole Urban Platform: existing and extensions (full picture: see 10.2)

4.3 STAGGING subsystem

This subsystem contains all the necessary adapters to transform the incoming field data into the target standard, i.e. Sensorthings API. If a data publisher provides data in the expected target format, then no adapter is required.

However, the case where the data publisher builds up its solution according to the Urban Platform specification does not occur in the context of mySMARTLife and its duration. Indeed, the actions in mySMARTLife rely on existing solutions and business logics (e.g. streetlighting solutions all come equipped with the underlying IT system such as StreetlightVision or FlashNet) and also the scope of mySMARTLife actions does not cover all aspects of the data publisher's business (e.g. charging stations data come from parking management systems which have to manage payments).

Setting up and using a common standard is rather an investment regarding the future data publisher's IT systems and the time it takes for the industry to adopt new standards. Already Nantes plans to add Sensorthings API compliance in the requirements for specific IT systems.

For the mySMARTLife project, the following adapters are achieved:

- REST/JSON adapter for electric meters referential ontology

- REST/JSON adapter for electric power load curve 10mn points
- REST/JSON adapter for electric daily consumption
- REST/JSON adapter for electric yearly consumption for not connected meters
- File/CSV adapter for electric meters reference table and contract optimization threshold
- File/CSV adapter for streetlighting energy consumption and referential data
- File/CSV adapter for streetlighting KPIs estimates
- REST/JSON adapter for charging station referential ontology
- REST/JSON adapter for charging sessions
- REST/JSON adapter for heating network substation temperatures (ongoing)
- REST/JSON adapter for heating network referential ontology (ongoing)
- File/CSV adapter for non-IT-based mySMARTLife WP5 KPIs
- File/CSV adapter for mySMARTLife KPI ontology

This subsystem represents most of the development work load and is based on the following open-source components: OpenJDK (Java), Pentaho Kettle CE, Python, Pandas, PostgreSQL.

4.4 WORK subsystem

This subsystem is, with MANAGER, the core of the Urban Platform. It provides the incoming endpoint as per the Sensorthings API standard, stores the data and performs the transformations services.

The storage unit stores all data to be exposed to the end users (closed or open data) but also all necessary data not meant to be exposed to the end user, but which are used to elaborate and calculate other data which aim at being exposed.

Transformation services realized for mySMARTLife involved:

- Referential resolution: how to link observation data with the observed asset in the context of Nantes referential as opposed to the data publishers referential, cf. example for Electricity consumption in public facilities).
- Data privacy enforcement, especially by means of aggregation, cf. example for Charging stations use case.
- KPIs calculations, cf. example for Charging stations use case.
- Complementary data integration at transformation level such as conversion tables.

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

The WORK subsystem is dedicated to heavy workloads rather than to supporting users' interactions. It is based on the following open source components: OpenJDK (Java), FROST-Server (Tomcat), PostgreSQL & PostGIS.

4.5 EXPO subsystem

This subsystem is dedicated to making data available to the end users. It provides read-only entry-points to query or retrieve data and mostly transfer the data from WORK subsystem.

The key aspect of differentiating WORK and EXPO is to physically keep the data which are not meant to be exposed, such as sensitive data or intermediate data, away from the access features (portal, dashboards, …). The transfer of data between WORK and EXPO depends on Nantes Metropole's strategy on which data types are eligible to exposition.

For mySMARTLife, integrating with the portal was carried out by adapting the portal to the Sensorthings API standard to perform part of the requests. However, heavy queries are still performed by means of file outputs.

It is based on the following open source components: OpenJDK (Java), FROST-Server (Tomcat), PostgreSQL & PostGIS. The existing Urban Platform portal is OpenDataSoft.

4.6 MANAGER subsystem

This subsystem gathers transversal and technical functions involved in operating the Urban Platform:

- Centralized parameters (excluding adapters parameters)
- Centralized logging
- Dashboards
- Authentication (dashboards)
- Access management (APIs)

This subsystem is rather agnostic to the data processed and stored in the Urban Platform except for dashboards specifically designed for some specific use cases whose values required specific attention, cf. example for Electro-mobility KPIs.

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

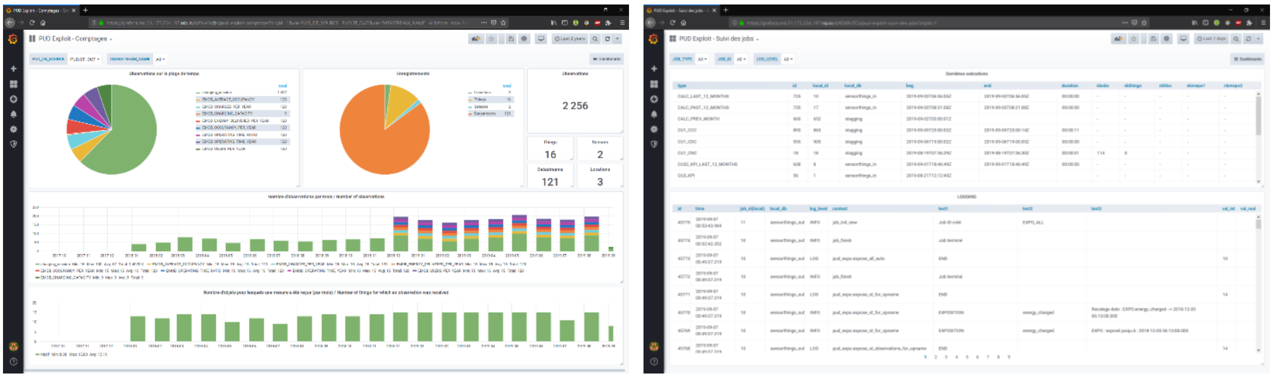


Figure 8: General dashboards for data and activity monitoring

The MANAGER subsystem relies on the following open-source components: NGINX (reverse proxy), Keycloak (authentication), WSO2 AM (API manager), mySQL, PostgreSQL, Grafana (dashboards).

4.7 Deployment

Deploying and monitoring all subsystems components in several environments (development, preproduction, production) was thoroughly considered in addition to the development work load. System maintenance represents a non-negligible activity in terms of surveillance, resource tuning and surveillance throughout the production period.

Replication was considered as a constraint in terms of how many times the system was bound to be deployed as opposed to a one-time SaaS deployment. In this view, extra effort was made to evaluate different techniques to facilitate the installation and deployment procedures. As a result, the initial extension components were ported to docker containers (except for ETL python scripts): NGINX, FROST-Server, PostgreSQL, mySQL, Keycloak, Grafana, WSO2AM, WSO2 Analytics.

In addition, for mySMARTLife, integrating with Nantes Métropole information system was carried out as a request to early replication first by exporting data to the OpenDataSoft portal, then by integrating the API at portal level.

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

5. Use case exploration

5.1 Exploration methodology

To find use cases of the Urban Platform is to find use cases of the data it holds. Far from building a framework, the way data have been valorised up to this point could be categorised into four complementary valorisation approaches:

(1) Data itself: for instance, changing the data format to expose it in Open Data, unveiling intrinsic information

(2) Sectorial data crossing: for instance, crossing sensor values with geographical reference data

(3) Transversal data crossing: for instance, crossing energy information from different services

(4) Multiple partners data crossing: for instance, crossing mobility data from shared campus companies

Keeping in mind the features of the Urban Platform and the state of its development, Nantes' use case research focused on approaches (1), (2), and (3) of above list. To focus on the added-value of the multi-disciplinary exploration process, focus was brought on approaches (2) and (3).

The use case exploration therefore looked at both sectorial and transversal data crossing; a choice which also makes sense considering Nantes demonstration expertise which focused on the Urban Platform contribution to public services performance.

To conduct the research, the project organisation was derived from NAN project management reference principles. To experiment with a new methodology, the project was led by a duo coming from the digital sector for the first partner and energy for the second. The project was headed by an orientation committee which included, along with the leading duo, people in charge of various services in relation to energy and, eventually, data. This trans-disciplinary approach allowed the project to seize, and embrace, a very wide range of ideas and opportunities data science can bring. The overall process iterated over 5 steps.

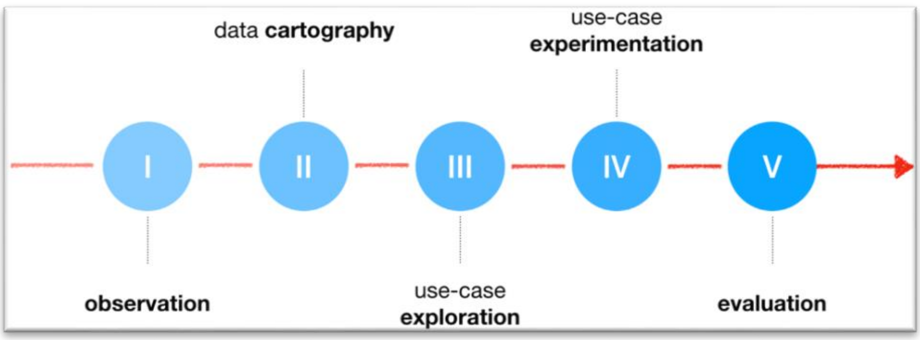


Figure 9: use case exploration 5-step methodology

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

5.1.1 Observation

The first step aimed at getter a deeper understanding of the different departments involved with questions such as: “how do people work?”, “where and how are data involved in the processes, or else, where and how could data bring something to the processes?”, … One main question to understand was to always query the people: “do you work with data?”, and “what does data mean for you?”. Starting from where the people are is crucial.

Mutual understanding was the necessary first step to come to work together.

5.1.2 Data cartography

A first breakthrough was that of the paradox that two services could work on the same kind of data but not share the same data, data model, data format, or yet, data quality. Data are often scattered within organisations, as a result of their inherent processes. To share the same vision of the raw material we can work with was necessary : a comprehensive data cartography had become self-evident; thereby, it became the second step of the methodology.

5.1.3 Use case exploration

The data cartography providing the raw material upon which use cases can be projected on, ideas can start flourishing both from the data cartography and towards it, assessing to some extent its feasibility. It has been as important to be curious and explore internally as to seek inspiration from other initiatives, in France and abroad. About ten use cases were finally drafted, it pointed in 4 different directions: energy management, public spaces, public buildings, renewable energies.

5.1.4 Use case experimentation

Use cases experimentation process seeks to produce a minimal viable product (MVP) in order to assess each use case opportunity value. As well, the experimentation phase is often that of iterating over the use case itself, refining some parts of it. All over the experimentation, an important focus is brought to ensuring enough data is collected to evaluate use case hypotheses.

5.1.5 Monitoring and evaluation

Experimentations start from the hypotheses. Experimentations therefore require carrying a close look on the extent with which hypotheses are validated throughout the experimentation. KPIs are defined for this purpose and they are monitored.

This provides some raw material for experimentations evaluation, which takes place at the end of the process – although some evaluation is also carried along the way.

5.2 ESPRESSO framework to define use cases in a standardised way

ESPRESSO project (“systEmic Standardisation apPRoach to Empower Smart citieS and cOmmunities”) is one H2020 Smart Cities & Communities European project (espresso-project.eu).

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

The concept of smart cities has led researchers to explore a method for optimising data exchange and access so that each city can obtain information that can be used on a tailor-made basis. The main objective was to achieve interoperability and reduce data silos by identifying a collection of data that worked well together. It was achieved through one architecture of standards and references, to activate an urban data platform for smart cities which supports the vision of the European Innovation Partnership for Smart Cities and Communities, especially in terms of conceptual standards framework (business processes, monitoring and indicators, information models, not the technical computing standards). It also aimed at identifying gaps and weaknesses in the framework of available standards.[3]

In the deliverables of the project, Rotterdam & Tartu chose a particular way to define their use cases: both cities adopted a common framework to define and describe each city's use cases. This framework is straightforward and has the benefit of addressing the complexes challenges of making cities more liveable in a very accessible way.

For mySMARTLife project, here in Nantes, we found this global approach very interesting. We decided to try using this framework for our use cases: in this deliverable, several references will be made to our ESPRESSO sheets in the appendices, where each use case is described in one specific sheet; this is what we call: our "ESPRESSO use cases library".

- ESPRESSO sheets numbered **UC#01** to **UC#06** refer to Energy Datalab use cases
- ESPRESSO sheets numbered **UC#10** to **UC#15** refer to territorial energy planning use cases
- ESPRESSO sheets numbered **UC#20** and **UC#21** refer to use cases of the solar cadastre raw data

The ESPRESSO sheets are gatherd into a single document: cf. 10.3

5.3 Services designed as part of the Energy data lab initiative

The Energy data lab is an initiative which looks at providing Nantes Metropole with data from energy distributors (cf. D2.11). For one side, the data is exposed through an online service running since spring 2017. The service's APIs have been connected to the Urban Platform. Data integration allowed Nantes Metropole to experiment with different use cases both internally and with third-parties. Internally, the data contributed to the Energy Director Schema definition, as well as use case experiments led alongside the Urban Platform development. Externally, discussions were engaged with local SMEs and experimentations were conducted together with Atlanpole (ATL), Enedis (ERD), and Nantes Metropole (NAN).

Working with the data exploration methodology depicted above, 3 years later, a handful of use cases were designed.

[3] See espresso-project.eu: the "Who?", "What?", and "How?" paragraphs

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

5.3.1 UC#01: Interactive Data Light

Born from the 2016 CADO[4] challenge, the **Interactive Data Light** is a project for a connected urban luminaire (street lamp), combining LED technology with the presence of users (vehicles, pedestrians) in order to provide the most accurate street lighting possible: dimmed lighting in the absence of a passage, alternated with lighting calibrated to ensure safe traffic.

To experiment this solution, the Interactive Data Light project received further support from Nantes Metropole through the Nantes City Lab labellisation.

Figure 10: InteractiveDataLight illustration

The experimentation took place on the public space, with the temporary installation of this project lampposts onto the street: "Rue La Noue Bras de Fer", in the heart of the Island of Nantes.

The **Interactive Data Light** also integrates numerous sensors to collect urban environment data (air quality, sound environment, etc.) to foster the urban environment analysis exploration. The idea is to take advantage of the existing network of city lighting masts (Smart Grid) to collect information in order to plan and optimize uses.

Providing rich information from the smart lighting electrical load curves, the Energy Datalab platform naturally played a key role in this project, providing the support for the monitoring of **Interactive Data Light** impacts. This experimentation lasted six months and collected data now is being processed to provide analysis in terms of energy savings, comfort improvement, users feedbacks. This use case is described in the appendices: Espresso UC#01.

Figure 11: InteractiveDataLight public lighting mat

[4] CADO ("Challenge for Western Digital Acceleration") is a call for proposal which allowed beneficiaires to access to national financing arrangements dedicated to innovation. It was operated by "Pôle Images et Réseau", a competitiveness cluster and dedicated to digital innovation.

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

5.3.2 UC#02: Public lighting outage detection

The Energy Datalab allows Nantes Metropole to get operational insights one day after. Electrical load curves can give information on past day public lighting working states thanks to the load curve analysis: public lighting electrical consumptions follow a regular pattern of no-consumption / lighting consumption schedule; so that whenever the load curve peaks or drops away from this pattern, this means something is happening.

When the load curve drops while it should be at baseline level, it usually informs one or more public lighting bulbs is undergoing an outage.

Over the last year and half this service has been experimented, over 650 of the alerts which were raised by this service have been taken into account. Oftentimes, it is a minor issue or about a work which was already planned or just effected, but it has raised several interesting cases which permitted a better management of public lighting infrastructures (and notably in terms of fixing issues before the citizens' complaints). This service was rewarded with an integration to a multi-regional ecosystem of services and is currently experimented in other territories (e.g. Brittany); ESPRESSO card for this use case can be found in the appendices: Espresso UC#02.

5.3.3 UC#03: Electrical contracts optimisation

This use case illustrated one way a single dataset can provide a further understanding with a deeper analysis: incoming load curves from Enedis provide both the 10-minute or 30-minute electrical consumption load curves as well as the power contract. Comparing this former with the latter unveils interesting insights about how optimised electrical contracts can be.

The purpose of this use case is to develop this measure-per-measure comparison larger and doing so on the whole public equipment behaviours; for instance, to ensure not to be misjudging summer states of optimisation with energy intensive winters.

A lot of work was on finding the right formula, visualisation technics, and way to make all of this generic to merge implementation for both public spaces and public buildings which, as depicted above, show different specificities (public lighting notably shows electrical profiles with a very low volatility).

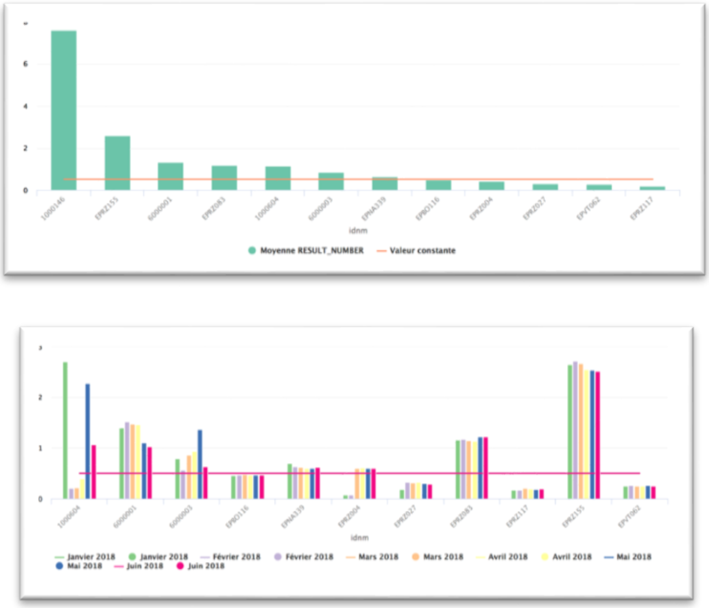


Figure 12: public buildings (left) and public lighting (right) least optimised electrical contracts

This use case is running in the Urban Platform extension developed by Engie and the visualisation layer has been developed on top of the Urban Platform Open Data portal. This use case is described in Espresso UC#03.

5.3.4 UC#04: Electricity bills automated checking

Thanks to the high granularity electricity distribution data coming from Enedis load curves, the regular electricity bills can be verified against these data with an algorithm. This has been prototyped and the experimentation went on with a company to try their tool alongside machine learning facilities (e.g. learning from consumption deviations, …). This use case is described in the appendices: Espresso UC#04.

5.3.5 UC#05: Optimisation of public buildings electrical consumption baselines

The electrical consumption baseline is the minimal electrical energy consumption for a building, which mainly corresponds to the out-of-activity electrical consumption, for instance a Sunday in an office building. It can provide some interesting insights on buildings such as how optimised is it, or insulated, and therefore can contribute to the global public buildings energetic transition policy of Nantes Metropole. Notably, smart algorithms can target the biggest potential sources of energy loss within the big pool of public buildings.

Starting from this idea, Nantes Metropole together with Enedis and Atlanpole, looked out for potential partners to experiment a data-driven approach of consumption baseline analysis. Discussions with Akajoule were engaged after a workshop nearby and thanks to the Energy Datalab initiative, all partners quickly started up to experiment a new service to highlight buildings with highest energy savings opportunities; based on the consumption baselines which can be retrieved from the electrical load curves provided by the Energy Datalab.

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

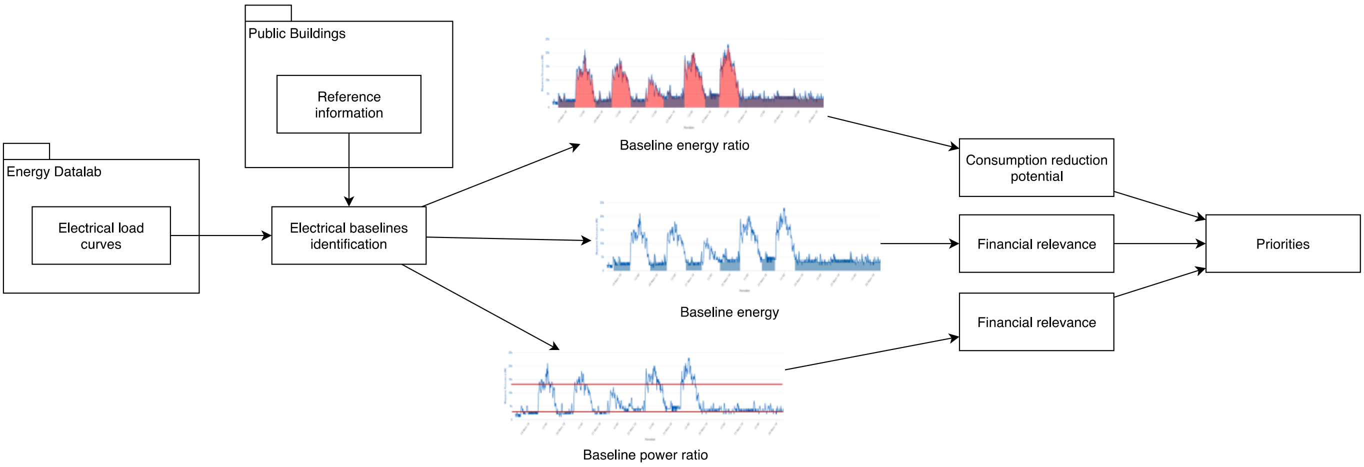


Figure 13: UC#05, consumption baseline analysis process

As illustrated in ESPRESSO UC#05 in the appendices, the work started with identifying the right consumption baseline for each building, computing three different indicators to provide complementary insights which, finally, can be integrated into a final visualisation to provide users with a decision aiding view of buildings state of electrical energy optimisation opportunities.

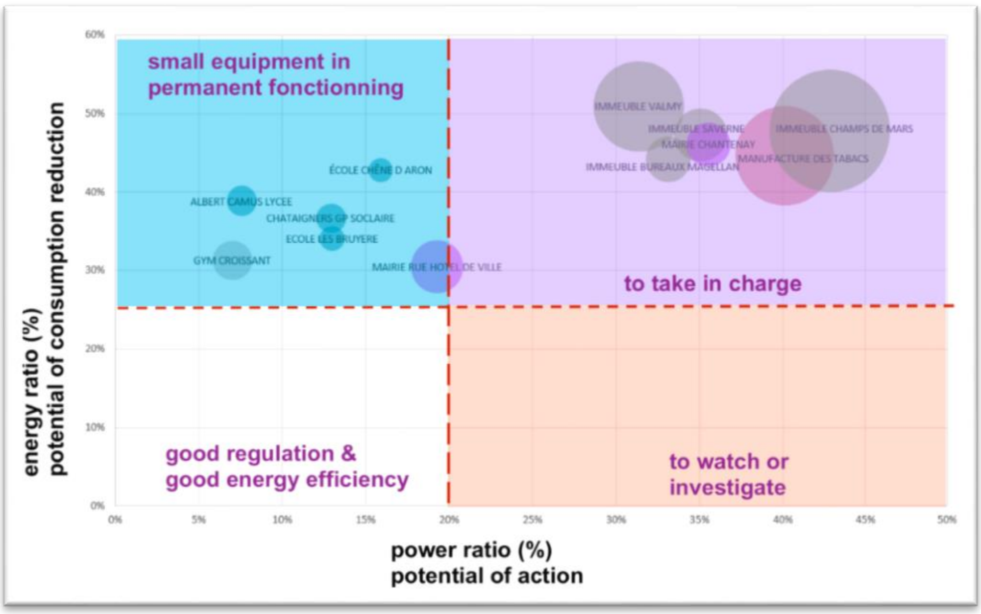


Figure 14: UC#05 visualisation view, public buildings electrical energy optimisation radar

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

5.3.6 UC#06: Automatic detection of public buildings electric behaviour deviations

This use case is born from the ecosystem animation work which gave visibility to possibilities of interaction & experimentation with Nantes Metropole and, in the scope of this project, electrical load curves of public buildings. Edgemind is a local company created in 2014 which develops predictive maintenance solutions, mobility simulation, industrial systems simulation and business data recovery.

For the purpose of this use case, Edgemind and Nantes Metropole collaborated to explore the possibilities of machine learning algorithms, and their explanatory power in response to business needs such as equipment management, energy efficiency, and anomaly detection of public buildings electrical behaviours.

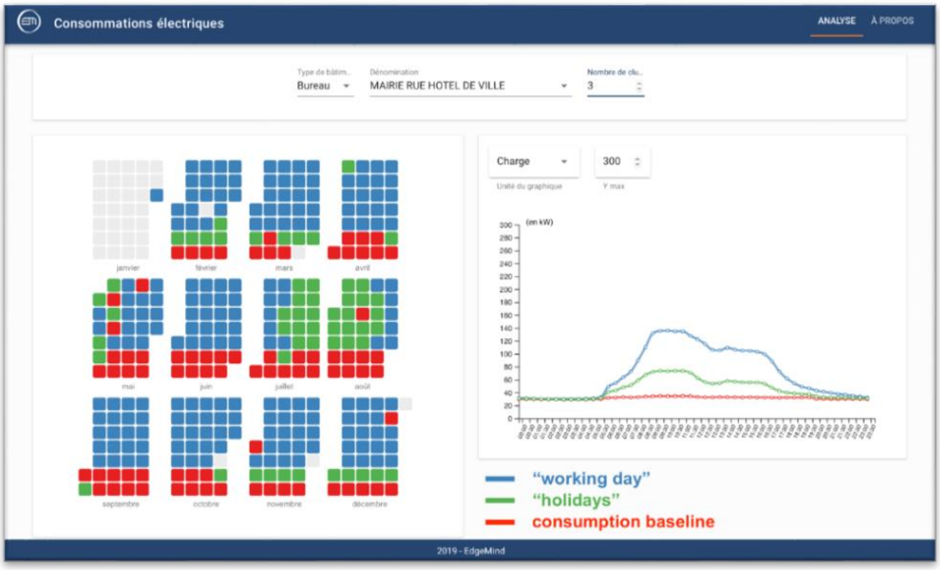


Figure 15: building's three typical daily electrical behaviours

With clustering algorithms, electricity daily profiles of public buildings electrical consumption have been established in the first place. This allowed in a second step to make electrical consumption predictions and, therefore, hopefully provide insights on electrical deviations and potential anomalies. This use case is described in the appendices: Espresso UC#06.

5.4 Local energy data for territorial energy planning

With regards to the law for energetic transition for a green growth ("loi de transition énergétique pour une croissance verte") and in application of the article 179 decreed in July, 18th of 2016; the French ministry of environment, energy & oceans, henceforth provides **local energy data** to regional authorities and city councils. As regarding Nantes Metropole and as a result of the fact it disposes of the energy distribution networks of its territory, therefore acting as their organisation authority; delegating energy distribution activities to operators (and notably to national electricity and gas operators, respectively, Enedis and GRDF), Nantes Metropole retrospectively required the local energy data emanating from aforementioned operational

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

activities. For this section, the detailed work is scoped within the perimeter of such local energy data; the purpose is to contribute to territorial energy planning activities, as part of the global energetic transition public policies implementation.

While local energy data details consumption at the address grid for the whole territory, GDPR concerns are taken into account with disclosure policies. Energy consumption data are provided at the address scale and detailed for each sector (agriculture, industry, tertiary, residential and unaffected); however for residential data, limitations apply: they are anonymised for all addresses where less than 11 households are living there and that their annual energy consumption is not below 200MWh.

Exploring data with various people from the energy sector, the local energy opened the doors for new possibilities to improve the territorial energy planning; using data to contribute to the energetic transition public policy planning, and implementation.

5.4.1 UC#10: Constitution of a territorial energy reference frame at the address mesh

Working with data starts with valid & clean datasets; for this purpose, the use case #10 aims at constituting a territorial energy data reference frame, in the form of a mesh address grid. Thanks to the opening and sharing trend of the energy data, more possibilities are becoming possible with the work and analysis on new datasets. In the context of the Energy Datalab, Enedis made available to Nantes Metropole a mesh address electrical energy data.

Unfortunately, there is no national reference frame or identifiers for properties and buildings, hence, it is a necessary first step to match the references between the various stakeholders: Enedis and Nantes Metropole for electricity, but this is replicated to gas and district heating energy infrastructures. Bringing together the mesh address data from all energy sources on the whole territory can, therefore, provide the necessary keystone to develop data use cases with the purpose, finally, of contributing to territorial energy planning. In a nutshell, the purpose of this use case is to provide an interoperable mesh address of all annual energies' consumptions of the territory.

To qualify addresses, a property qualificative datasets has been collected from the national public finance direction, which had built such a dataset from all declarative and reference information processed for the local residence tax. Many issues were raised, matching property references with energy addresses; all of this on top of data quality disparities which complexified the potential for interpretation of results.

Notwithstanding, opportunities for exploiting this data frame were sought and the following use cases are as much opportunities to leverage on the mesh address energy data frame; with more or less complexities, they demonstrate the importance of such a transversal energy data frame this use case looks after.

5.4.2 UC#11: Energy-intensive buildings identification

Based upon what UC#10 could provide; UC#11 works from the crossing of two potential inputs:

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

1. Property data, which can provide estimates of energy consumption profiles per building and/or parcel;
2. Local energy data, which provides annual consumption for each source of energy, taking into consideration GDPR concerns and, therefore, being available only for the biggest buildings (for instance, more than 10 households should be living in is one GDPR requirement). This does, nevertheless, provide some real observations of energy consumption.

Comparing estimates with the real observations can highlight interesting insights: if the real consumption is found to be "too much" above of estimates, it could either indicate approximations in the estimation process, or issues in the building usage, and this is something the accompaniment policy of energy-intensive buildings can be interested in.

Using the energy territorial data and crossing it with the buildings territorial data can unveil estimations of buildings for which for overall consumptions either look higher than other similar buildings, or else, higher than some national or local energy consumption recommendations.

This helps Nantes Metropole public policy planning providing insights on the territorial sectors to plan resources allocation more efficiently and towards the – supposedly – most energy-intensive buildings. Espresso description for this use-case can be found in the appendices.

5.4.3 UC#12: Support for condominiums retrofitting

The purpose of this use case is to bring decision aiding to the implementation of the retrofitting accompaniment public policy. This use case aims at qualifying condominiums from an energetic efficiency point of view in the first place. This use case would mix inputs from the ongoing UC#10:

- Property data, from which condominiums can be highlighted. To find condominiums, a straightforward way is to find buildings of which plural housing premises can be attached to. The condominium scale is necessary to take into consideration the GDPR concerns because energy data can only be provided for addresses of more than 10 households.
- Energy data can thereafter come into play to qualify such condominiums.

A short analysis can quickly help implementing the retrofitting accompanying policy, helping to focus resources and energy on the most relevant opportunities. On the subject of retrofitting, a website has also been developed as action 32 of mySMARTLife (single desk for energy retrofitting). Planning efficiently is a key aspect of implementing public policies to face financial & acceptance constraints and using the territorial energy & property data can contribute to these public policies implementations. Espresso description for this use-case can be found in the appendices.

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

5.4.4 UC#13: Evaluation of before/after retrofitting

Evaluating the impacts of retrofitting is not so easy. To assess of the impacts of retrofitting at the global scale of the whole territory requires data and this is where the data frame undergoing development from UC#10 could contribute to provide useful insights:

- With the territorial energy data, for each address can be highlighted the evolutions in terms of energy consumption.
- Besides this, Nantes Metropole accompanies retrofitting projects; Nantes Metropole could, therefore, from this list, follow the impact of it.

Evaluating the different accompanied retrofitting projects, this use case would participate to the retrofitting support policy more globally providing insights contributing to the retrofitting impact objectives assessment. Espresso description for this use-case can be found in the appendices.

5.4.5 UC#14: Evaluation of new buildings compliance with energy targets prescribed

To implement the territorial planning, public policies are traduced in rules which are then established in specific planning documents. Notably, Nantes Metropole, with the publication of a new Metropolitan Urban Plan (April 2018), illustrated one way regulations can be implemented on the territory and throughout practical actions. On the topic of energy and energetic transition, energy targets of new buildings & constructions are prescribed based on the projects' location and local rules.

Using data and notably from UC#10, some kind of an elementary evaluation process of energy targets compliance could be approached; this is what could be possible:

- From territorial energy data, energy consumption could be known at the address grid;
- Using a geographical operation, comparing above energy consumption with local rules and energetic targets (which are prescribed per geographical zone) can provide a first assessment of these compliances.

This use case is described in a specific Espresso sheet: UC#14 in the appendices.

5.4.6 UC#15: Identification of buildings heated with fuel oil for conversion to the heating network

A key aspect of energetic transition is shifting energy sources towards more renewable or, at least, low-emitting energy sources. Because heating is often the first source of energy consumption for housing and buildings, bringing energetic transition on fuel oil heated houses is a major action to reach the environmental objectives.

In relation with the use cases #11 and #12, this use case aims at targeting fuel oil heated buildings to work on conversion to the heating network. This can be done from the territorial property and energy datasets

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

with the following criteria for instance: no gas heating, no electricity heating, no heating network heating, but the presence of a central heating (or not, but this can presage of a better social acceptance).

What is more, Nantes Metropole wants to target primarily buildings of people with low energy condition such as household in situation of energetic precarity. To do this, energy precarity profiles can be estimated from the work done in use cases #11 and #12, as well as to cross this with some demographic information.

This use case requires a transverse vision of energy sources and property information as well as some extra knowledge to provide the right diagnosis. Data from UC#10 could help to tackle this issue; once developed, could be retrieved from the territorial mesh address energy data frame:

- property data with estimates of buildings energy consumption profiles as seen on UC#11;
- energy data, especially providing comparisons with above property-based estimates;

Where there can be a consequent difference between the Gas/Electricity annual consumptions and consumption estimates, and that, thereafter, we can, from the property data, estimate of the presence or not of a central heating system and, finally, matching it with a building Heating Network annual consumption or not: we can reasonably estimate there is a potential for a presence of a fuel oil heating system!

Obviously, and as with every data use case, it cannot be linked with a decision straight after; it rather, reasonably, provide enough information for a public agent expert to process the diagnosis. This use case is described in a specific Espresso sheet: UC#14 in the appendices.

5.4.7 Connection with the “Territorial Self-Data” experimentation

With the aim to outsource the data appropriation and look out for use cases in a much more collaborative way, the Territorial Self-Data experimentation was the opportunity to experiment a new way to approach emerging subjects.

Led by la Fing (“Fondation Internet Nouvelle Génération”), French think tank on emerging digital subject, we’ve worked on how can services leverage on personal data at a much higher level, but with a much higher respect of confidentiality and security: by design.

The aim for Nantes Metropole was to question how can personal data contribute to massifying behaviour change in the field of energetic transition, with regards to the public policy born from Nantes Metropole’s “Great Debate on Energetic Transition”.

Actors from energy, ICT, and the energetic transition more globally, were brought together to co-imagine use cases, with the Self-Data paradigm, and how could they be experimented. This is described in deliverable D1.4: “Delivery of Workshops for citizen engagement”.

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

5.5 Exploitation of the solar cadastre: the data behind

The solar cadastre is a web platform developed by In Sun We Trust for Nantes Metropole. It is one of the measures adopted to develop solar energy on its territory, as part of the answer to the “Solar plan” of Nantes Metropole – one objective being developing small solar power plants. Anyone can use this innovative platform to have information about the solar energy production of any rooftop on the Metropole area. After having selected a rooftop and answered a few questions regarding the details of the installation wanted, a cost estimate can be realised. The solar cadastre has been operating since May 2017. Since June 2018, the platform has had an average of 358 visitors per month.

On top on services the platform delivers, the solar cadastre raw data provide precise and rich information at the square meter scale such as: shadowing, azimuth, inclination, monthly producible. This is very interesting and contribute to use cases beyond the website! Applying the same data exploration methodology, the data science work around the solar cadastre raw data went further into two use cases.

Easting	Northing	Altitude	Tilt	Azimut	GTI,1	GTI,2	GTI,3	GTI,4	GTI,5	GTI,6	GTI,7	GTI,8	GTI,9	GTI,10	GTI,11	GTI,12	GTI,y
353186	6687223	12	41.6	74.9	24.6	41.8	74.6	110.7	132.6	163.7	137.1	121.4	98.5	57	27.2	20.6	1010
353185	6687223	12.6	27.9	65.1	22.8	40.2	76.9	115.5	140.2	177.4	148.1	128.5	99.6	56.9	26.1	19.7	1052
353184	6687223	13.1	31	53.5	19.8	34.4	68	105	131.4	165.8	138.8	117.5	89.2	49.1	23.1	16.6	959
353186	6687222	12.1	33.5	81.2	28.3	48.2	83.9	120.8	142.3	176.9	147.9	132.3	107.7	65	31.3	24.5	1109
353185	6687222	12.8	35.4	77	26.2	44.6	80.9	117.2	139.3	172.9	144.7	128.6	104.2	61.3	29.5	21.9	1071
353184	6687222	13.4	36.7	61.8	21	36.4	69.5	105.7	130.8	163.1	136.8	117.7	91.4	50.8	24.2	17.8	965

Figure 16: an extract of the solar cadastre raw data

5.5.1 UC#20: public buildings solar energy production diagnosis

Nantes Metropole ambitious energetic transition public policy has set the goal of 40% share of local & renewable energy sources in the electrical consumption of its public buildings by 2030. A substantial budget will be allocated each year to reach this objective; with more solar plants to be implemented on public buildings every year and until 2030.

Considering about 800 buildings are potential candidates, a key aspect of solar plants deployment is efficiency which relies on choosing the right buildings. To help this decision-making process, the solar cadastre can provide prioritization KPIs such as the solar production potential for instance.

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

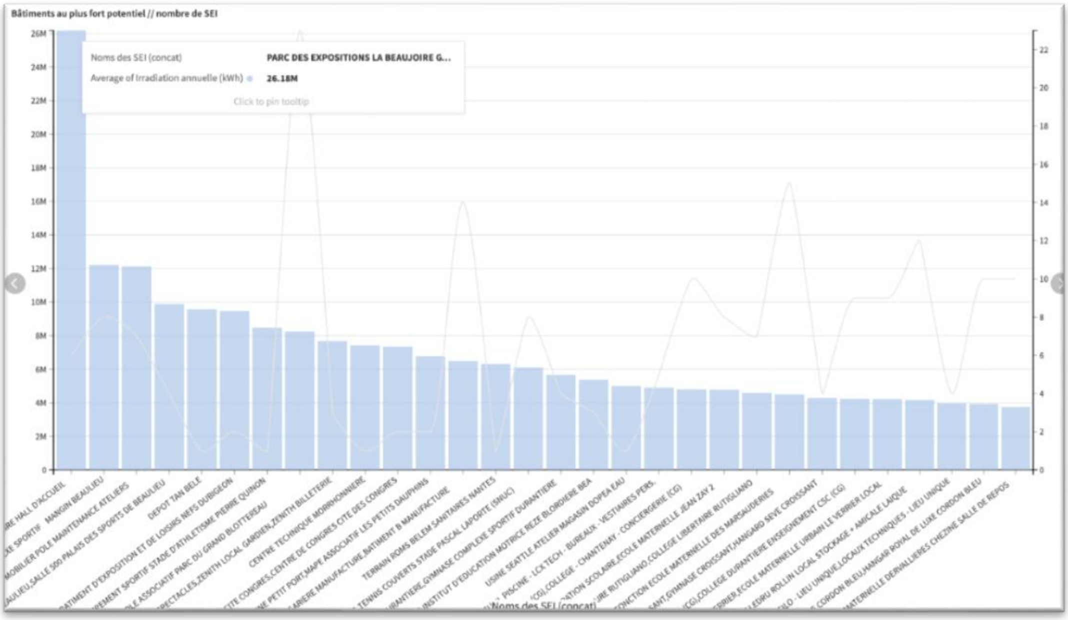


Figure 17: public buildings diagnosis of solar individual self-consumption potential

This use case is detailed in Espresso: UC#20 in the appendices.

5.5.2 UC#21: contribution to territorial development of renewable energy sources

Nantes Metropole energetic transition public policy carries its values at the territorial scale as well. This is often represented by the major ambition born from the Great Debate to become the first French canopy by 2030, which practically translates to a 100% of rooftops to become useful – providing food, energy, habitation arrangements, …

While the solar platform (nantes-metropole.insunwetrust.solar) allows people to assess solar opportunities efficiently, working with solar cadastre raw data can provide insights on territorial energetic transition planning such as targeting energy sharing potential communities, or finding the best sites for local associations such as CoWatt which leverages on crowdfunding to develop local solar projects.

This use case is detailed in Espresso: UC#21 in the appendices.

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

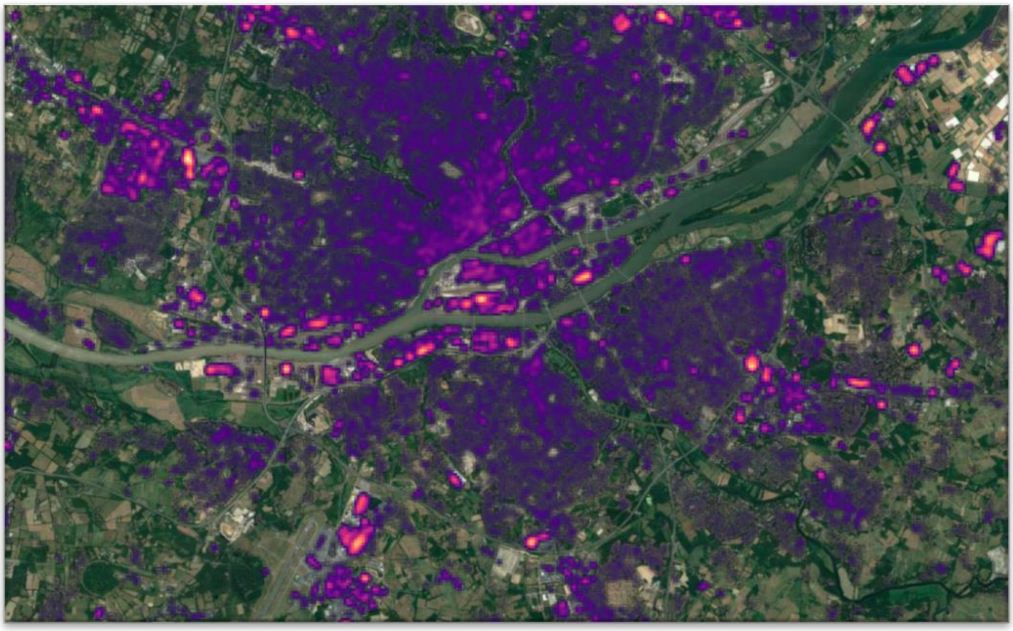


Figure 18: territorial diagnosis of collective solar electrical self-consumption potential

5.6 Use case prototypes evaluation: what to focus on

MySMARTLife is a big project with important deadlines and a perimeter to consider. We could make a distinction between two sets of actions:

- "secondary" actions, which consisted in evaluating the data, building up the according use cases and implementing the IT aspects
- and "primary" actions: PV plants, charging stations, … with their respective KPIs.

Such secondary actions depended on primary ones: having to tackle with a common deadline for these two sets of actions added complexity in the implementation phase and eventually lock-ups. To face this challenge regarding the implementation of use case prototypes discussed above, ENG and NAN collectively decided to bring the focus on use cases matching a specific set of conditions:

- use cases for which the necessary raw material is already available: collecting new data is time consuming and not always easy to fit into a constrained schedule. This requirement is central in terms of planning: the use case exploration feeds on the actions implementation and the implementation is therefore bound to follow up the data-producing actions.
- use cases which regulatory boundaries and specificities are well defined and allow such uses; notably: data property or usage limitations was a key aspect to define, before to take into consideration.

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

- use cases with coherent typologies in terms of data: Nantes' Urban Platform extension developed within mySMARTLife mainly addresses data coming from a wide variety of sensors, models, formats, …

The purpose of use case exploration is to provide new ones to experiment within the Urban Platform in order to contribute to its development. Knowledge was of course shared with other business directions to see how use cases can contribute to other purposes, eg. energetic transition roadmap implementation.

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

6. Use case implementation

6.1 Transverse implementations

Common process had to be built up to ensure consistency between the use cases. This chapter applies to all following use cases integrated in the Urban Platform extensions.

Use case and data availability:

As demonstrated in the previous chapter, a large amount of work was carried out to research use cases. However, the feasibility criteria of such use cases also involved when the definition and data would be available.

Observation types ontology:

As mentioned in the “Interoperabilities” chapter, ontologies must be set and if possible shared as best as possible. One of the most obvious ontology to be set is the observation types ontology. Between raw (field data) and calculated (KPI) observations, more than a hundred different types are planned to be stored and available for query in the Urban Platform.

Based on the work of integrating the field data and the WP5, the type ontology is stored as constant parameters in the Urban Platform and its working relies on it. All adapters implementations, KPI calculations and dashboards definition rely on this ontology.

Regarding definition of quantities (what is measured) and units (how is it measured), the Urban Platform extension rely on the QUDT non-profit organization[5] and all data were analysed to confirm their unit of measurement (e.g. Watt or km/h) and the quantity kind (what it relates to in the real world, e.g. energy or velocity).

Observations metadata:

Although Sensorthings model is not very big (7 main classes), the planned amount of data to be stored makes it necessary to limit the use of referential links between tables and especially the observation table, which should store several million records. To answer this concern, metadata are set at “observation” and “thing” level to facilitate the queries. On the other hand, such metadata must be kept small since denormalizing the observation data could lead to significant amount of storage space. The following metadata are used in mySMARTLife extensions with help of the “parameters” and “properties” SensorThings attributes:

- Observation type: equivalent to the DataStream’s name to save one referential link.

[5] Example of unit of measurement: http://www.qudt.org/qudt/owl/1.0.0/unit/Instances.html#Kilowatthour

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

- Observation nature: to facilitate the queries for KPI dashboards; can have two values: “mesure” (observation) or “kpi”.
- Sensor type: to make it possible to build up queries on equipment types without having to check all names possibilities.
- Thing type: to make it easier to locate all charging stations without the need to check whether observation of a certain kind exist.

Generic objects:

When it comes to KPIs calculation, the following question arises, what is it related to? The whole demosite? The area of Nantes mySMARTLife actions are experimented at? The mySMARTLife intervention the action producing the KPI is associated to? A cross between those?

First two repositories were designed from scratch: interventions and indicators. Both repositories implement WP5 requirements for the Urban Platform.

Then, the initial configuration and services implementations could be designed and achieved based on the above-mentioned repositories. The choice was made to add extra virtual referential records to designate the interventions the level of which the KPIs must be evaluated. Therefore, all WP5 KPI must be associated to an intervention and be set up in the Urban Platform as intrinsic settings. As a result, a “thing” entity located at the centre of Nantes if no other information is available is created for each intervention. The KPI calculation is not performed at a thinner scale.

6.2 Electricity consumption in public facilities

The electric energy data lab aims at both fostering energy digital service innovation (axis 1) and contributing to Nantes Metropole’s energetic public policies through data (axis 2) - especially concerning electricity (action 45). This is done through data exposition to Nantes Metropole in the first place, and third-parties over a second phase to experiment with new services. Most notably, Enedis makes the following data available for Nantes Metropole to re-use: 10-minute or 30-minute consumption of 300 public building & public lightning meters (also known as “electrical load curves”). This data gives precise indications on buildings behaviours for instance. It has been requested by some companies as well, as they strive to access to such precise data (this is thoroughly detailed in the deliverable D2.11: energy data lab initiative).

Incoming data	Protocol	Format	Comment
Power load	REST/JSON	Proprietary	
Cons. for connected meters	REST/JSON	Proprietary	
Cons. for not connected meters	REST/JSON	Proprietary	
Meters geographical information	REST/JSON	Proprietary	

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

Incoming data	Protocol	Format	Comment
Meters reference table	File/CSV	Proprietary	

Data in the urban platform	Observation nature	
Power load	Measurement	
Daily energy consumption	Measurement	
Yearly energy consumption	Measurement	
Contract adequacy	KPI	Monthly

Four adapters were developed to fetch the data provided by ENEDIS, electricity company, one for each type of electricity consumption related data: power load, connected meters energy consumption, non-connected meters energy consumption, and one dedicated to fetching the meters geographic information.

Although the incoming formats are similar, differences in the data attributes did not allow to elaborate a unique adapter. This illustrates if needed the sound approach of choosing a single standard for the Urban Platform: Urban Platform users will not have to develop three adapters to fetch the three types of data.

Example of API query to fetch the first 100 data provided by ENEDIS regardless of their subtype:

```
https://stin.msl.31.172.234.197.nip.io/Observations?$filter=startswith(parameters/type,'ENEDIS')
```

Example of API query to fetch the first 100 daily consumption data provided by ENEDIS:

```
https://stin.msl.31.172.234.197.nip.io/Observations?$filter=parameters/type eq 'ENEDIS_datalab-conso_c2c4c5'
```

Work was achieved to map the structure of incoming data with the target Sensorthings API, formalized as technical specifications, shared and validated with Nantes Metropole as per consistency with the existing services. Codes, unit definitions, metadata were created and applied to all attributes deemed to be stored in the Urban Platform.

This use case data allows to monitor the energy consumption by calculating a KPI for the adequacy between the maximum amount of energy subscribed as per the contract with the electrical company and the actual energy consumption: $\frac{1}{N} \times \sum_{i=1}^{N} \left|\frac{OBS\_CDC.Ps(t_i) - OBS\_CDC.Px(t_i)}{OBS\_CDC.Px(t_i)}\right|$ were Ps is the subscribed power load (max) and Px the instant power load and t_i the n^{th} percentile of observation above a threshold defined per meter.

This use case can also open the field of data science studies by crossing the data with external sources such as the weather conditions.

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

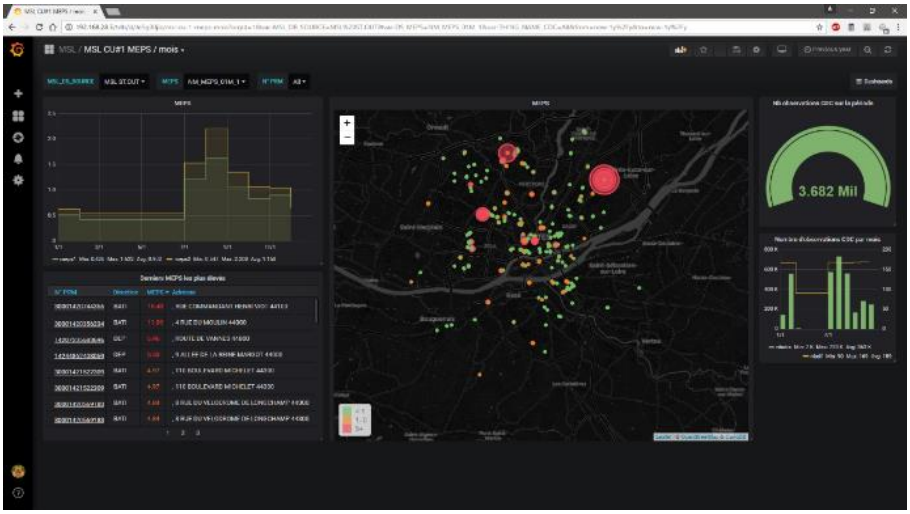


Figure 19: Dashboard for contract optimization

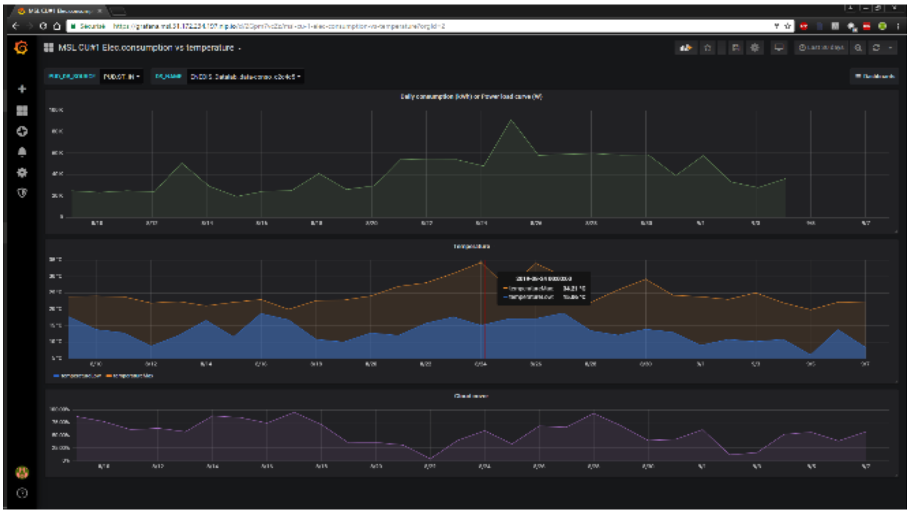


Figure 20: Dashboards for Weather influence

6.3 Public lighting

80 public lighting points have been replaced with LED systems and they have been equipped with sensors and connected to a managing system. This intervention has been described specifically in deliverable D2.15: “design and implementation of public lighting concept”.

To provide monitor this solution, the public lighting system was integrated into Nantes’ Urban Platform.

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

Incoming data	Protocol	Format	Comment
Installation power			
Energy consumption (monthly)			REST/JSON planned in 2020
Greenhouse gas emission	File/CSV	Proprietary	
Initial installation power			

Data in the urban platform			
Energy consumption	Measurement		Monthly
Energy used for lighting	KPI	KPI #E8	
Total greenhouse gas emission	KPI	KPI #E31	
Electrical consumption	Measurement		Monthly
Greenhouse gas emission	Measurement	KPI #E30	Monthly
Reduction in annual lighting energy	KPI	KPI #E12	
Reduction of gh gas emissions	KPI	KPI #32	

A first adapter was designed to integrate data from the first system due to be installed as part of mySMARTLife action. However, for reasons external to the building of the Urban Platform, the provider was removed and had to be replaced. The first adapter was therefore abandoned at integration stage.

For the new provider – Flashnet – a common ground had to be found between specific and existing constraints. Whereas real-time data are available by means of websocket at equipment level, energy consumption batch data are available by means of CSV file. However, an API is planned as per the cooperation with ENGIE Livin' platform. Therefore, an adapter is built to integrate street lighting data and KPIs and its design follows a modular approach which will make it possible to integrate the API when it is available and change the workflow of incoming data.

6.4 Charging stations

As part of the mySMARTLife project, Nantes Metropole is committed to the deployment, by 2020, of 65 smart and connected charging points for electric vehicles (EV) in the car parks located in the metropolitan area centre. More specifically, Nantes Metropole is committed to provide with the installation of "supervisable" charging points, divided into:

- 49 "slow" charging points
- 14 "accelerated" charging points

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

- 2 “fast” charging points.

This is detailed in deliverable D2.13: “monitoring solutions for EV uptake”. As the deliverable name highlights, a strong aspect of it regards vehicle charging points connection to Nantes’ Urban Platform so that data related to the use & functioning of the charging infrastructures can be monitored and integrated into Nantes Metropole information system.

Incoming data	Protocol	Format	Comment
Charging sessions	REST/JSON	OCPI 2.1.1(*)	Amount of energy, times, user
Referential assets	REST/JSON	OCPI 2.1.1	Location, ch. station, connectors

(*) A slight difference exists with the official OCPI 2.1.1 specification.

Data in the urban platform	Nature	Comment
Energy delivered per session	Measurement	With times as metadata
Number of users	Measurement	Monthly aggregation per charging station
Average occupancy duration	KPI	
Charges per year	KPI	KPI #M20
Charging capacity	KPI	
Total energy delivered	KPI	KPI #M17
Total occupancy duration	KPI	
Average operating time ratio	KPI	KPI #M22
Total operating time	KPI	KPI #M21
Total number of users	KPI	KPI #M26.a

This use case deals with charging stations for electric vehicle. The data is provided using a known and opened standard: OCPI. However, the implementation of the OCPI specification contains a slight difference with the specification and it had to be considered. The observation adapter developed for mySMARTLife extensions cannot therefore be reused in a true OCPI context without a little re-engineering.

Two adapters were developed: one for the referential data, one for the observations although the observation service provides all the information about the asset (charging station) the observation relates to. The reason to develop a specific referential adapter is that to gain knowledge of all the referential assets would require to receive data for all of them. Choice was made to develop a specific adapter which fetches all the referential data before fetching the charging session related observations.

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

As per GDPR concern, a special attention was given to the observation data necessary to calculate the number of users of each charging station. All charging session observation provide a unique identifier associated to the user who recharged its vehicle. Although this identifier is anonymized, the fact that one could determine the habits of a user in terms of when and where he or she would use the stations and at what frequency was a concern and Nantes Metropole made the request not to store the information this way in the Urban Platform. As a result, user identifiers are stored in the Urban platform only at monthly level as one observation unrelated to the actual charging session, which contains the precise information of beginning but no user identifier.

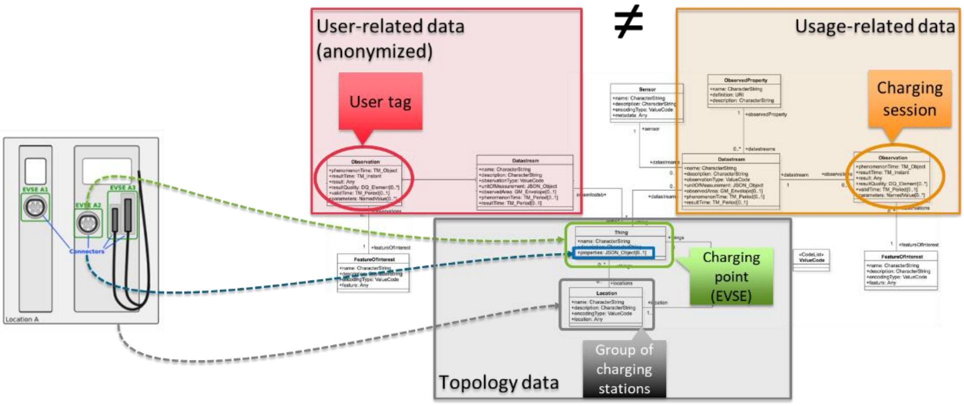


Figure 21: GDPR concern in modelling observation data (UC#3)

KPI are designed as per WP5. They are based on a per year basis. However, to see the evolution of such KPIs, a 12-month window calculation is planned: KPIs will be calculated every month.

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

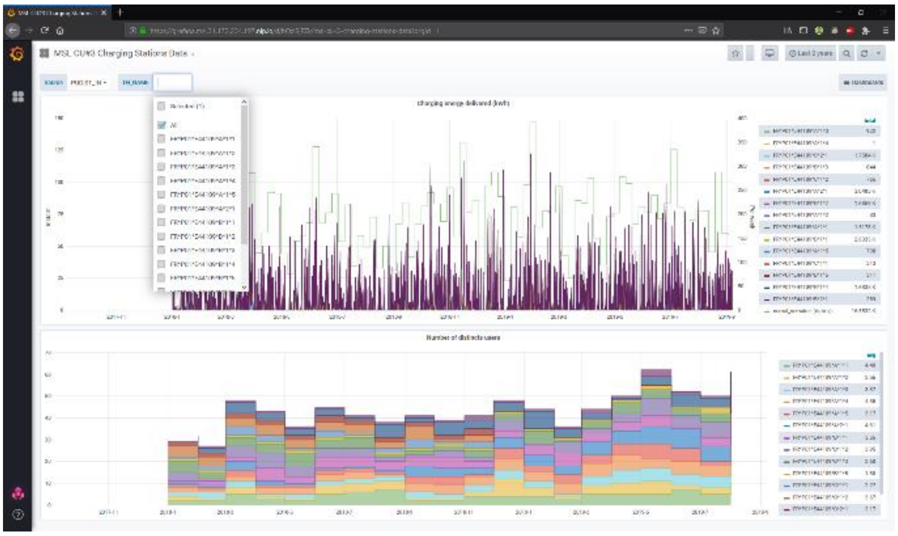


Figure 22: Collected charging stations data

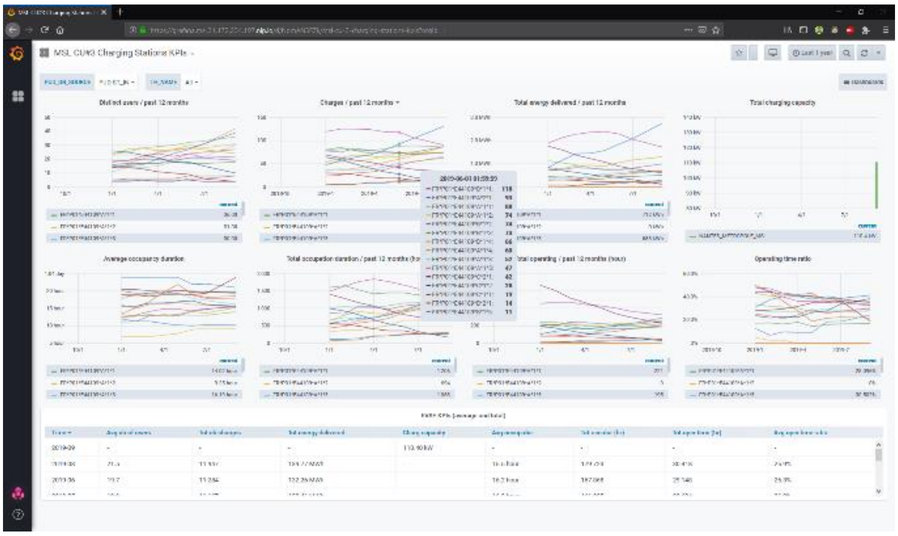


Figure 23: mySMARTLife KPIs for charging stations

6.5 District Heating Network optimisation

At the time of writing, this use case is at design stage. As such, final details of design and implementations are not provided in this document version. The purpose of this use case is to provide district heating data consumers with a single standardised & interoperable API to expose district heating network data, namely the SensorThings API. In the terms of Nantes' Urban Platform, this means: integrating ERENA into the Urban Platform ecosystem as data provider, providing a SensorThings API service to integrate incoming

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

data into the specified district heating data format(s), and to expose data to data consumers, namely ARM at times of writing.

ARM is interested into this service as it allows a better integration of ERENA district heating data into the district heating network optimisation intervention they lead. More details about this work is provided in both: deliverable D2.10 regarding the district heating network optimisation, deliverable D2.9 about the decision aiding tool.

To implement this use case started with regulatory agreements between the stakeholders: ERENA to provide data to the Urban Platform; NAN to take responsibility for the data security & privacy concerns, and to endorse them with the data consumers; and ARM, finally, to accept the confidentiality agreement to use the data.

From this moment on, NAN and ENG started the District Heating Network integration into the Urban Platform.

Incoming data	Protocol	Format	Comment
Sensors measures	REST/JSON	Proprietary	
Heating network sensors reference table	File/CSV	Proprietary	

Data in the urban platform	Format	Comment
Sensors measures	Measurement	
Monitoring KPIs	KPI	Either NAN or ARM to provide the KPIs

Adapters were developed to fetch assets and observations data provided by ERENA, heating network company in charge of the public delegation of service of Centre-Loire district heating network operation. Adapters were developed specifically to the hierarchical structure of the API which is provided by “Cofely Vision”, national API portal of ERENA.

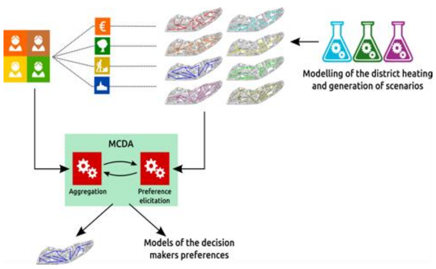


Figure 24: multi-criteria multi-stakeholder decision aiding overview of Diviz

The aim of this use case is to integrate the heating network data which is necessary for the heating network optimisation research action, currently led by Armines (ARM) as within mySMARTLife, but such usage could be both: extended to the whole heating network operated by ERENA, and replicated to other heating networks (i.e. Nantes can count on a total of 5 district heating networks, ERENA’s being one of them).

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

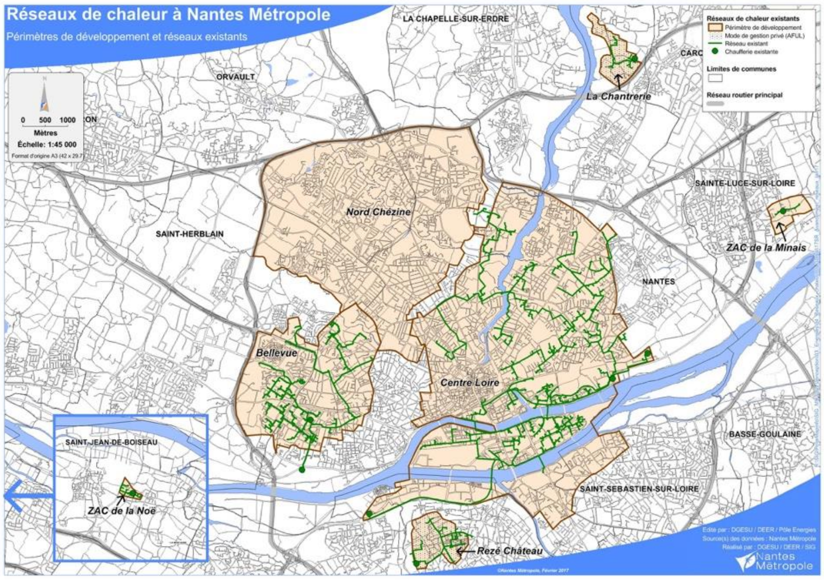


Figure 25: map of Nantes' five district heating networks

6.6 Cross-modal mobility observatory

Based on the smart data on mobility action (action 44), the cross-modal mobility observatory aims at building a comprehensive observatory on mobility, to constitute both a tool to monitor actions and to support decision processes and communication on the mobility policies. The goal is to develop an observatory to gather data from all activities related to mobility policies. In fact, this action covers a whole dimension of data management around the objective of developing this observatory; the observatory consecrates this. Deliverable D2.12 is about the cross-modal mobility observatory.

Data in the urban platform	Format	Comment
Public on-street parking spaces	NAN Open Data	
Public off-street car parks	NAN Open Data	
Public parks & ride facilities	NAN Open Data	
Public urban roads sections	NAN Open Data	
Public bike infrastructures	NAN Open Data	
Public bike parking spots	NAN Open Data	
Car-sharing parking lots	NAN Open Data	
Regional train traffic at stations	NAN Open Data	

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

While a set of 300 KPIs was predefined and the KPIs assessment has been planned, a first observatory on a subset of 18 KPIs was developed within the Urban Platform portal using the OpenDataSoft solution. This first version can work as a prototype for which data gathering and KPIs calculation is already automated, scrapping from many Open Data sources or data available internally including Sensorthings API available data, keeping itself up-to-date, and thus allowing to precise the final version of the cross-modal observatory.

This first iteration highlighted the need for spatial analytics software to handle the predominant geographical aspect of the data workflows, as for the mobility observatory; and it further revealed some visualisations aspects, possibilities and difficulties, of Nantes Urban Platform portal data visualisation features and served as an experimentation of it.

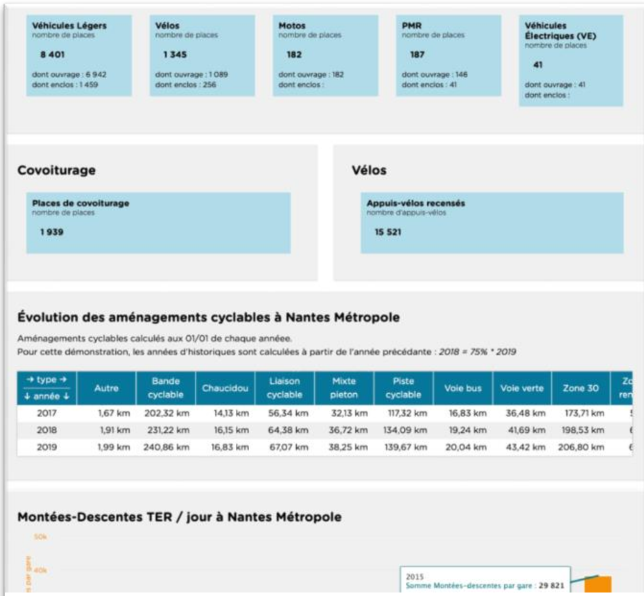


Figure 26: cross-modal mobility observatory: screenshot of the first version

6.7 Energy monitoring of public building PV plants

Since 2018, a new public policy regarding the development of renewable and local means of energy production has been voted. It sets the transition ambition higher than the national levels on energetic topics, with a first goal of a 40% share of renewable and local electricity in the final electrical consumption of the public buildings, by 2030, with a further goal of 50% by 2040. There are about 800 public buildings concerned by this objective.

mySMARTLife set the path for this larger roadmap of energetic transition of public buildings, with installation of 13 new PV plants on public buildings by 2020. Deliverable D2.7 focuses on the Smart Energy Supply and Demand implementation with RES which this roadmap is part of.

To prepare upcoming growing monitoring demand, in the scope of mySMARTLife, the Urban Platform will be the hub of public PV plants; aggregating monitoring KPIs from the various PV plants, and their consequently various data formats, and modality, of collection and exposition.

Incoming data	Protocol	Format	Comment
PV plants KPIs		Multiple formats (various PV plants)	

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

Data in the urban platform	Format	Comment
Monitoring KPIs	KPI	Standardised monitoring of KPIs
Electrical energy consumption	KPI #E2	
Annual energy consumption	KPI #E4	
Primary electrical energy consumption	KPI # E19	
Total primary energy consumption	KPI #E21	
Total greenhouse gas emissions (electrical)	KPI #E29	
Total greenhouse gas emissions	KPI #E31	
Total renewable electrical energy production	KPI #14	
Total renewable energy production	KPI #15	
Degree of energy self - supply by RES	KPI #17	
Reduction in annual energy consumption	KPI #5	
Reduction of total greenhouse gas emissions	KPI #32	
Increase in local renewable energy production	KPI #16	
Increase of degree of energy self - supply by RES	KPI #18	

The Urban Platform will be the hub for the PV plants monitoring processes. It will provide formatted and interoperable data to allow the service in charge of the monitoring to follow the same process regardless of the PV plants equipment specificities.

In the long-term, this presages of a possible future positioning of the Urban Platform to deliver a standardised production load curves and other sensors-related measures from the whole variety of PV plants, to expose to the rest of Nantes information system. And notably, the Vertuoz energy data monitoring solution for public buildings.

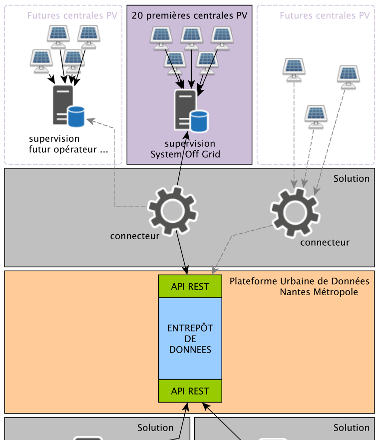


Figure 27: public buildings PV plants Urban Platform integration architecture

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

7. Lessons learned

7.1 Planning: Urban Platform Extensions vs Data Publishers systems

Data integration can start only when the data publisher has chosen which IT system he will deploy.

Action / Data Publisher's Solution ≫ Urban Platform Adapter development

As opposed to all actions related to setting up equipment (photovoltaic panels, charging stations, …) or work (retrofitting houses, …) which are not linked between each other, transversal activity on the Urban Platform depends on those actions. Planning the end of the work on the urban platform at the same milestone does not take this into consideration and results in difficulties to meet the deadlines when an action is designed near the implementation deadline. Several attempts were made to cope with this difficulty: anticipation and genericity.

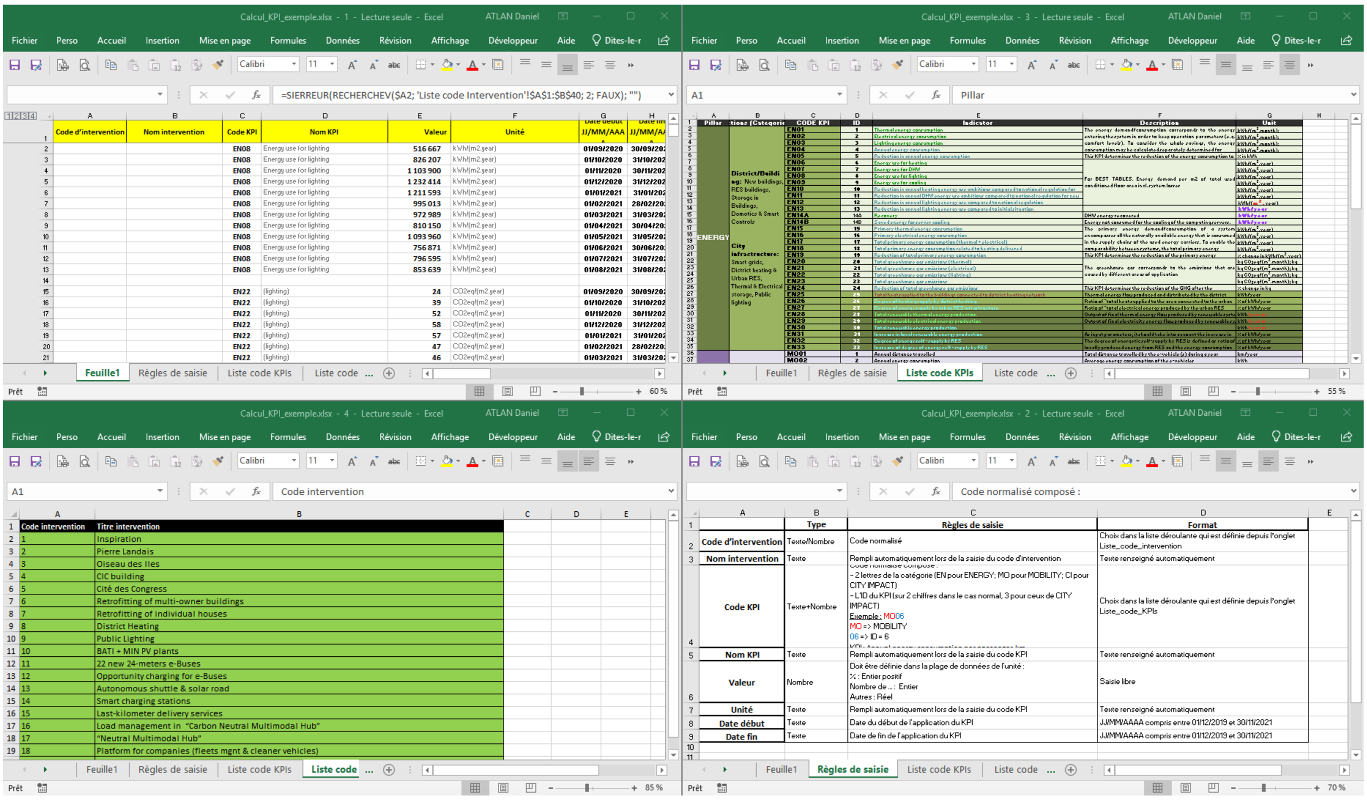
Anticipating the chosen solution represents a risk as per the example of streetlighting solution: an adapter was developed to connect to a system which in the end defaulted and had to be replaced by another solution (Flashnet).

Genericity was used to integrate externally defined KPIs, the stabilized list of which was communicated around M30 vs deadline at M30: a template based on the available KPI ontology was designed to be filled by the actions' stakeholders. This template is not a replacement for the ontology requirement because it is dedicated to human users, as opposed to the open API, which is dedicated to systems.

Recommendation: include a macroscopic level of actions dependencies at planning level.

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

Figure 28: Generic external KPI template, KPIs list, intervention list, help page



7.2 Planning: Urban Platform vs Monitoring

Integrating monitoring KPI list, more than a hundred KPIs long, consecrates the preparation of monitoring equipment and systems including the Urban Platform itself; the monitoring work from WP5 implies much of coordination and it has been necessary to bring a transverse integration framework to interventions' responsible.

KPI definition ≫ Urban Platform Service development

Further, the calculation of certain KPIs rely on what data are actually made available by the Data Publisher's system.

Action / Data Publisher's Solution ≫ KPI definition ≫ Urban Platform Service development

7.2.1 Monitoring preparation

The first step was to define a simple integration policy; to be shared with monitoring stakeholders:

- Either, the interventions' responsible collects, calculates, and provides the necessary KPIs (for instance when the action relies on an existing system not designed to share its data);
- Or, Nantes' Urban Platform does so.

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

From this choice, a big work was conducted with stakeholders of all Nantes' interventions to co-create the **common monitoring integration framework**. Starting from the list of KPIs shared between all three lighthouse cities, identifiers were added and referenced everywhere KPIs could be: from the monitoring tables, all KPIs were just one implementation of the KPIs identified, referenced back to the common KPI list. This actually prefigured of the Urban Platform KPI ontology, described above in this deliverable.

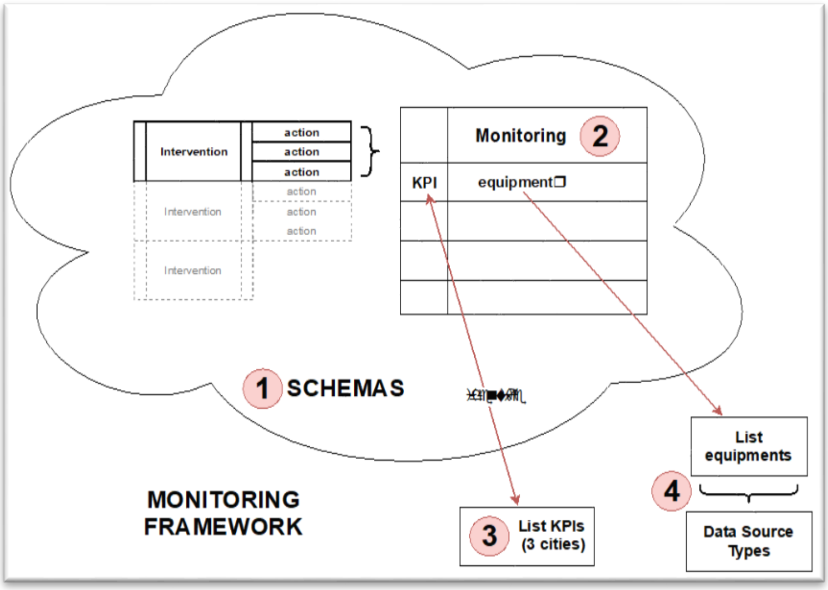


Figure 29: Nantes' monitoring framework

Ensuring with such a strong link took time but eventually provided a consistency across all mySMARTLife Nantes interventions' monitoring, with one systemic framework bridging actions' responsible with the Urban Platform experts; keystone for a safe monitoring implementation.

7.2.2 Monitoring planning

In terms of planning, the stabilized list of KPIs was shared in M30 with more than a hundred KPIs to gather and normalize within the Urban Platform. Such KPI list can only be finalized in detail when the actual sensors or supervision systems are known, i.e. the observations, data, history, frequencies, units, aggregations levels, etc. are known. Furthermore, any sensor data-based service can only be implemented once the data are known in detail. For example: in order to design a decision aiding tool to adapt public lighting at the end of public events, one must first make sure that the public events are available at API level and that the lighting system has tasking capabilities also available at API level.

At M34, the KPI list was modified, KPI numbering was changed which directly involves the integration workflow. Less than two months were left to alter the planning, update the Urban Platform and be ready for M36.

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

Recommendation: include macroscopic dependencies between the work packages at planning level and include the milestones in the project duration estimate.

7.3 Latency vs Systems of Systems

In Nantes demosite, all data are produced by dedicated supervision systems. These systems are in charge of device provisioning and low-level protocol integration. Also, they perform specific business processes outside the scope of mySMARTLife actions, such as billing or real-time supervision with security alerts and the according availability constraints.

For these reasons the scope of mySMARTLife Urban Platform is of “system of systems” type, providing a higher-level of integration. Mostly, data publisher’s systems are responsible for their data quality, availability and provisioning.

In this context, we provide a focus on the matter of data latency. One distinguishes the time at which a measurement is performed and the time at which it is made available. As a result, if two systems perform periodic tacks to integrate and exchange data, the overall time interval between the measurement and its availability can be up to the sum of their respective time periods. But mostly, the way data are exposed between systems most often rely on the time of measurement, so to not fetch the same data twice, the fetching time window most be updated.

This involves that data not available at the time of the query, but which should have been fetched, will never be integrated again. In other words, if the data publisher’s system cannot guarantee that all data are available at the same time, it may cause data loss between systems.

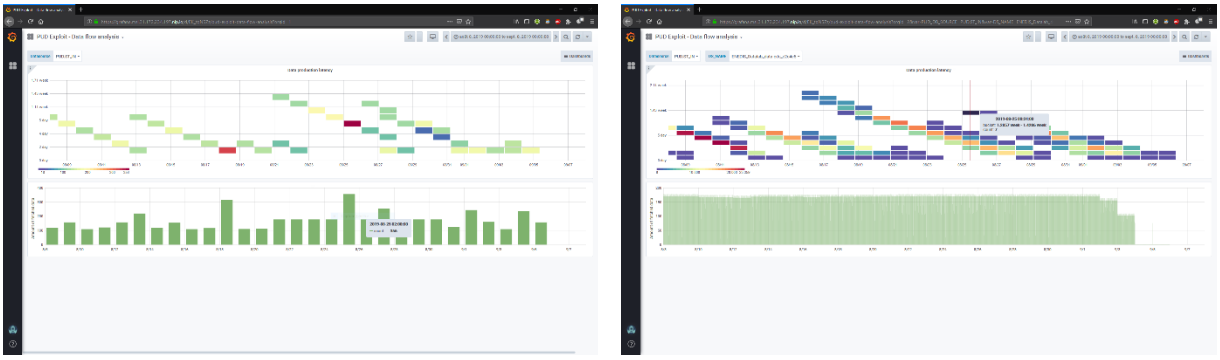


Figure 30: Examples of data latency (Y-axis in days)

The possible solutions are:

- Option1: Re-fetch data and deal with possible duplicates. This option is not retained considering the amount of data and the impact on the systems performance. Also, the amount of time to re-fetch data on a supposed already covered time period is equivalent to making non-verified hypothesis about each provider, which would not produce better result than option 4.

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

- Option 2: Continuous data integration. In this case, the data publisher must commit to detecting if the recipient – the Urban Platform – received the data correctly and if not resend them afterwards.
- Option 3: keep track of which data was received and which is not. In this case, one can no longer consider that system of systems applies since the Urban Platform would then be in charge of all device provisioning including data production frequency.
- Option 4: Wait for the data to be available. In this case, KPI calculation is possible without data bias but depending on the data publisher's system, one may wait for several weeks to see the data and associated KPIs (9 to 10 days or so in the above screenshot).

  This is the solution applied to use case #3 with the hypothesis that data are all available and will not be updated at most 24 hours after the time of the observation.
- Option 5: Modify the data publisher's API to fetch data not by time of observation but by time of availability. This approach does not require big extra developments and is robust.

7.4 Referential synchronisation

A key aspect sensor data collection relies on is the repository. Repository describes the "static" assets the observations directly or indirectly relates to. For example, the repository involved in energy management is a least composed of: the meters and the asset (building, lamppost, …) the meters are associated to.

Once the assets are known, one must consider, at the same level the sensor data are collected, that such asset information must be collected and updated. In other work, one cannot consider observation collection without repository synchronization.

Repository synchronization is considered as another flow of data which the additional specificity that it often is known both by the Data Publisher and also by the Platform Provider. For example, each electric meter located in a public building in Nantes Métropole has an identification number within ENEDIS (Data Provider) system and another identification number in Nantes Métropole (Platform Provider). Provisioning new sensors involves provisioning new assets (for example a new building).

Several ways to tackle with this situation can be envisaged:

- The Platform Provider agrees with the Data Publisher on using the Platform Provider's identification system.
- The Data Publisher includes the Platform Provider's repository into its own data (as meta data for instance). The Data Publisher must therefore wait for the updated information when provisioning a new asset.
- The repository used is that of the Data Publisher and the Platform Provider maintains a correspondence table between the two repositories.

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

- The repository used by the Data Publisher has no equivalent within the Platform Provider Information System.

Practically speaking, the last two situations were met for mySMARTLife actions. In all cases additional data synchronisation was added to the connectors as repository level and for the specific case of the electricity consumption, for which MEPS KPIs were calculated based on parameters only defined at Nantes Métropole's level, a lookup table was integrated in the working of the KPI calculation service.

Figure 31: Repository lookup table extract for electric meters

PRM	IdNM	Libellé	Direction	CentileMMPrecis	CentileMMLarge
14214616487940	EPVT062		EPICE	99,00%	95,00%
14232416716433	EPNA339		EPICE	99,00%	95,00%
14265701761132	EPRZ055		EPICE	99,00%	95,00%
14266714821377	EPRZ090		EPICE	99,00%	95,00%
14285817478503	EPRZ083		EPICE	99,00%	95,00%
14293632255818	EPRZ155		EPICE	99,00%	95,00%
14200289294702	EPRZ117		EPICE	99,00%	95,00%
14209406541425	EPOR059		EPICE	99,00%	95,00%
14290303811820	EPRZ004		EPICE	99,00%	95,00%
14282344250527	EPBO116		EPICE	99,00%	95,00%
14228798722144	EPRZ027		EPICE	99,00%	95,00%

were "PRM" is ENEDIS (Data Publisher) meter's identification and "idNM" id Nantes Métropole (Platform Provider) identification. The following data are Nantes Metropole's own KPI calculation parameters.

7.5 Technological readiness

The system at the core of the Urban Platform extension was initiated as a viable and verified solution for data exchange in the context of the Smart Cities or Industrial machine-to-machine information systems and was mostly compliant with the API framework in terms of functional and technical layers.

In the context of mySMARTLife, the effort was set to integrate an interoperable standard – SensorThings API – agreed with the mySMARTLife partners and to re-engineer the deployment at industrial level to facilitate maintenance and replication.

As a result, the system composing the Urban Platform extensions has reached new levels of readiness and is now running live, integrating data continuously, calculating KPIs and providing dashboards for monitoring the mySMARTLife project.

The resulting system is now candidate to technological readiness at level 9.

7.6 ICT teams cooperation

At documentation level, interoperability binds the lighthouse cities Urban Platforms with similar constraints. However, the collaboration between the lighthouse cities ICT Teams covered more than a technical goal.

During the course of mySMARTLife implementation, much information and knowledge were shared with the ICT Teams of Hamburg and Helsinki: defining the overall requirements of a Urban Platform, what common API was to be used, what difficulties were met, knowing that not all re-engineering and design was carried

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

out at the same time or at the same pace, what solutions were set up even if they answered to problems not necessarily shared.

Working sessions were setup at each periodic meeting in the view of the long-term process of meeting the program's objectives (architecture framework, interoperability scheme) and organized with the consortium coordinator, periodic calls at monthly rate were also organized. But soon, practical and technical meetings naturally became necessary between ICT Teams to share the practical design and implementation questions or issues. Such cooperation appeared to be very valuable specially to "translate" respective understanding into a common view and understand were each situation may be different.

Recommendation: help teams working with the same or similar constraints and objectives to organize themselves autonomously to share knowledge.

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

8. Conclusion

The concept of an Urban Platform is sound regarding the challenges and opportunities involved by the digitization of the business processes and a growing part of our daily life. However, as the EIP SCC pointed out setting interoperability as a central constraint of an urban platform, the fields of application of such urban platforms depends on the capability to exchange data with various systems.

The joined task of choosing a common open API, even if other levels of interoperability remain to be dealt with, such as the semantic level, is a very positive step in the context of mySMARTLife and other EU projects following the same guidelines. The endeavour is even more positive that the difficulty is high regarding existing systems: existing systems require great efforts to be upgraded, knowing that they bear their own understanding of a business process, conquering new businesses may be achieved by means of proprietary standards, especially when the market is young.

The three lighthouse cities and their partners came up with a joined technical standard thanks to mySMARTLife. The knowledge and experience shared with the partners and acquired during the project will last beyond the project’s timespan. As per today, ENGIE already tries to include Sensorthings API in the technical proposals for smart cities.

The setting up of the Urban Platform regarding mySMARTLife use cases related to actions and KPIs is a challenge since the deadlines are equals whereas the tasks depend on each other. Efforts and innovative ways of designing use cases were performed and a use case thesaurus now exists: some use cases were fit to be implemented in mySMARTLife, the others will fill the Nantes Information System roadmap.

In the end, the Urban Platform extensions have reached the level of industrial maturity required for replication, which is being considered by Nantes Métropole. In the meantime, as a complementary component to the Nantes’ Urban Platform, the Urban Platform extensions bridge the gap between the sensors’ field measures and the IT system, through a collaborative (eco)”system of systems” approach.

Exploring the new path of data science, the Urban Platform has allowed us to open, thanks to data interoperability standards, the use case exploring phase was rich and brought interesting prototypes which eventually became services into the Urban Platform for some of them.

To this day, the Urban Platform extension prove useful and will continue to be a central piece of the Nantes’ Urban Platform through mySMARTLife, considering – at least – the prominent role it will play in integrating the monitoring of the project.

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

9. References

[1] European Commission, "Requirements specification for Urban Platforms", EIP SCC, Integrated Infrastructures action cluster – Urban Platform, technical report, v2.2

[2] Auer, S. R.; Bizer, C.; Kobilarov, G.; Lehmann, J.; Cyganiak, R.; Ives, Z. (2007). "DBpedia: A Nucleus for a Web of Open Data". The Semantic Web. Lecture Notes in Computer Science. 4825. p. 722. ISBN 978-3-540-76297-3. doi:10.1007/978-3-540-76298-0_52.

[3] TechTarget, "open API", [online] http://searchmicroservices.techtarget.com/definition/open-API, last accessed August 2017.

[4] Heuser, L., Scheer, J., "Reference architecture & design principles", EIP SCC Work Stream 2, technical report, v0.8, November 2016.

[5] AENOR CTN-178, (2015), UNE 17804:2015, [online] https://www.aenor.es/aenor/normas/ctn/fichactn.asp?codigonorm=AEN/CTN%20178#.WG58xBvhC71, last accessed August 2017.

[6] SmartEnCity project partners, "Deliverable 6.2: CIOP architecture generic implementation", technical report, v1.0, January 2017.

[7] ESPRESSO project, "systemic Standardisation approach to Empower Smart citieS and cOmmunities", Grant Agreement #691720, [online] http://espresso-project.eu/, last accessed October 2017.

[8] Facchin, I., De Lathouwer, B., "D4.3: Products and best practices for Smart City implementations", technical report, v1.4, April 2017.

[9] Cox, A., Parslow, P., De Lathouwer, B., Klien, E., Kempen, B., Lonien, J., "D4.2: Definition of Smart City Reference Architecture", technical report, v4, June 2016.

[10] CNET, https://www.cnet.com/news/researchers-find-smart-meters-could-reveal-favorite-tv-shows/, online article, last accessed August 2017.

[11] Open Geospatial Consortium, [online] http://docs.opengeospatial.org/is/15-078r6/15-078r6.html, v1.0, last accessed June 2017.

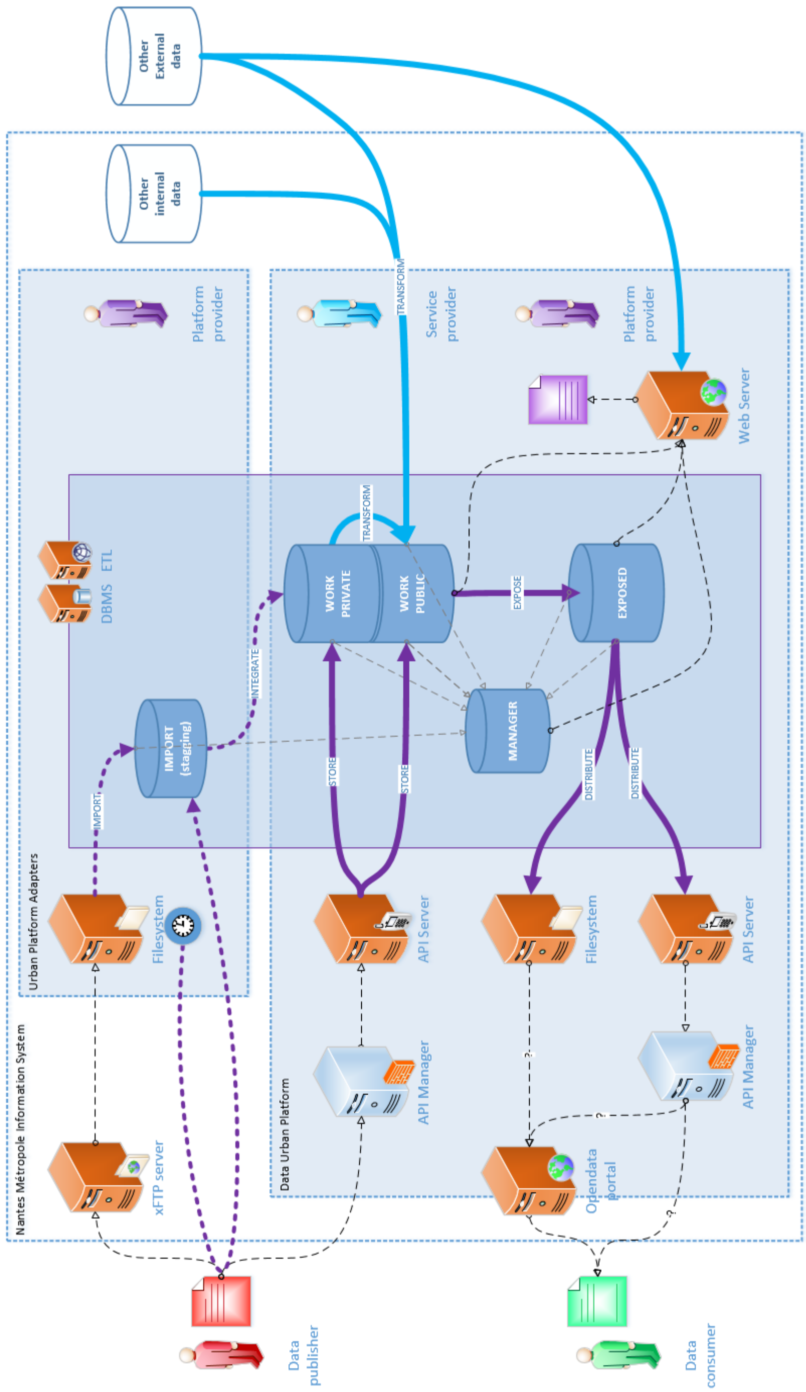
[12] Fraunhofer Institute, SensorThings API Server Certification statement, [online] https://www.iosb.fraunhofer.de/servlet/is/68690/Presseinformation%20OGC%20Sensor.pdf?command=downloadContent&filename=Presseinformation%20OGC%20Sensor.pdf, last accessed June 2017.

[13] TechTarget, "open API", [online] http://searchmicroservices.techtarget.com/definition/open-API, last accessed August 2017.

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

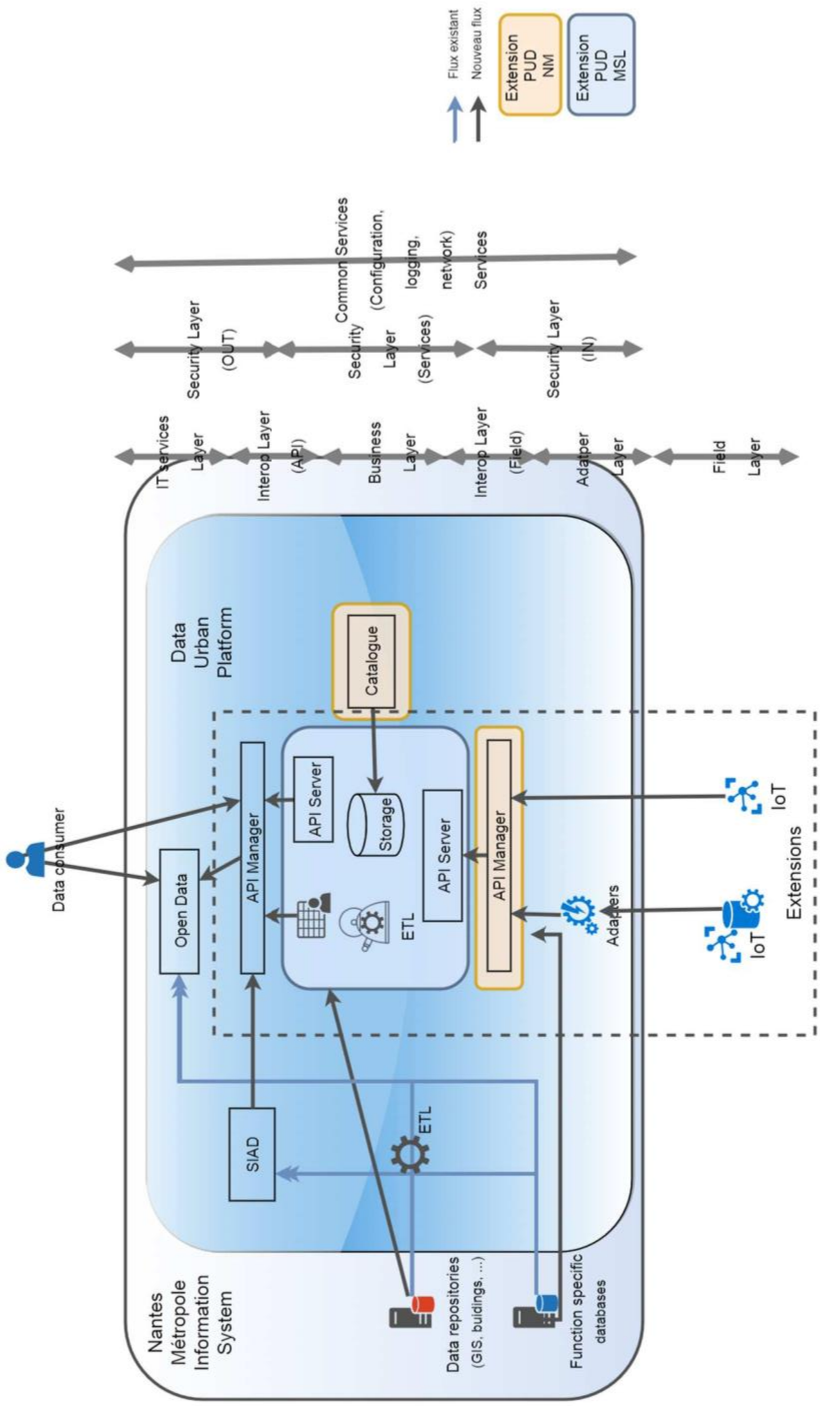
10. Annexes

10.1 Urban Platform Extension Architecture Principle



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

10.2 Nantes Urban Platform General Architecture



10.3 ESPRESSO formatted use cases

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

USE CASE 1: Interactive Data Light

1. Use Case name

NAN_UC01_interactive-data-light

1.a. Domain/Sector of activity

- Public lighting

1.b. Sub-domain(s)

- Smart public lighting

1.c. Objectives/Benefits of the Use Case

Monitoring of a smart public lighting system and evaluation of new sensoring possibilities.

2. Description

This use case proposes the testing of intelligent light sources, operating on the simple principles of presence detection and interaction with road users, whether they are motorists, cyclists or pedestrians.

New technologies, namely wireless remote control, presence detection and the remarkable reactivity of LED sources, are paving the way today for a range of equipment with extensive possibilities, both in their management and their scalability. These qualities are now well known and understood by light source manufacturers and technical departments responsible for public lighting. However, one aspect seems to be missing; the management of the control and data that these new technologies embody in their boxes.

If public lighting is at the heart of the fundamental issues of energy saving and reducing light pollution in the 21st century, new technologies are now enabling to collect usage data. Year-round traffic volumes, video protection and audio recording are technological solutions that can be integrated into public lighting systems and would provide valuable assistance in the management and organisation of public services.

This is what this use case aimed at experimenting, using various sources of data to provide city with a better public lighting and understanding.

2.a. User Story description

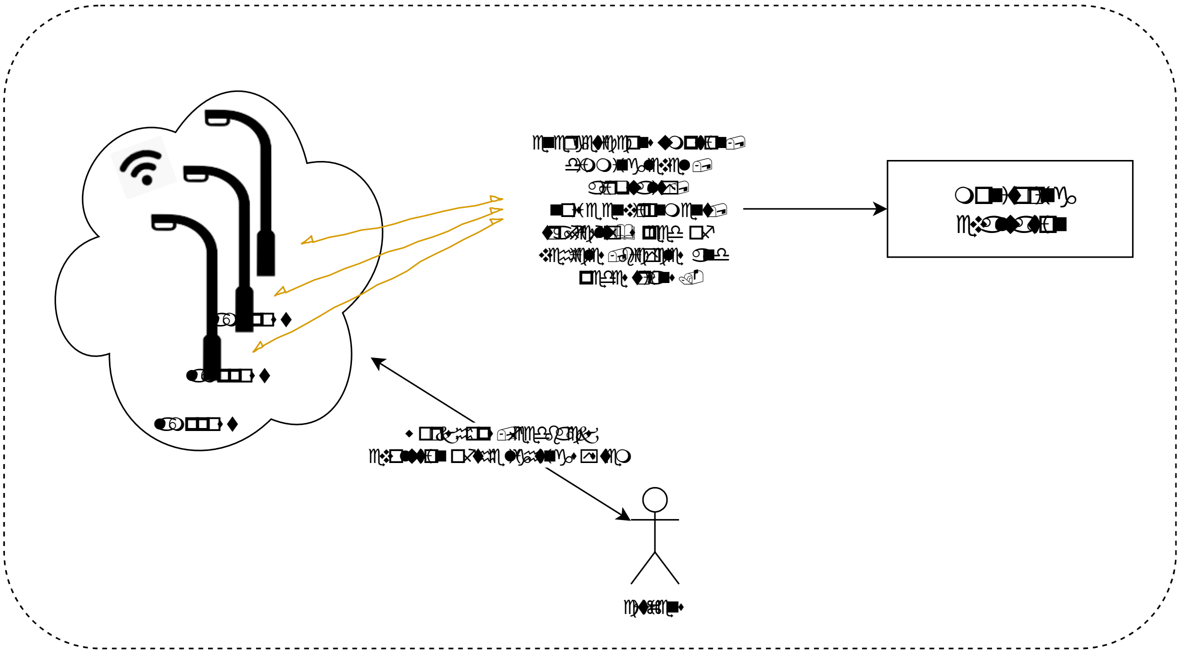
Following a methodological process on a six-month period, Nantes Metropole with the different stakeholders, conducted this use case experimentation from the collective design of the lighting system to the evaluation of it, involving citizens.

Data was collected on energetic consumption, dimming levels, air quality, noise environment, traffic flux and speed of vehicles, bicycles and pedestrians.

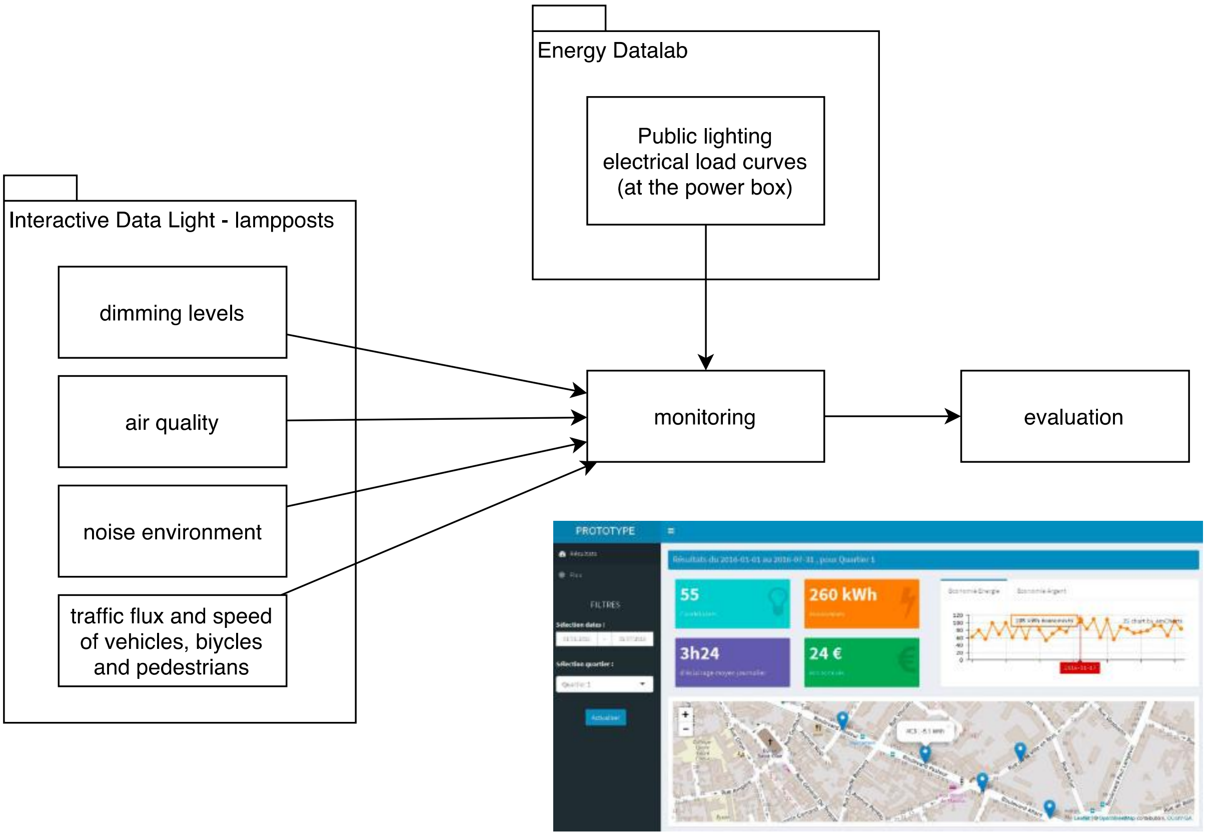
Along the six months, various dimming levels were experimented, co-construction and feedback workshops were conducted with citizens, to shift, from a lighting system based technical standards, to usage-centred design of lighting standards.

2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Public lighting
Benefits	Smart public lighting monitoring and evaluation of the experimentation

4. Actor List and Requirements

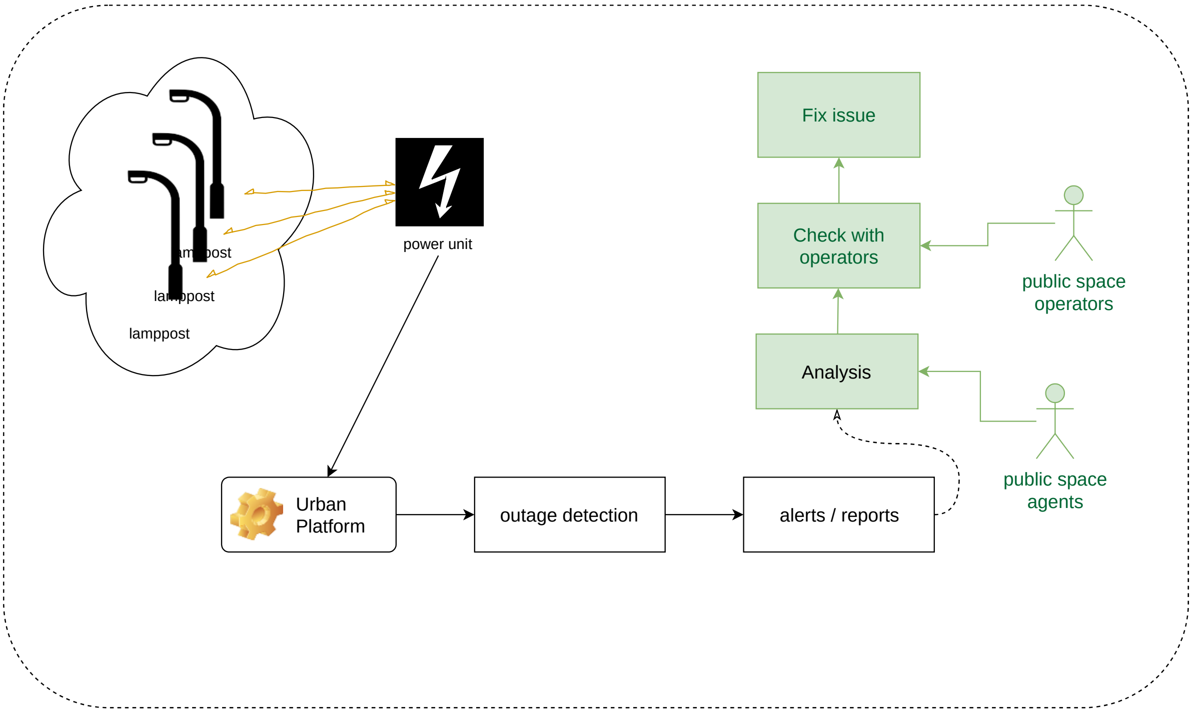
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Actors identified	Public lighting agents, Public lighting third-parties Support to the experimentation on the public space
Requirements (from Actors' perspective)	Public lighting electrical & functional requirements Citizen dialogue mandate Possibility to experiment on the public space
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	energetic consumption through the Energy Datalab dimming levels, air quality, noise environment, traffic flux and speed of vehicles, bicycles and pedestrians.
Useful data coming from Open Portals	

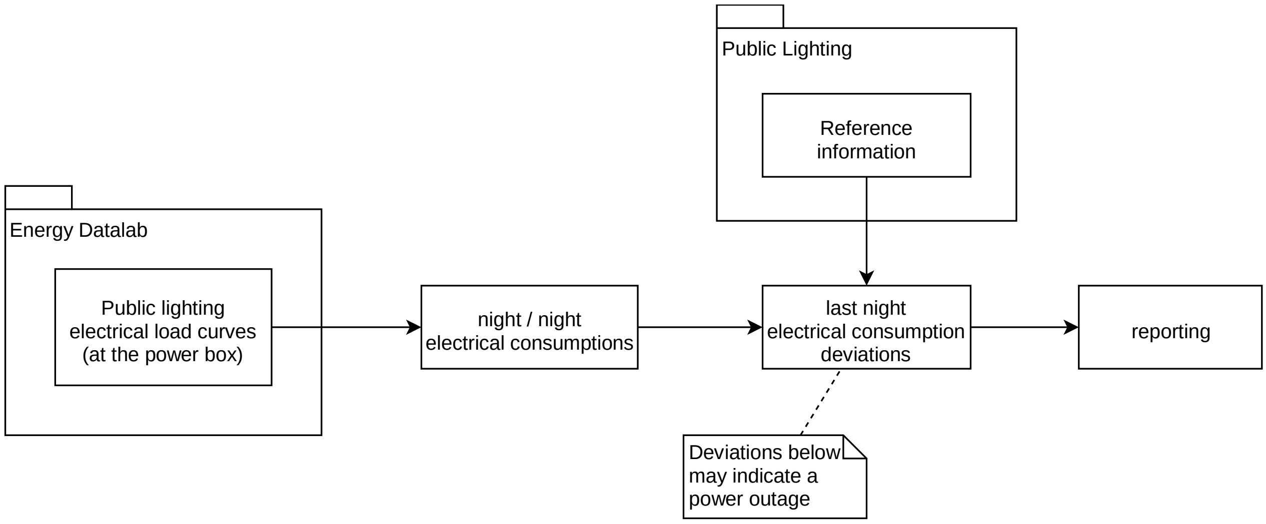
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 2: Public lighting outage detection
1. Use Case name
NAN_UC02_public-lighting-outage-detection
1.a. Domain/Sector of activity
• Public lighting
1.b. Sub-domain(s)
• Maintenance
1.c. Objectives/Benefits of the Use Case
Improve public lighting service quality through automation of public lighting outage detection
2. Description
Currently, the public lighting service knows a lamppost is down after someone notifies the administration through the city public service application (“Nantes dans ma poche”). However reliable, this method may incur a certain delay between a given outage and the actual acknowledgement of such. The current use case intends to improve this delay leveraging on public lighting electrical load curves. Knowing public lighting electrical consumption behaviours and given it shows very regular load curves, electrical consumption for a group of lamppost powered by the same electrical box can be accurately calculated. From this point, any rational variation of the load curve indicates something, where any variation below the load curve may indicate an outage.
2.a. User Story description
How to report public lighting outages? Previous systems didn’t have facilities such as sensors to detect issues, etc. Public lighting outages can be fixed after someone notifies the administration through “Nantes dans ma poche” application. With this new approach based on the monitoring of public lighting power units’ load curves, every morning or so one algorithm can be performed to challenge the load curves and detect any possibilities for a power outage. With a report of so when it occurs, one issue of this kind can be taken into account next morning by the service in charge.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Public lighting
Benefits	Smart public lighting maintenance

4. Actor List and Requirements

Actors identified	Electrical infrastructure agents from ENE. Public lighting agents, Urban Platform agents, from NAN.

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

Requirements (from Actors' perspective)	Electrical load curves should be available, Public lighting electrical & functional requirements should be matched.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Energy Datalab load curves
Useful data coming from Open Portals	

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

USE CASE 3: Electrical contracts optimisation

1. Use Case name

NAN_UC03_electrical-contracts-optimisation

1.a. Domain/Sector of activity

- Public buildings
- Public spaces

1.b. Sub-domain(s)

- Energy management

1.c. Objectives/Benefits of the Use Case

Generate financial savings with better electrical contracts harmony through decision aiding based on electrical load curve monitoring.

2. Description

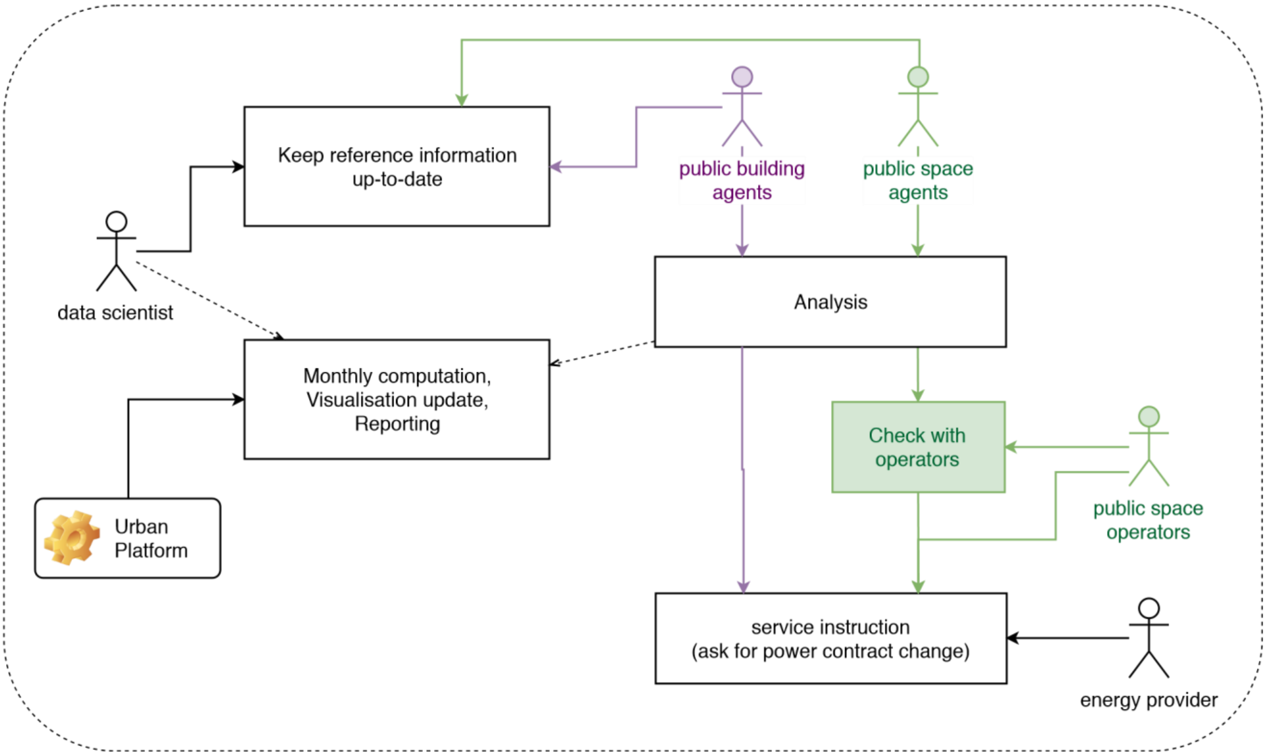
Manually, it is not possible to follow all public equipment electricity contracts. As for NAN it represents more than 800 public building meters and above 2,700 other meters for public spaces.
With the deployment of smart electrical meters all over France, more and more of NAN public equipment electrical load curves are becoming available.
Using the load curves to determine the electrical consumption profiles of each public equipment on one side, and comparing it to the electrical contracts on the other side, together can help to determine which equipments show the biggest space for electrical contract optimisation.
This data service does not replace any job, it rather empowers NAN agents with insights to help looking at the right place faster.

2.a. User Story description

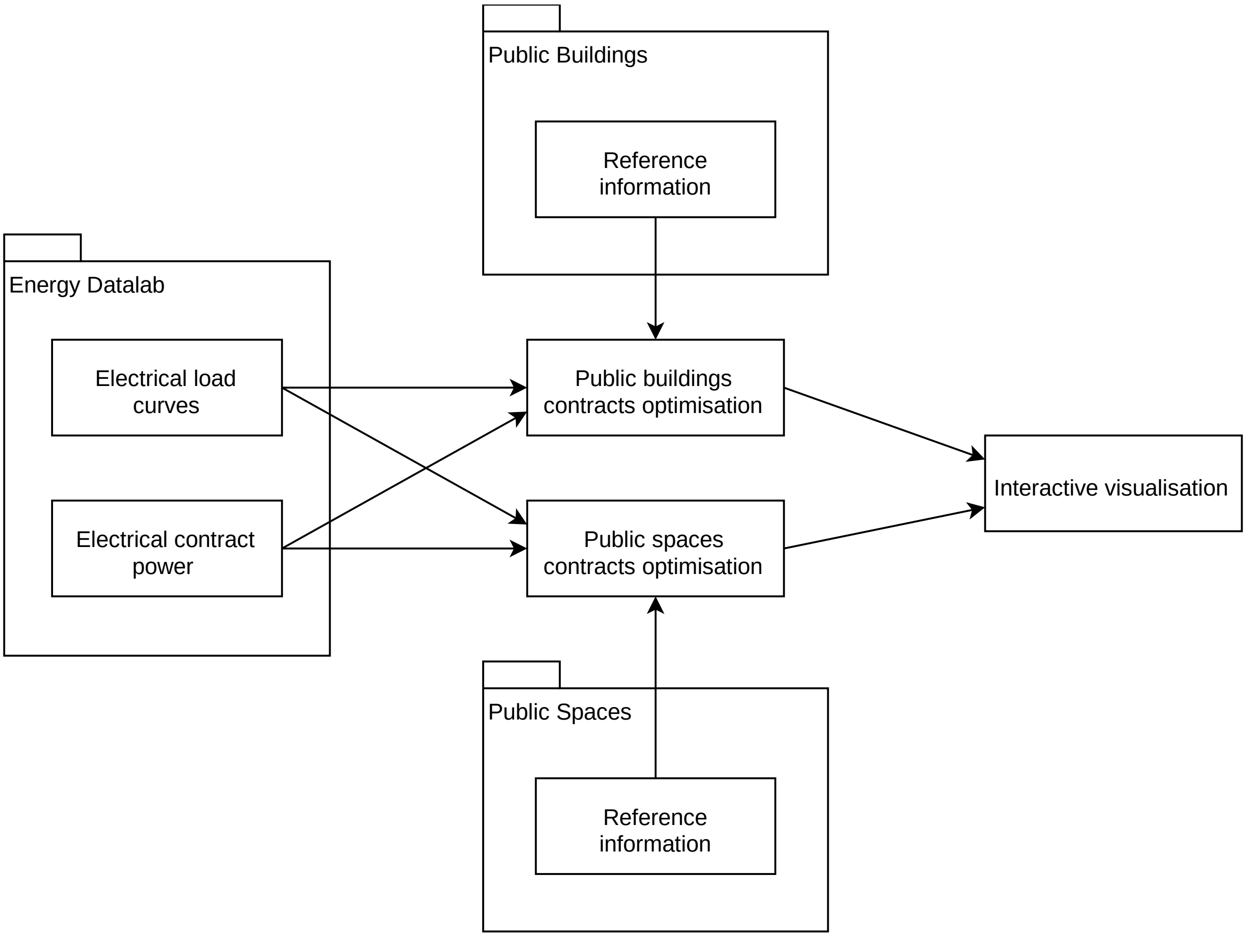
With the help of this Use Case visualisation dashboard, NAN agents can determine which public equipments should be looked at first.
For each equipment, financial savings come from a better adjusted electrical contract, which basically consists in finding the best fitted electrical contract power. Depending on the concerned business direction, details on the contract power adjustment may differ. For instance, a public building may often be oversized because some margin on the contract power is advised.

2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

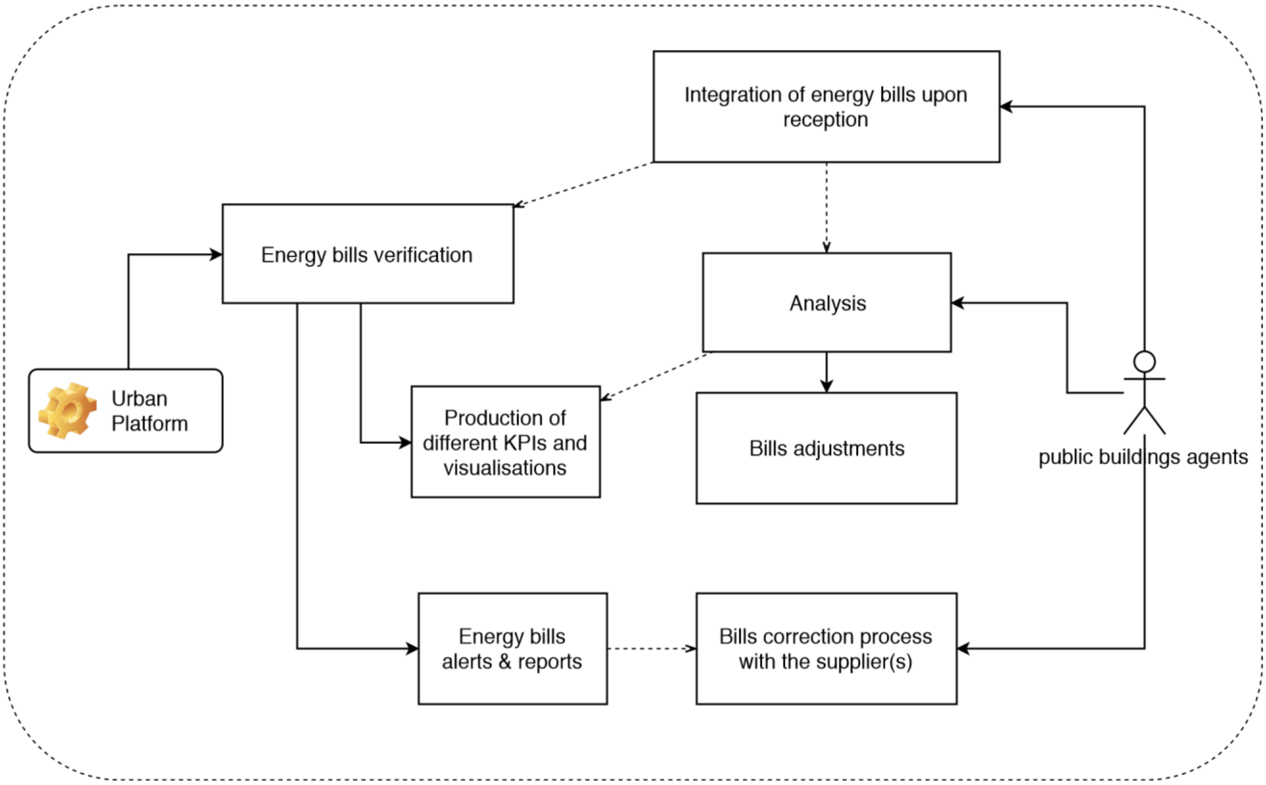
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Scope	Public buildings electrical meters, Public spaces electrical meters.
Benefits	Financial savings coming from better electrical contracts.
4. Actor List and Requirements	
Actors identified	Public building energy management agents, Public spaces energy management agents, Energy department agents, Urban Platform agents.
Requirements (from Actors' perspective)	Electrical load curves should be available, Urban Platform should support the service, Service should support differentiation between business departments, Service should provide an easy way to access the results.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Energy Datalab load curves Public spaces & buildings reference information
Useful data coming from Open Portals	

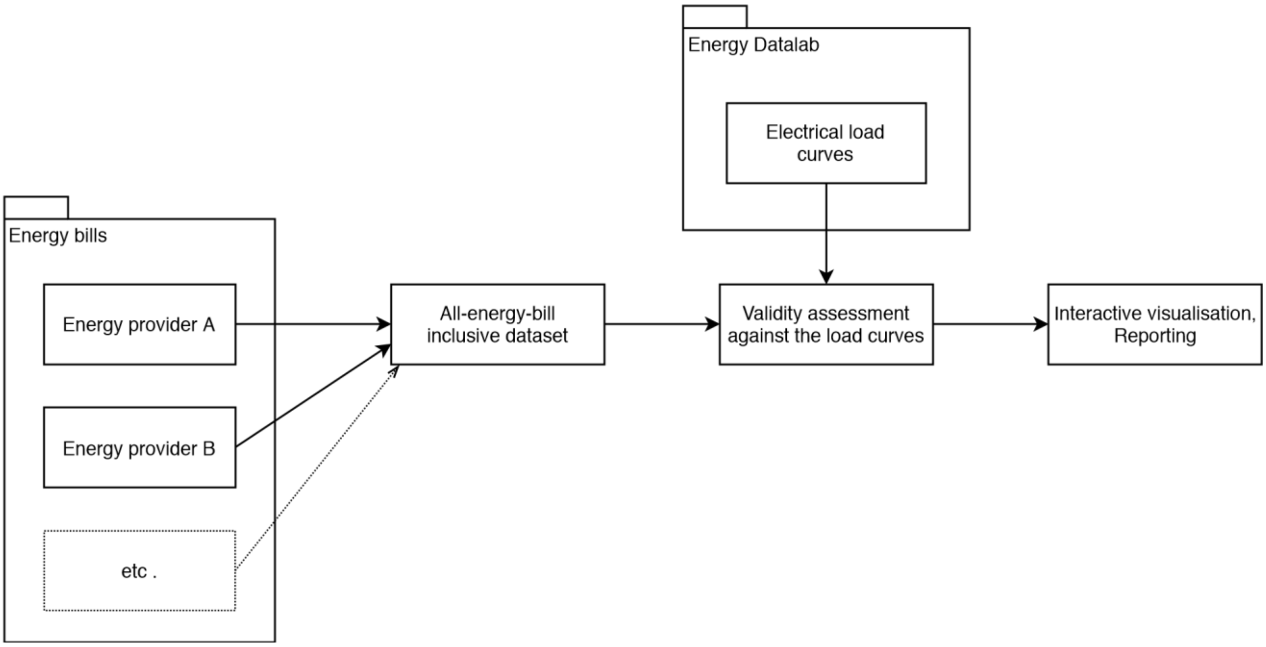
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 4: electrical bills automated checking
1. Use Case name
NAN_UC04_electrical-bills-automated-checking
1.a. Domain/Sector of activity
• Energy • Public buildings
1.b. Sub-domain(s)
• Accounting
1.c. Objectives/Benefits of the Use Case
Facilitate the energy bills verification process for public buildings using ICT
2. Description
Manually checking each & every energy bill coming from the public buildings energy consumption can be fastidious. Multiple actors from various services can be implied and the process of back-and-forth administration verifications is time-consuming. Usually, bills can take up to 6 months to be verified, after which it may finally be integrated into the Urban Platform. With more and more data available on one side, and the uncovering of data science possibilities on the other; the purpose of this use case is to leverage on these two opportunities to experiment with a new approach to manage the regular energy bills verification loops.
2.a. User Story description
Connecting to the energy providers interfaces, the Urban Platform would integrate the data coming from the regular energy bills. Using a common standard, energy bills coming from different providers would be standardised and therefore made interoperable with each other. Regularly, agents from the public buildings department could access the visualisation interface, or read through the reports, to get a fast assessment of incoming bills.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Public buildings
Benefits	Smart energy bills verification

4. Actor List and Requirements

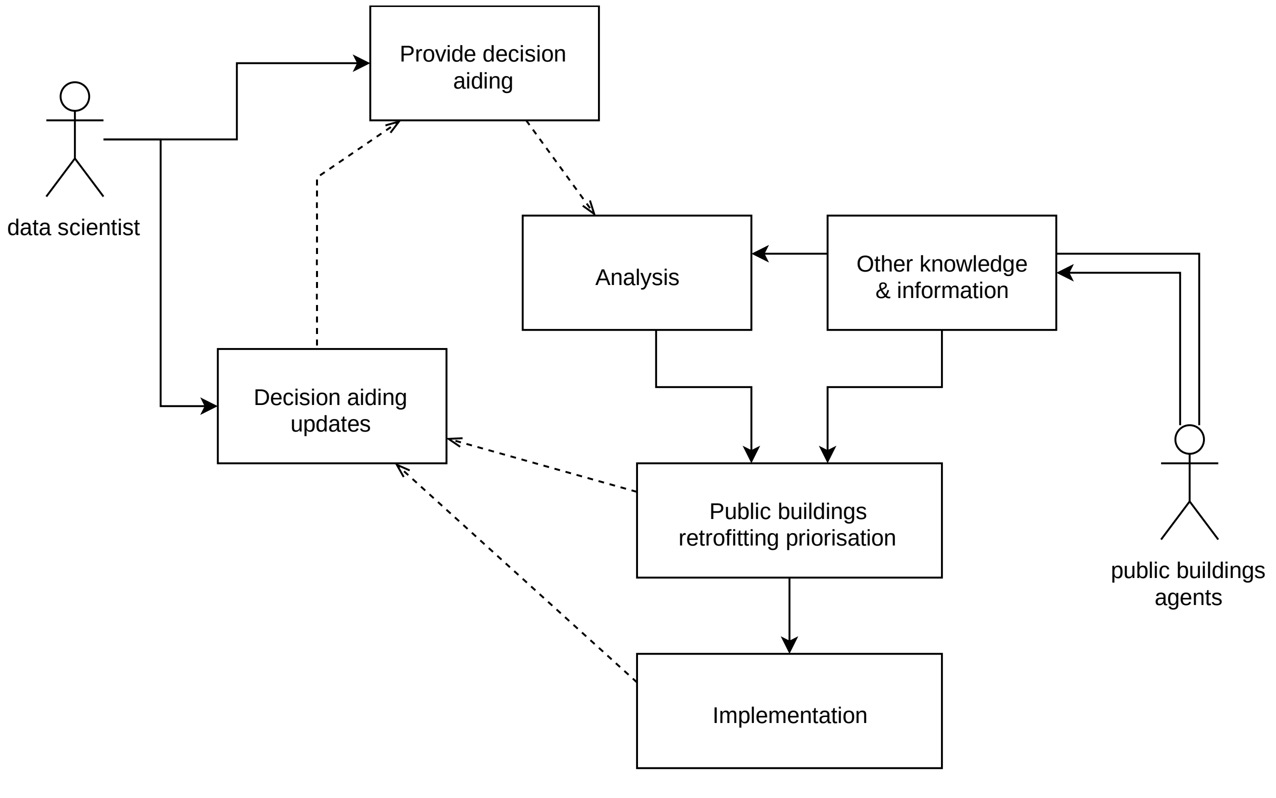
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Actors identified	Public buildings management agents, Energy management agents, Urban Platform agents.
Requirements (from Actors' perspective)	Electrical load curves should be available, Energy bills should be available, Data should be made interoperable between the different energy providers, Urban Platform should support the use case.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Energy Datalab load curves, Energy bills.
Useful data coming from Open Portals	

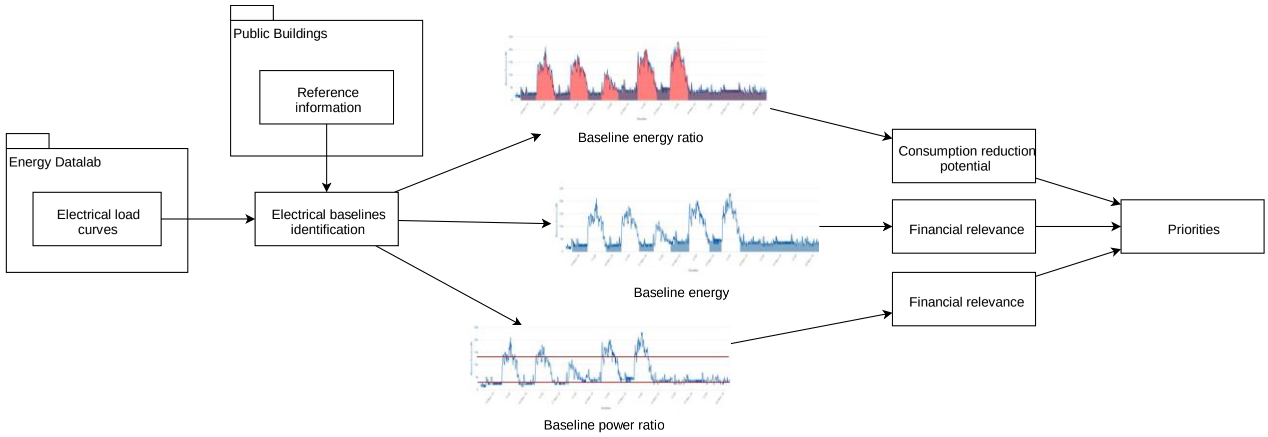
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 5: Optimisation of public buildings electrical consumption baselines
1. Use Case name
NAN_UC05_optimisation-public-buildings-electrical-consumption-baseline
1.a. Domain/Sector of activity
• Energy • Public buildings
1.b. Sub-domain(s)
• Energy management
1.c. Objectives/Benefits of the Use Case
Improve public buildings energy management (better knowledge, energy savings, financial savings) through electrical baselines optimisation.
2. Description
Electrical consumption baseline is the electrical energy minimal consumption for a building, which mainly corresponds to the out-of-activity electrical consumption, for instance a Sunday for office buildings. It provides some interesting information on buildings such as how optimised is it, or insulated, and therefore can contribute to the global public buildings energetic transition policy of Nantes Metropole. Notably, smart algorithms can target the biggest potential sources of energy loss within the big pool of public buildings. This kind of tool has been developed and experimented with a regional company through the Energy Datalab and with the participation of experts from Nantes Metropole public buildings service. For the purpose of this use case, the focus has been on: providing a decision aiding solution for public buildings retrofitting policy implementation (notably: helping choosing the right buildings).
2.a. User Story description
The tool can provide a fast way to assess the state of public buildings energy state of optimisation from their consumption baselines; combining this information with buildings energy consumption also highlights the best opportunities from a financial point of vue. These aspects are crucial to assess beforehand to get a better view at the wide scale of the global public buildings pool, as the first step to help identifying the best sites for retrofitting implementations processes.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Public buildings
Benefits	Energy savings, Financial savings, Better knowledge of public buildings electrical energy behaviors.

4. Actor List and Requirements

Actors identified	Public building agents, Energy department agents, Urban Platform agents.

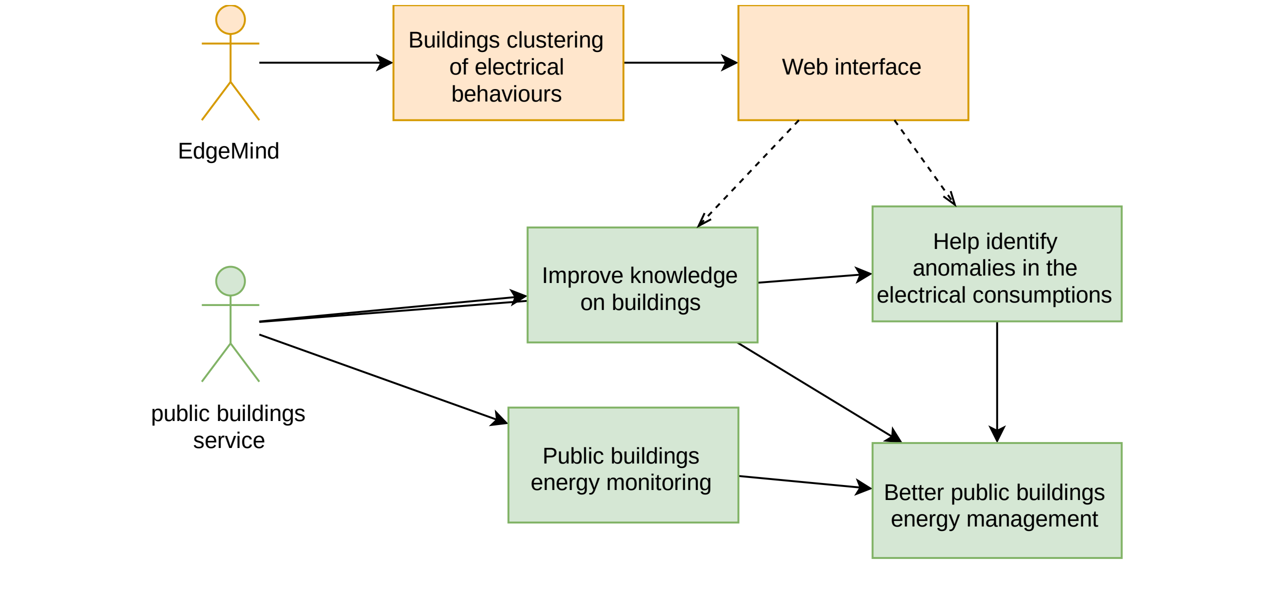
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Requirements (from Actors' perspective)	Electrical load curves should be available, A place to perform the computations should be available.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Energy Datalab load curves Public buildings reference information.
Useful data coming from Open Portals	

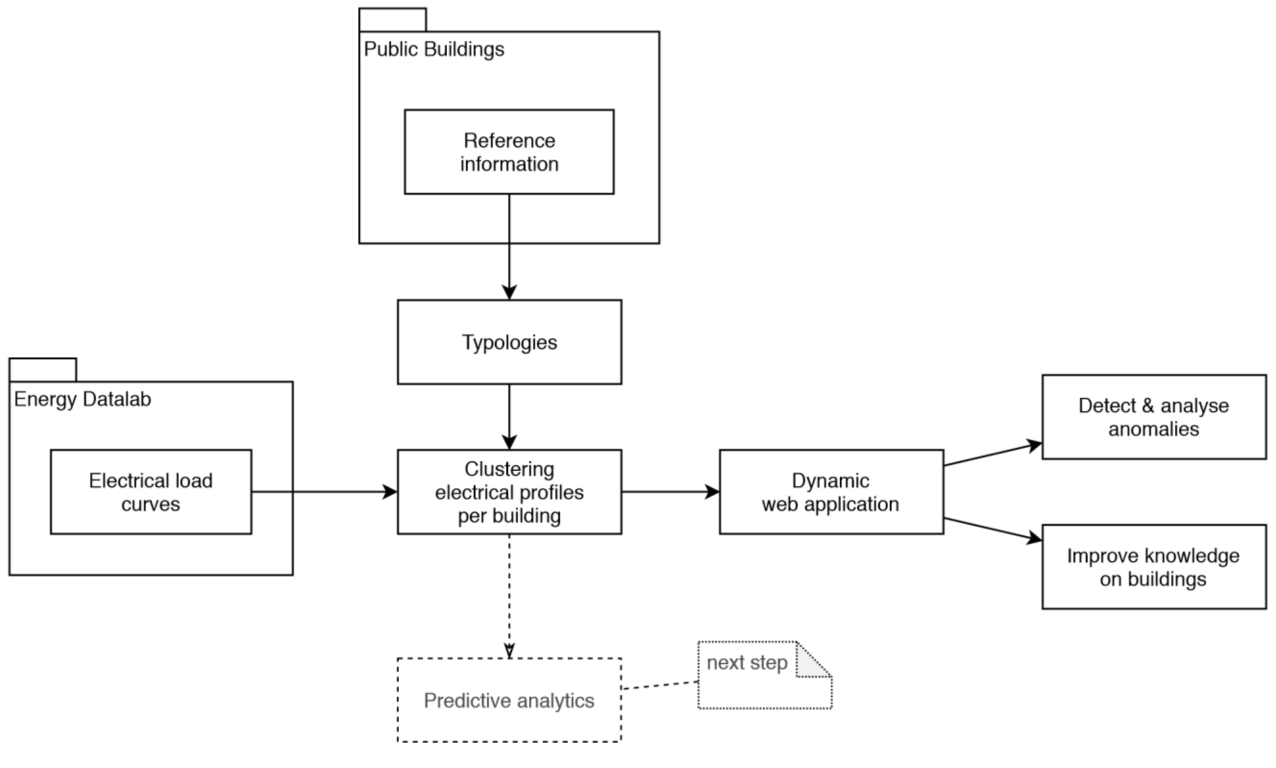
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 6: Automatic detection of public buildings electric behaviour deviations
1. Use Case name
NAN_UC06_automatic-detection-of-public-buildings-electric-behaviour-deviations
1.a. Domain/Sector of activity
• Energy • Public buildings
1.b. Sub-domain(s)
• Energy management
1.c. Objectives/Benefits of the Use Case
Clustering of public buildings electrical consumption profiles, day-by-day, to provide with a comprehensive view of the whole year and learn about buildings behaviours.
2. Description
This use case aims at leveraging on the possibilities of machine learning algorithms to explore their explanatory power in the fields of public buildings electrical behaviours. More precisely, the goal is to categorise public buildings from their electrical daily profiles in order to, notably, to get in a glance a view of all electrical consumption representative daily profiles of a year, for every single building of Nantes Metropole. A second step, working on the predictive possibilities for the public buildings, has been designed but there was not enough time to complete.
2.a. User Story description
This tool can provide a very quick way to understand one building's electrical behaviours other the year. This is very interesting in support of the public buildings energy & fluids monitoring activities as it provides a rich interface to get a better knowledge of buildings. This is great and useful for a service such as Nantes Metropole's public buildings service because it provide a door to open further investigations on these buildings, which is a main stake of this activity because there are many cases to follow at the same time and getting a quick information at a glance provides a very complementary option to the public buildings' fluids monitoring.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Public buildings
Benefits	Better understanding of public buildings electrical behaviours, Better reactivity to days with irregular consumptions.

4. Actor List and Requirements

Actors identified	Public building agents,

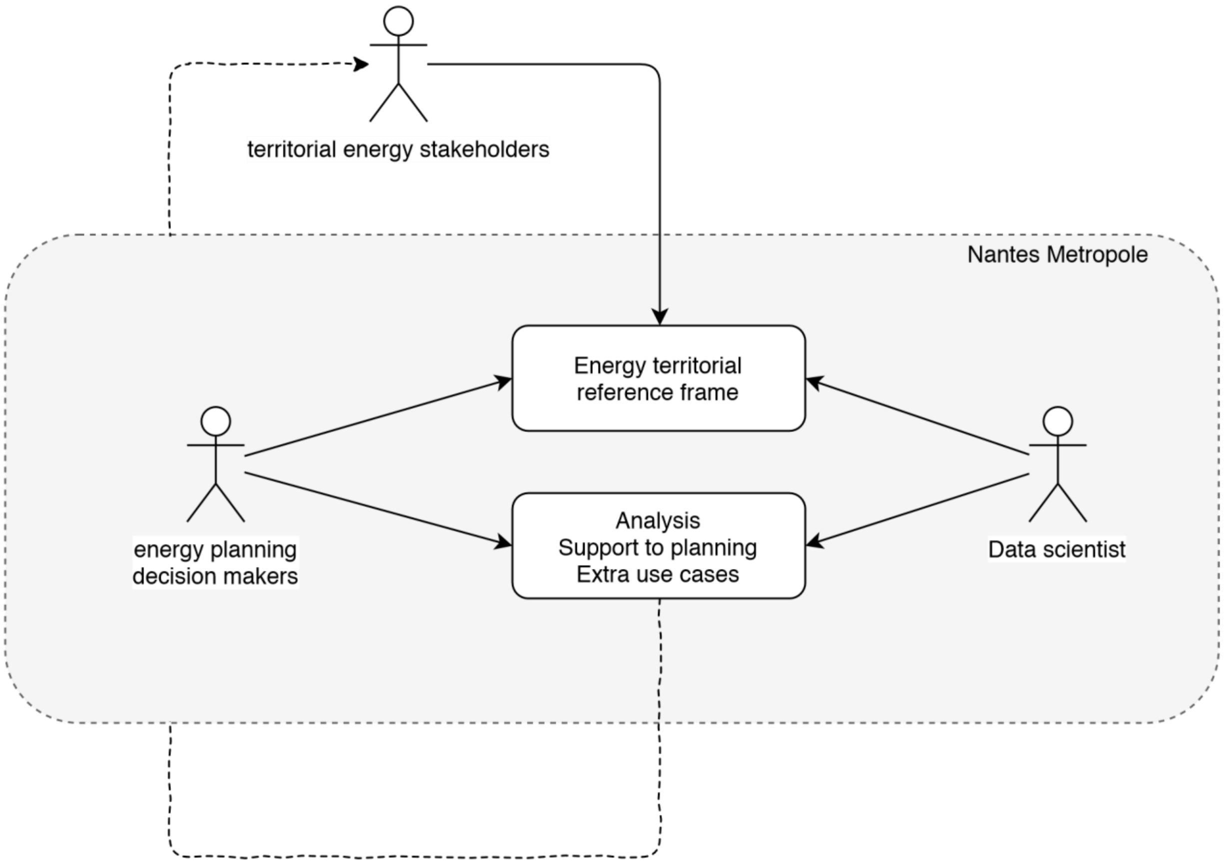
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

	Energy department agents, Urban Platform agents.
Requirements (from Actors' perspective)	Electrical load curves should be available, Service should provide an easy way to access the results, Service should not necessitate a pre-configuration.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Energy Datalab load curves Public buildings reference information.
Useful data coming from Open Portals	

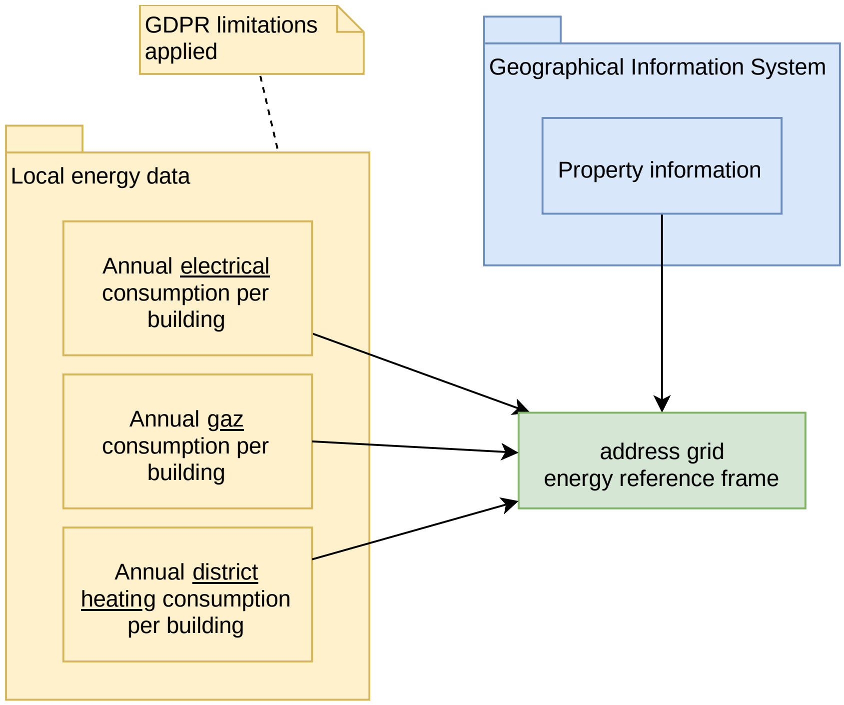
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 10: constitution of a territorial energy reference frame at the address mesh
1. Use Case name
NAN_UC10_constitution-territorial-energy-reference-frame-address-mesh
1.a. Domain/Sector of activity
• Energy
1.b. Sub-domain(s)
• Territorial energy planning
1.c. Objectives/Benefits of the Use Case
Provide energy planning decision makers with a territorial energy data frame.
2. Description
Looking at medium and long term energy planning at the territorial scale requires solid basis for decision making. More and more data are becoming available and notably in the field of energy. Harnessing the decision aiding opportunities of data is a key aspect of Nantes Metropole strategy. Combining energy (including non-energetic) data can help territorial energy planning. Constituting a territorial energy reference frame could help and doing so at the address grid is the purpose of this use case.
2.a. User Story description
With the recent evolutions of laws and the thriving context of energy, it is becoming more and more easy to work with the territorial stakeholders and notably those of the energy distribution. Nantes Metropole can gathering the local energy data, providing annual energy consumptions at the address mesh, and crossing it with the property reference table Nantes Metropole has, build a first solid basis for data science work in the field of energetic transition and the territorial energy planning activities.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Energy, territorial scale

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

Benefits	Contributing to energy territorial planning
4. Actor List and Requirements	
Actors identified	Energy territorial stakeholders (eg. energy distributors) Energy territorial planning decision makers Data engineers
Requirements (from Actors' perspective)	Energy data should be available Data to qualify properties (eg. how many premises) should be available GDPR concerns should be respected
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	- territorial property information - annual consumption data for gaz, electricity, and district heating; for each address; GDPR limitations: for residential addresses, at least 11 households living there, with cumulative annual consumption above 200MWh.
Useful data coming from Open Portals	- IRIS aggregates of annual energy consumption from national electricity and gaz distributors (respectively: Enedis and GRDF)

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

USE CASE 11: energy-intensive buildings identification

1. Use Case name

NAN_UC11_energy-intensive-buildings-identification

1.a. Domain/Sector of activity

- Public policy
- Energetic transition

1.b. Sub-domain(s)

- Energy-intensive buildings accompaniment

1.c. Objectives/Benefits of the Use Case

Identify potential energy-intensive buildings on the territory to target Nantes' energetic transition public policy more efficiently.

2. Description

Nantes Metropole leads an ambitious public policy in terms of energetic transition. A part of it goes to improving buildings' energy efficiency on the territory.

To implement this, Nantes Metropole works with the national and local energy consumption recommendations. The purpose is to bring buildings with energy consumption beyond such recommendations closer to it, or even below, through an extensive accompaniment and financial helps.

To direct public resources more efficiently, some territorial energy data could help:

- local energy datasets can provide the annual energy consumption for each building, as soon as the GDPR limitations are matched (eg. 11 households or more should be living in).
- property data, on the other hand, can be computed to provide an estimate of expected annual energy consumption, and help to compare with recommandations.

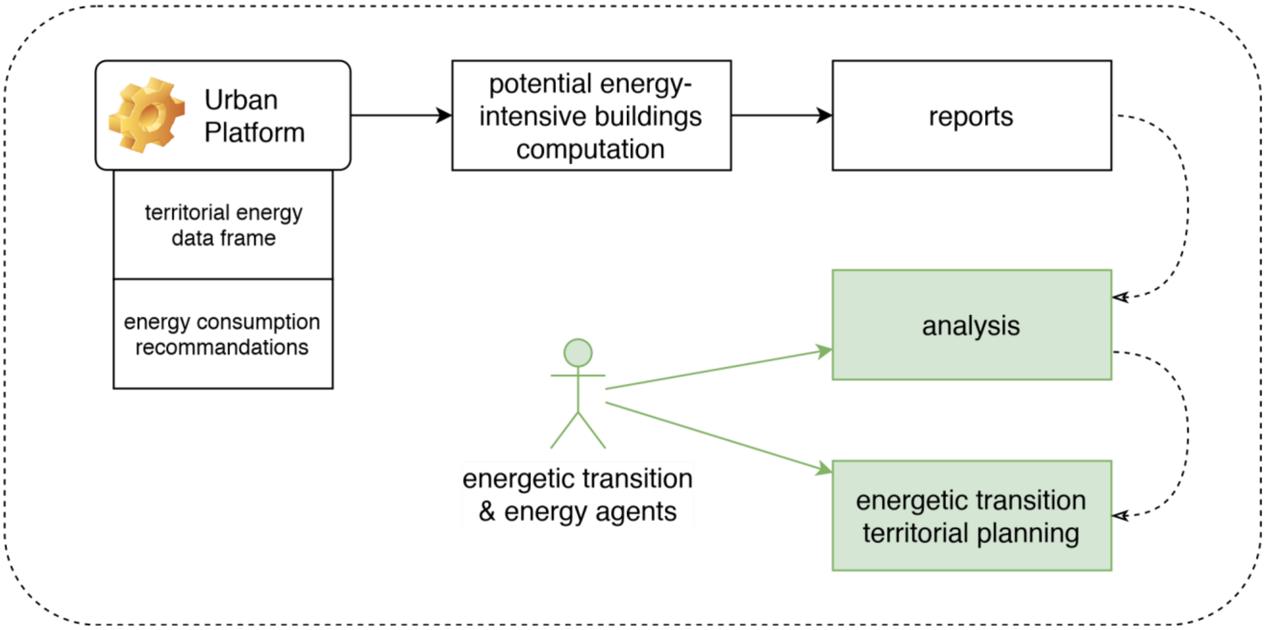
Comparison then can provide the first insights to help directing the energetic transition public resources towards the most energy-intensive buildings.

2.a. User Story description

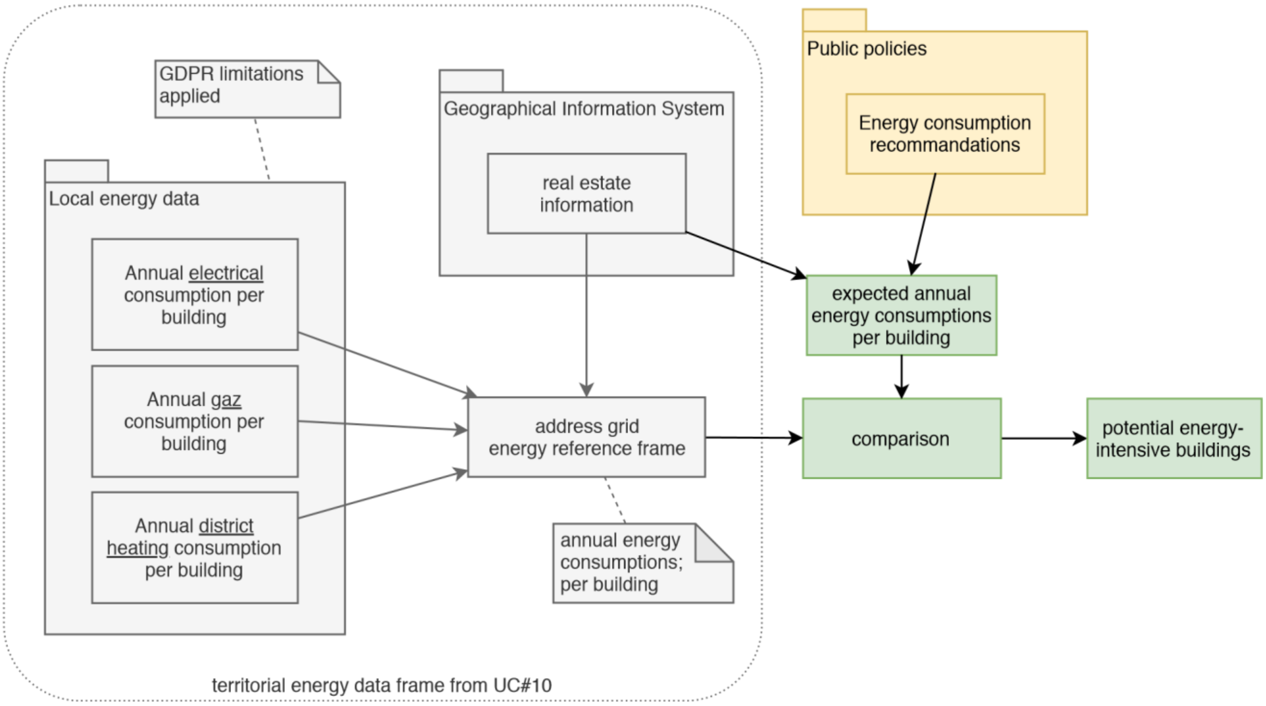
From the territorial energy data frame; the aim of this use case is to support the territorial energetic transition planning through reports on potential energy-intensive buildings. This can become a raw material to contribute a better knowledge of the territory, therefore, it can contribute to this territory's energetic transition planning.

2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Buildings with Nantes Metropole territory.
Benefits	More efficient implementation of energetic transition public policy

4. Actor List and Requirements

Actors identified	Energetic transition / territorial energy planning public agents Data engineers

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

Requirements (from Actors' perspective)	Local consumption data should be available for all energy sources GDPR concerns should be fully integrated
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	- address grid energy reference frame ongoing development (UC#10) - energy consumption recommendations
Useful data coming from Open Portals	

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

USE CASE 12: support for condominiums retrofitting

1. Use Case name

NAN_UC12_support-for-condominiums-retrofitting

1.a. Domain/Sector of activity

- Public policy
- Energetic transition

1.b. Sub-domain(s)

- Retrofitting
- Condominium

1.c. Objectives/Benefits of the Use Case

Create a condominiums dataset to support the condominium retrofitting accompaniment as part of the energetic transition public policies.

2. Description

Condominiums are a potential key actor of energetic transition, from the point of view of Nantes Metropole. To bring them on the path towards retrofitting, Nantes Metropole dedicates accompaniment and financial helps.

Facing financial and acceptance constraints of the retrofitting accompaniment, and especially that of condominiums, planning efficiently is a key aspect of this public policy. Territorial energy & real astate data can contribute to implementation of these public policies:

- real estate data, which gather information on properties, can be computed looking at buildings to which plural housing premises can be attached.
- constituted territorial condominium dataset can then be qualified on the energetic point of view using the territorial energy data frame one again.

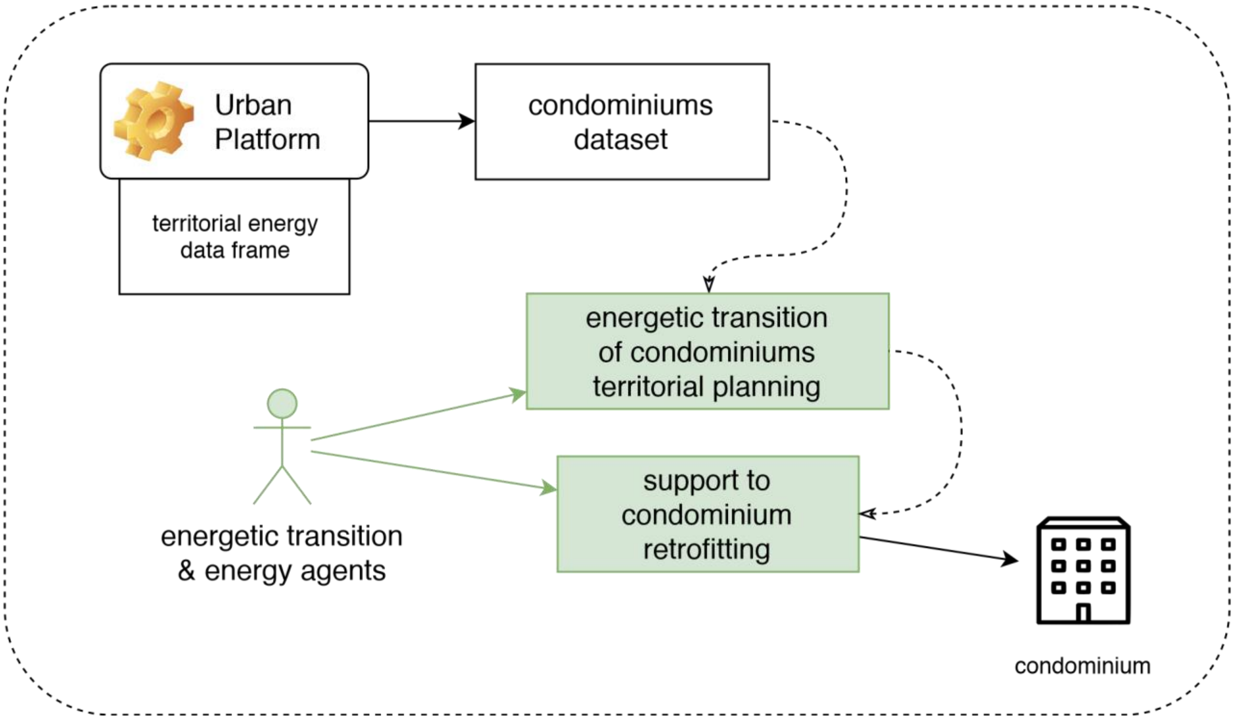
This condominium dataset could help energetic transition public agents working with condominiums, contributing to providing a global view for territorial planning.

2.a. User Story description

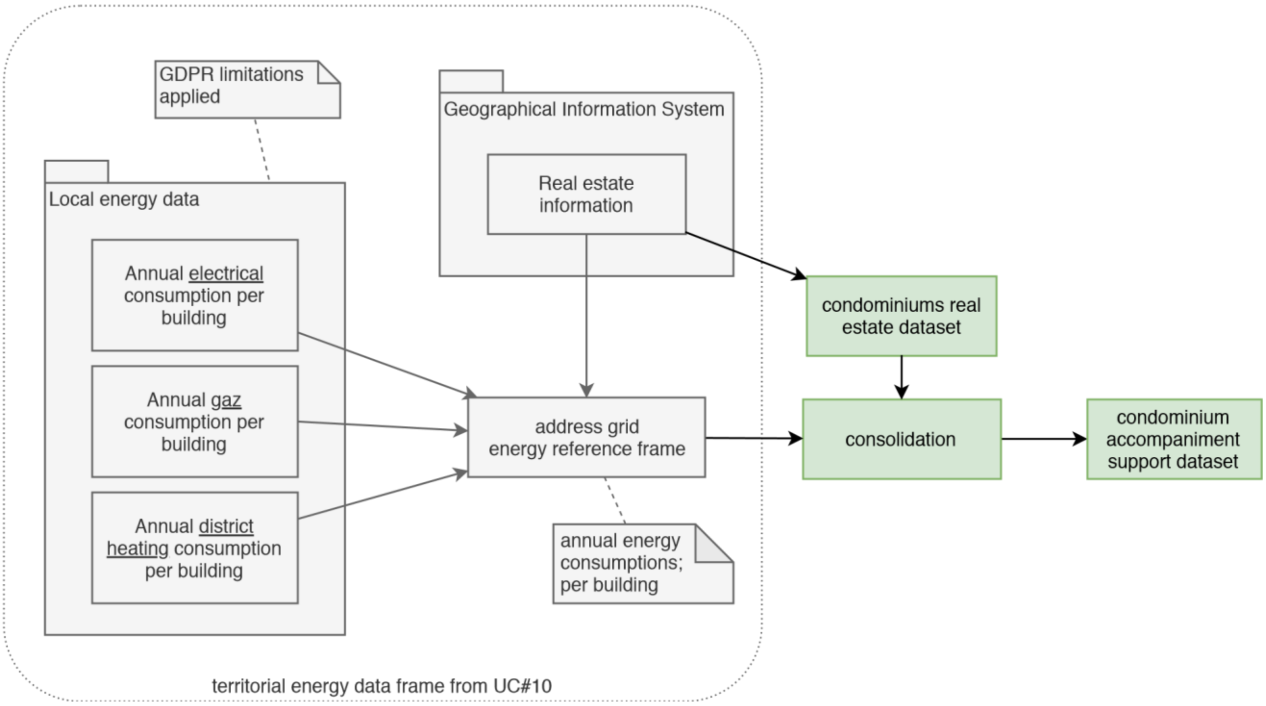
This use case supports the condominium energetic transition accompaniment activities.

2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Condominiums in Nantes Metropole
Benefits	Support dataset to condominium energetic transition public policy.

4. Actor List and Requirements

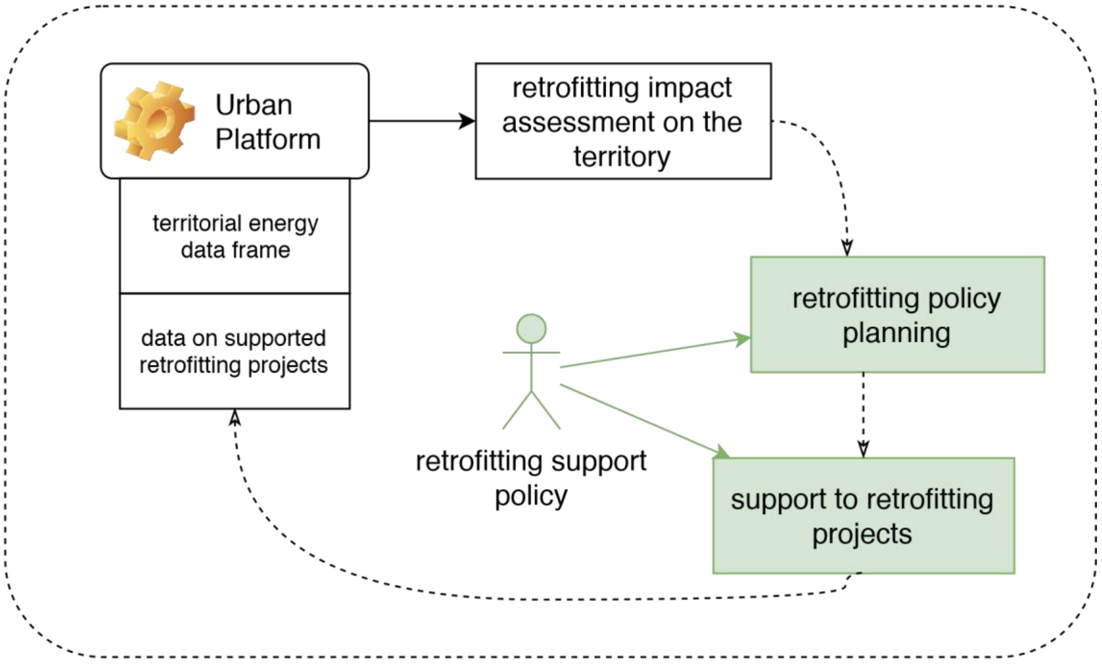
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Actors identified	Energetic transition / retrofitting / condominium public agents Data engineers
Requirements (from Actors' perspective)	Local consumption data should be available for all energy sources GDPR concerns should be fully integrated
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	- address grid energy reference frame ongoing development (UC#10)
Useful data coming from Open Portals	

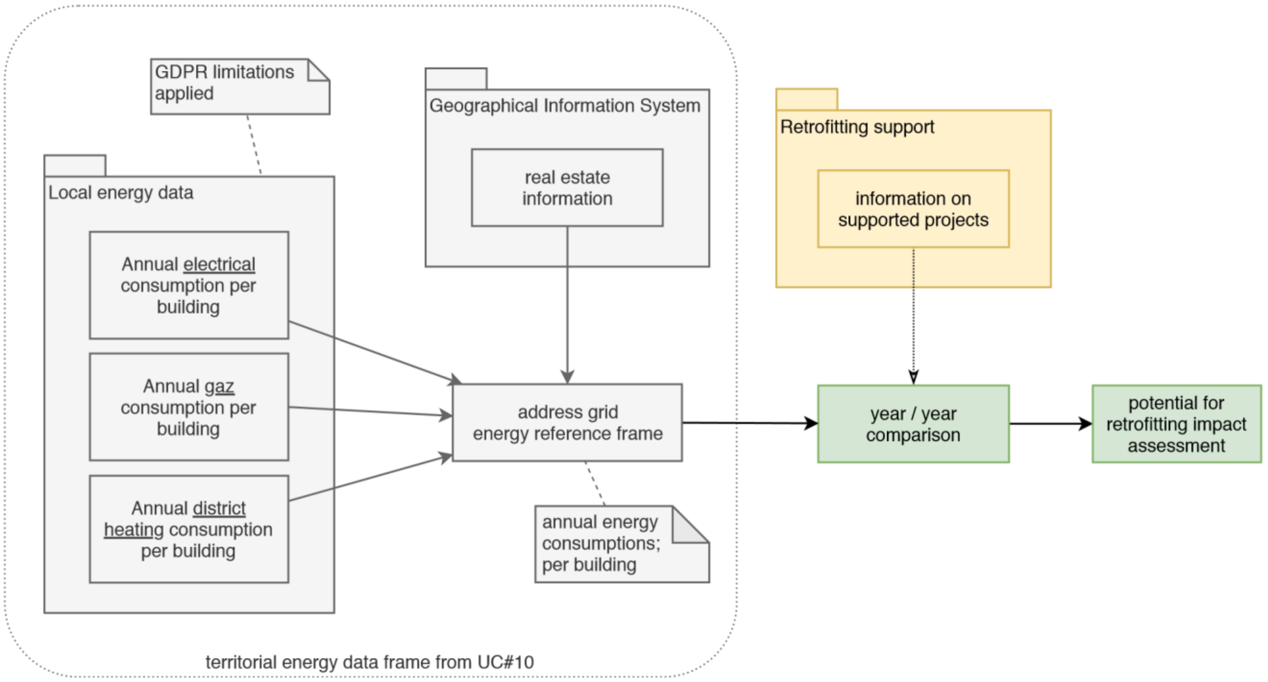
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 13: before/after evaluation of retrofitting
1. Use Case name
NAN_UC13_before-after-evaluation-of-retrofitting
1.a. Domain/Sector of activity
• Energetic transition • Public policy
1.b. Sub-domain(s)
• Retrofitting
1.c. Objectives/Benefits of the Use Case
Provide insights for a territorial assessment of retrofitting impacts.
2. Description
Using territorial energy data, such as local annual energy consumptions, for each address, impacts in terms of energy efficiency could be monitored for retrofitting interventions which, moreover, is one competency of Nantes Metropole. Nantes Metropole already accompanies retrofitting projects, but not all are under this help, and therefore, it is interesting for addressing retrofitting at the global scale to get a territorial vision to contribute to the public policy planning and implementation.
2.a. User Story description
The retrofitting impact assessment at the territorial scale provides an interesting source of insights for whom works on the retrofitting public policy planning & implementation. This use case can be seen as a support for these activities.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Buildings in Nantes Metropole
Benefits	Better allocation of resources and assessment of impacts of retrofitting public policy.

4. Actor List and Requirements

Actors identified	Energetic transition / retrofitting public agents Data engineers

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

Requirements (from Actors' perspective)	Local consumption data should be available for all energy sources GDPR concerns should be fully integrated
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	- address grid energy reference frame ongoing development (UC#10) - data on accompanied retrofitting projects (not structured)
Useful data coming from Open Portals	

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

USE CASE 14: evaluation of new buildings compliance with energy targets prescribed

1. Use Case name

NAN_UC14_evaluation-of-new-buildings-compliance-with-energy-targets-prescribed

1.a. Domain/Sector of activity

- Energetic transition
- Public policy

1.b. Sub-domain(s)

- Buildings

1.c. Objectives/Benefits of the Use Case

Assess new buildings compliance with energy targets prescribed.

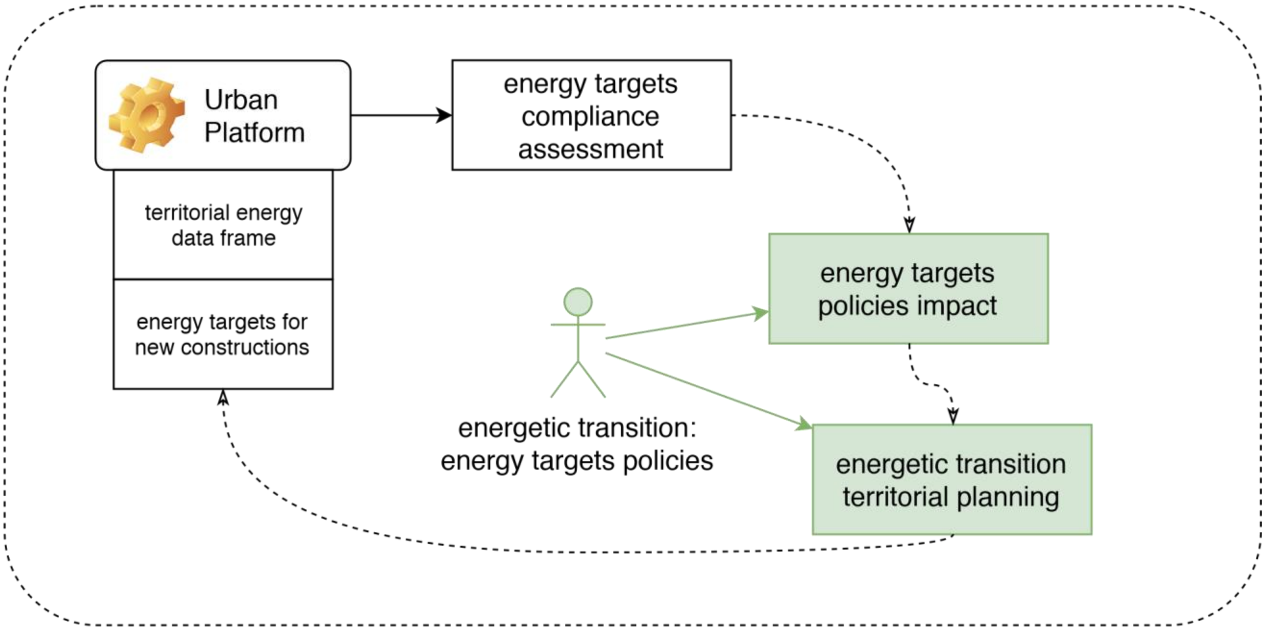
2. Description

Energy targets of new constructions are prescribed based on the projects' location and local rules. Data can help to follow policies and regulations implementations: Territorial energy data frame from UC#10 can provide the energy consumption at the address mesh; this can be compared with the local rules and energy targets based on this address mesh as they are prescribed per geographical zone. This is a first level of regulation compliance assessment.

2.a. User Story description

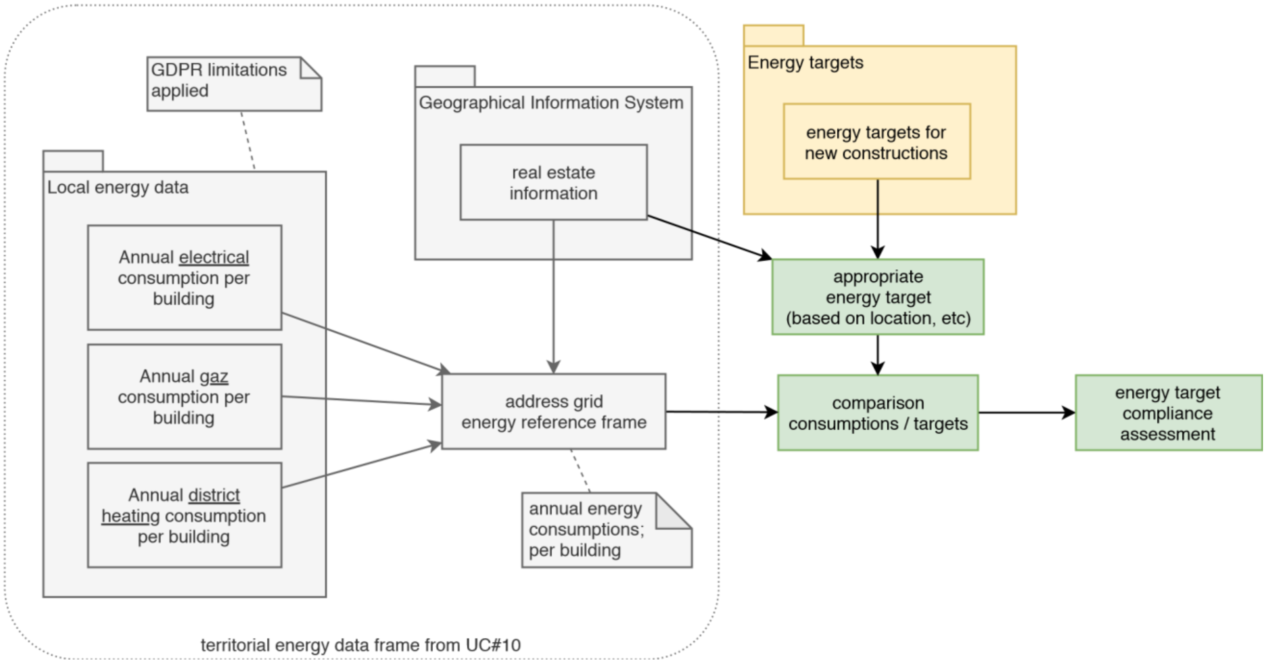
Assessing of the energy targets compliance provides a feedback to this policy planning and more globally, this is one asset to provide a factual support to the energetic transition territorial planning.

2.b. Storyboard



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

2.c. UML diagrams



3. Scope and Objectives

Scope	Buildings in Nantes Metropole
Benefits	A first level of assessment of energy targets compliance.

4. Actor List and Requirements

Actors identified	Energetic transition / territorial energy planning public agents Data engineers
Requirements (from Actors' perspective)	Local consumption data should be available for all energy sources GDPR concerns should be fully integrated

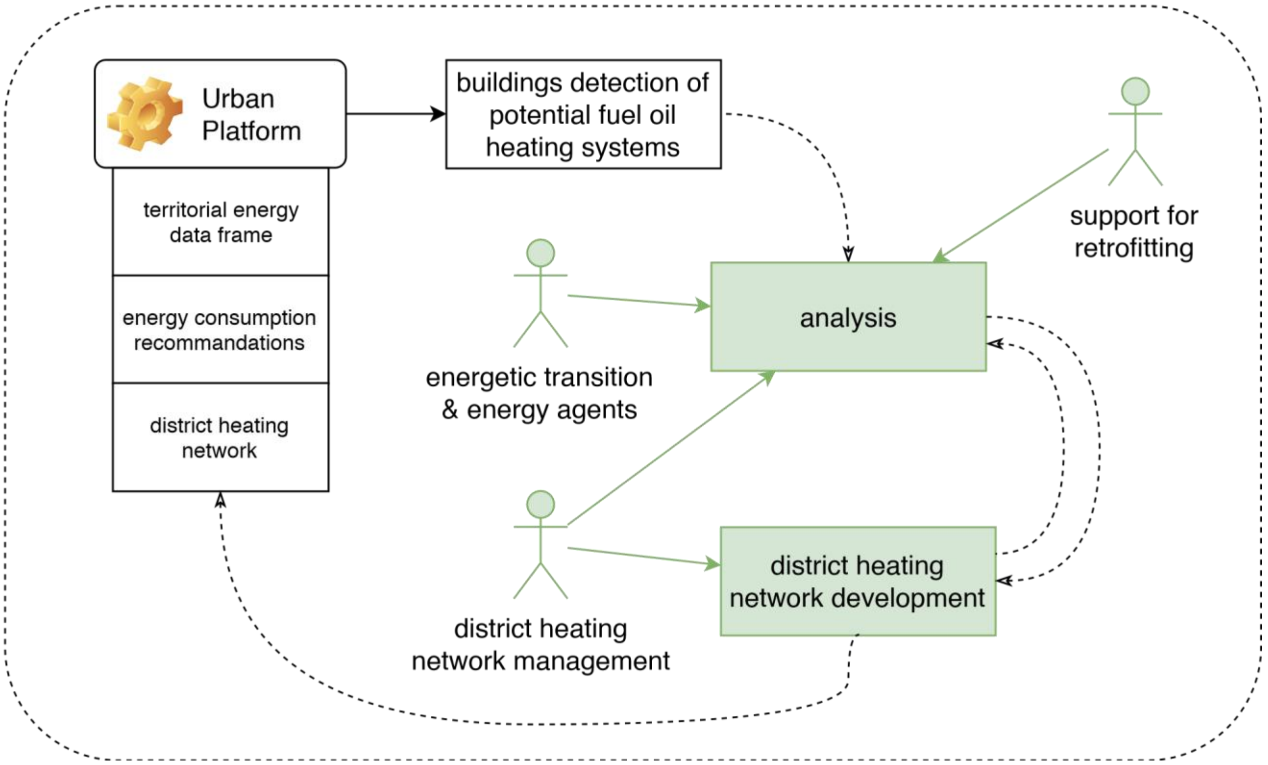
5. Available Data at the Pilot site and Open Portals

Available data at the pilot site	- address grid energy reference frame ongoing development (UC#10) - energy regulation targets
Useful data coming from Open Portals	

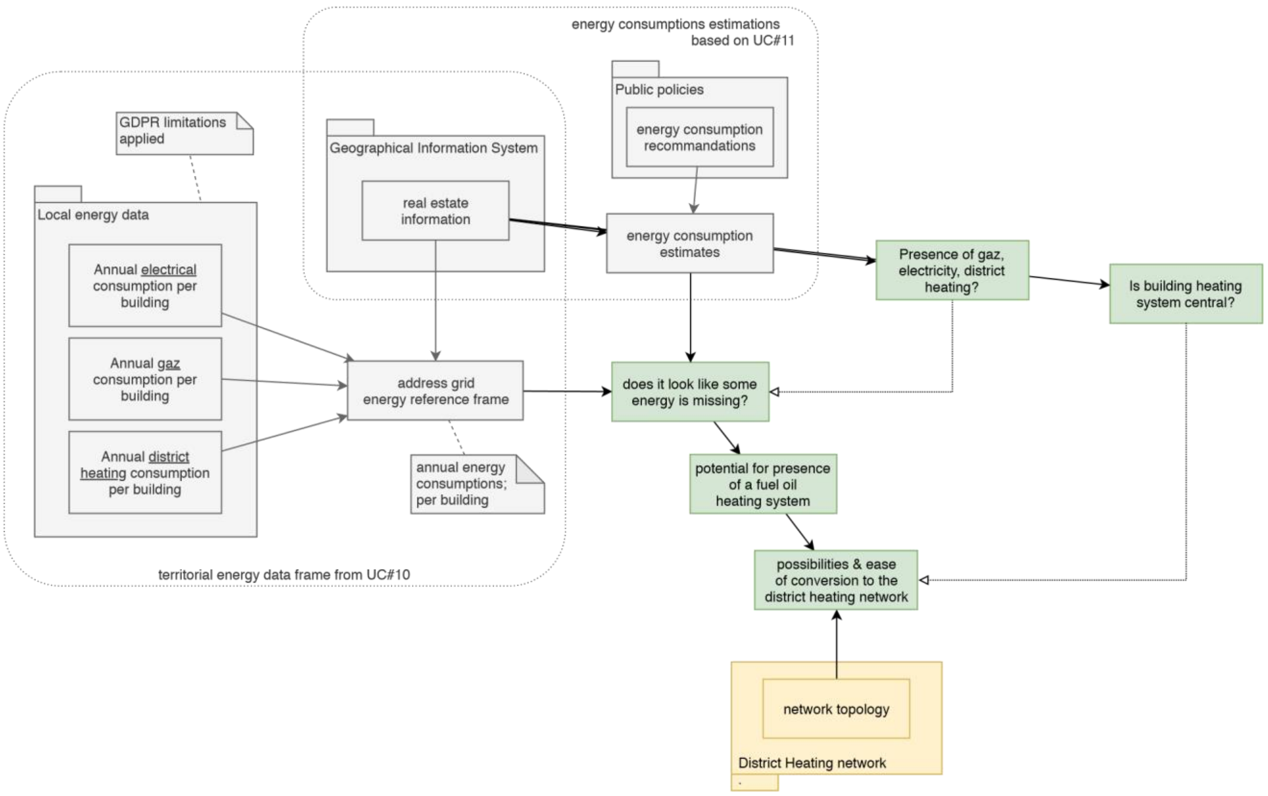
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 15: identification of buildings heated with fuel oil for conversion to the heating network
1. Use Case name
NAN_UC15_identification-of-buildings-heated-fuel-oil-for-conversion-heating-network
1.a. Domain/Sector of activity
• Energetic transition • Public policy • Energy
1.b. Sub-domain(s)
• Buildings • District heating
1.c. Objectives/Benefits of the Use Case
Identify fuel oil heated buildings for conversion to the district heating network
2. Description
Fuel oil heating systems are amongst the most polluting household heating systems. One aspect of Nantes Metropole's energetic transition public policy aims at reducing usage of this system through conversion towards cleaner ones. Notably, conversion of such towards the district heating network is an interesting topic because Nantes Metropole, one the other side, is very active in conducing its district heating networks expansion. From the territorial energy data frame; buildings heated with fuel oil systems could be identified from a property and energy data analysis: presence of gas, electricity, or district heating are given. Additionally, from the annual energy consumption at the address mesh, the cumulative annual energy consumption can be compared for each building to annual energy consumption estimates based on property data. One difference between the two can indicate one kind of energy is missing; what is more, detecting if such a building is connected to the heating network, can provide good indications for the possibility of one fuel oil heating system. Finally, whether the heating system is central or not to the building is also provided, which can be added on top of the identifications to possibly add one easing factor of social acceptance.
2.a. User Story description
The data works around fuel oil heating systems detection provide an interesting raw material to use when working on the retrofitting policy, district heating network management, and, more globally, the energetic transition territorial planning.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Buildings in Nantes Metropole

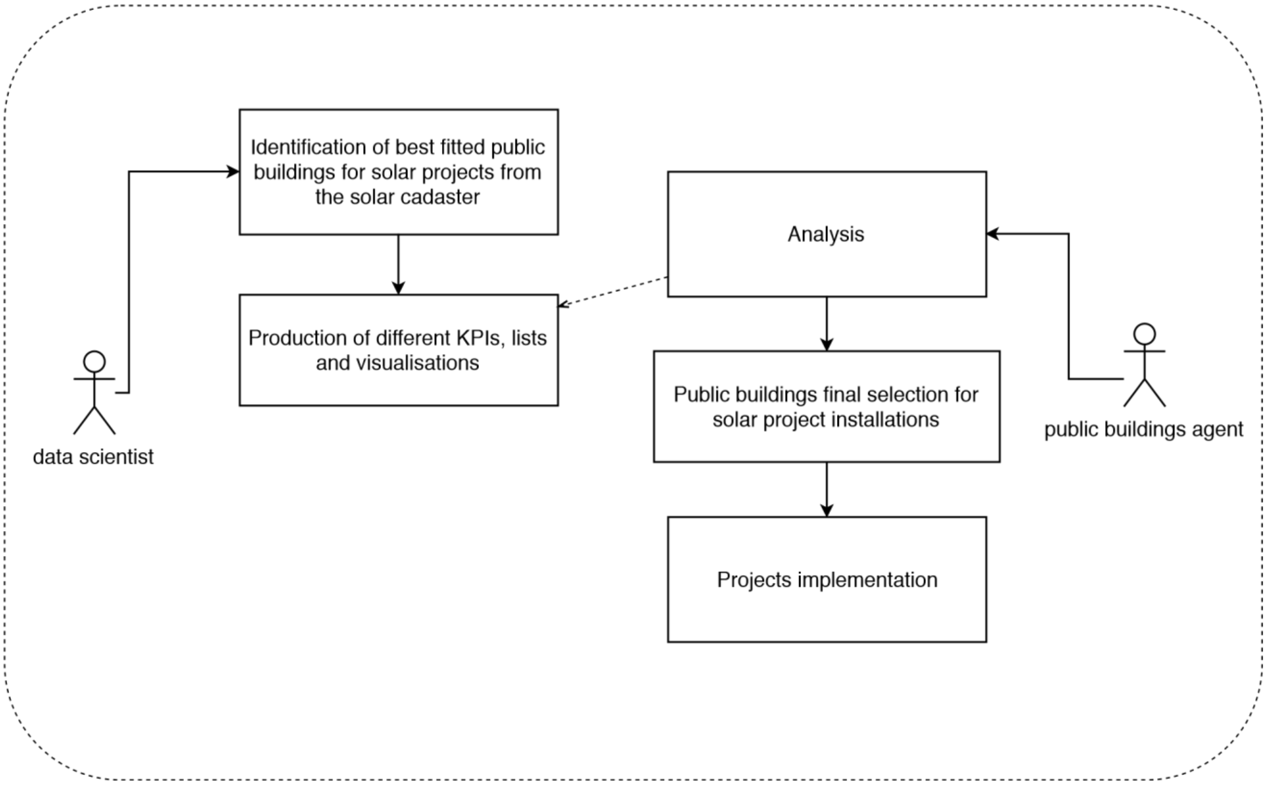
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Benefits	Better allocation of ressources for fuel oil heated households conversion towards the district heating network
4. Actor List and Requirements	
Actors identified	Energetic transition / territorial energy planning public agents District heating network management public agents Data engineers
Requirements (from Actors' perspective)	Local consumption data should be available for all energy sources GDPR concerns should be fully integrated
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	- address grid energy reference frame ongoing development (UC#10) - district heating network topology and other related data
Useful data coming from Open Portals	

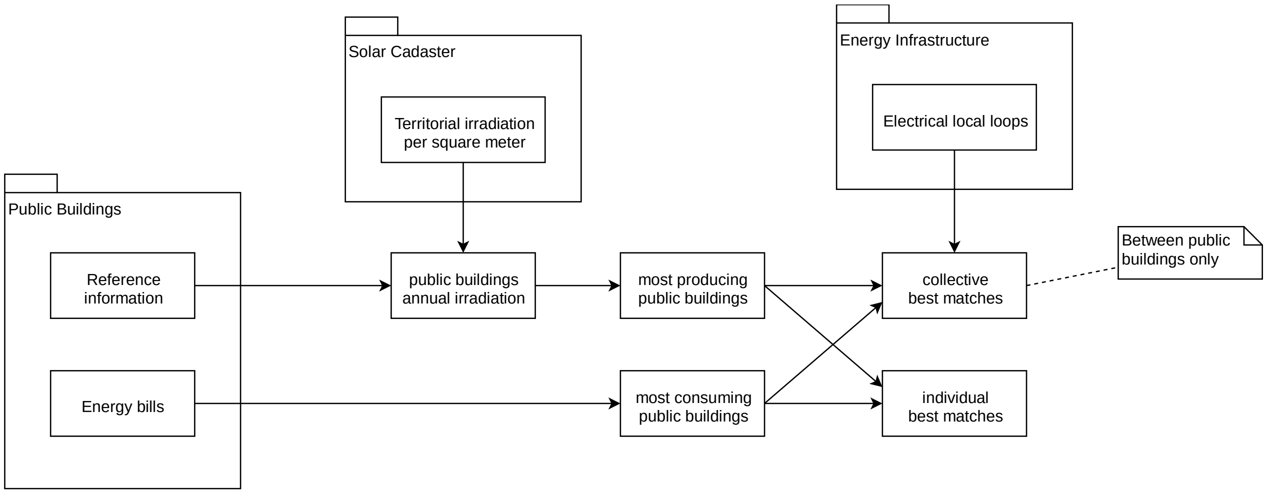
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 20: public buildings solar energy production diagnosis
1. Use Case name
NAN_UC20_public-buildings-solar-energy-production-diagnosis
1.a. Domain/Sector of activity
• Public buildings • Energy
1.b. Sub-domain(s)
• Renewable energy production
1.c. Objectives/Benefits of the Use Case
Help choose the best public buildings to implement solar plants
2. Description
Energetic transition is one key public policy of NAN; often it goes beyond national prerogatives. Regarding energy production, NAN public policy aims to reach a 40% share of local & renewable energy sources in public buildings electrical consumption by 2030. A substantial budget will be allocated to implement new solar plants every year until 2030. Using data can help identifying the best buildings for this purpose. Selecting the best projects over a panel of 800 buildings can be hard and time-consuming, considering the feasibility studies that have to be conducted over each and every project site. The purpose of this use case is to provide insights to help selecting solar project sites.
2.a. User Story description
This use case contributes to Nantes Metropole's energetic transition policy of its public buildings, through providing the public buildings agents with raw material as well as analysis on the biggest opportunities for PV plants deployment.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Public buildings Energy transition policy
Benefits	Decisioning aiding for public buildings solar deployment public policy.

4. Actor List and Requirements

Actors identified	Public buildings agents, Energy department agents, Urban Platform agents with GIS capabilities.

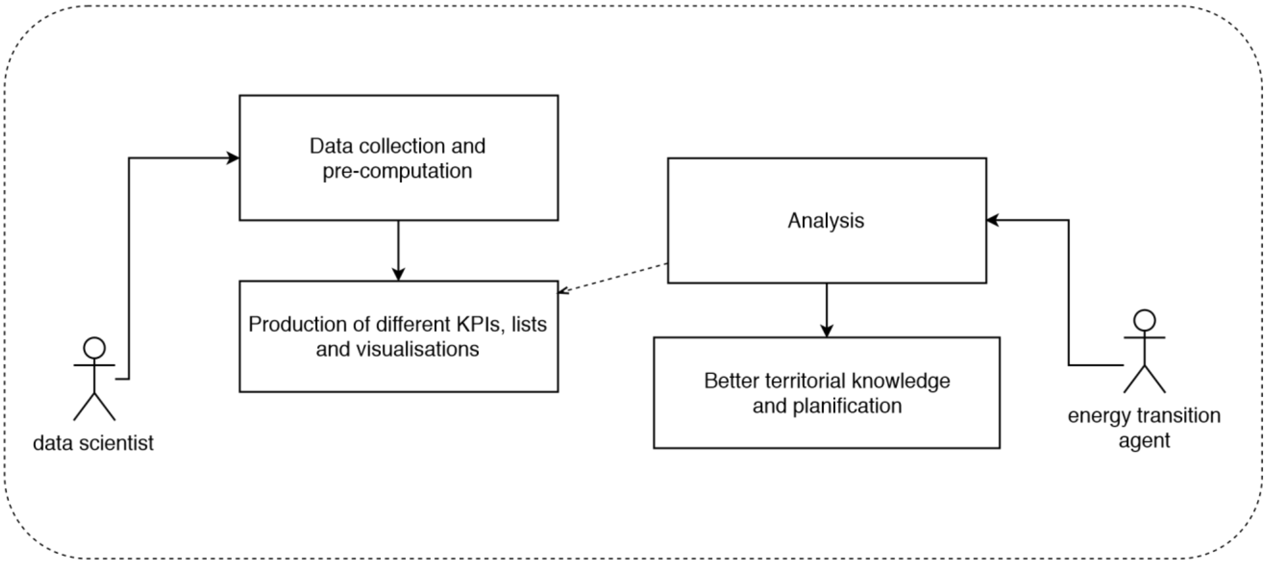
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Requirements (from Actors' perspective)	Electrical consumption data should be available, Electrical/Thermal production data should be available, Buildings structures should be able to support the solar plant, Solar cadastre should be available.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Solar cadastre Public buildings energy bills & reference data Public buildings grouping per electrical local loops.
Useful data coming from Open Portals	

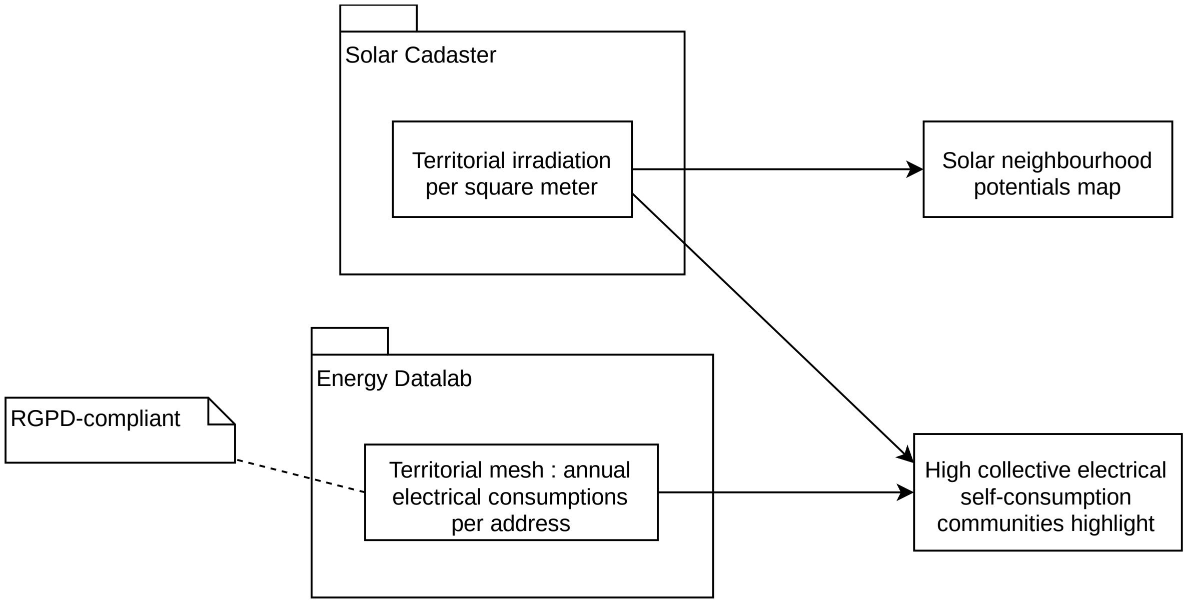
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

USE CASE 21: contribution to territorial development of renewable energy sources
1. Use Case name
NAN_UC21_contribution-to-territorial-development-of-renewable-energy-sources
1.a. Domain/Sector of activity
• Citizen Dialogue, • Energetic Transition
1.b. Sub-domain(s)
• Renewable energy production
1.c. Objectives/Benefits of the Use Case
Provide decision aiding support to energetic transition territorial planification.
2. Description
Energetic transition is one key public policy of NAN; it often goes beyond national prerogatives. Regarding urban transformation, NAN public roadmap for energetic transition (outcome of the Great Debate for Energetic Transition) carries the ambitious commitment to become the first French canopy by 2030; which translates practically to 100% of rooftops to become useful. Using data can support this major urban transformation and the purpose of this use case is to bring a focus on how data can contribute to the development of solar energy production at the territorial scale.
2.a. User Story description
This use case is directed towards the territorial knowledge and planification activities of Nantes Metropole's agents working on the energetic transition public policies, and notably, on the implementation of that of the 100% of rooftops to become useful by 2030 through raw material & analysis of territorial solar opportunities.
2.b. Storyboard

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



2.c. UML diagrams



3. Scope and Objectives

Scope	Citizen Dialogue, Energetic Transition.
Benefits	Decision aiding for territorial actors of the energetic transition.

4. Actor List and Requirements

Actors identified	Citizen dialogue agents, Energetic transition agents, Urban Platform agents with GIS capabilities.

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

Requirements (from Actors' perspective)	Solar cadaster should be available, Energy Datalab electrical annual consumption per address should be available, Use case should be implemented in direct relation with the energetic transition public policies.
5. Available Data at the Pilot site and Open Portals	
Available data at the pilot site	Solar cadaster, Energy Datalab electrical annual consumption per address.
Useful data coming from Open Portals	Energetic transition roadmap.

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