Nantes | Hamburg | Helsinki

Deliverable due date: M36 – November 2019

D2.11 Energy Datalab

WP2, Task 2.5, Subtask 2.5.4

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	D2.11 Energy Datalab
Diss. Level	PU
Status	☐ Working ☐ Verified by other WPs ☒ Final version
Due date	30/11/2019
Work Package	WP2
Lead beneficiary	Enedis (ex. ERDF)
Contributing beneficiary(ies)	Nantes Métrople (NAN), Atlanpole
Task description	**Subtask 2.5.4 Electric energy data Lab [WP 2] (17 PM)** ERDF will lead the development of a dynamic electricity data platform and provision of data sets from energy meters in a standardised format and aggregated at various scales, possibly from individual to building or district scales. This data lab will facilitate the development of energy services to customers as well as energy planning, promotion and regulation of the initiative towards ESCOs to create new services with Digital Start-up and SMEs, supply of complementary standardised aggregated data and of contextual data and integration into the urban platform. In this Subtask, use cases to target the most energy consuming buildings and optimize NM role in energy-efficient refurbishments, tackle fuel poverty with data, simplify quantification of the energy consumption of big stocks of buildings, improve the integration of renewable energy sources into the grid will be defined and tested.

Date	Version	Author	Comment
12/09/2018	0.1	David Le Chenadec (ERD)	Structure of the deliverable
09/05/2019	0.2	David Le Chenadec (ERD)	Structure of the deliverable
03/06/2019	0.3	Vincent Huré (NAN)	Structure of the deliverable
26/06/2019	1.1	Simon Boisserpe (ATL)	Part 4.2
12/09/2019	1.2	Marine Buron (NAN)	Part 5
16/09/2019	1.3	Guillaume Chanson (NAN)	Parts 4.1.4, 4.1.5, 4.3
16/09/2019	2	David Le Chenadec (ERD)	Parts 2, 3 + 1st consolidated version
27/09/2019	2.1	Marine Buron (NAN)	Part 5
07/10/2019	2.2	Guillaume Chanson (NAN)	Parts 4.1.4, 4.1.5, 4.3, 5.3, 5.4 + re-reading
10/10/2019	3	David Le Chenadec (ERD)	All
15/10/2019	3.3	David Le Chenadec (ERD)	15 october version shared

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21/10/2019	2	Benoit Cuvelier (NAN)	Overall review
24/10/2019	3.4	Guillaume Chanson (NAN)	Proofreading + consolidation of 5.3, 5.4, draft conclusion, description of the hackathon in 4.2
28/10/2019	3.4	Marine Buron (NAN)	Parts 5.1 and 5.2 + proofreading
13/11/2019	3.4	Guillaume Chanson (NAN)	Improvement of 4.1.5, 4.3, 4.4, 4.5
14/11/2019	4	David Le Chenadec (ERD)	Overall consolidation
18/11/2019	4	Guillaume Chanson (NAN)	Overall review
19/11/2019	4	Benoit Cuvelier (NAN)	Overall review
19/11/2019	4.1	David Le Chenadec (ERD)	Overall consolidation
22/11/2019	4.2	David Le Chenadec (ERD)	Improvement of Executive summury
27/11/2019	4.2	Guillaume Chanson (NAN)	Overall review
27/11/2019	4.1	Eduardo Miera (TEC)	Overall review
28/11/2019	4.4Final	David Le Chenadec (ERD)	Overall consolidation

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Abbreviations and Acronyms

Acronym	Description
Anti-DOS	Anti Deny OF Service
API	Application Programming Interface
AURAN	Planning agency for the Nantes Metropole Area
DSO	Distribution System Operator
Espreso	Systemic Standardisation approach to Empower Smart Cities and Communities
GDPR	Generale Data Protection Regulation
GPRS	General Packet Radio Service
geoJSON	Geographic JSON
HTTPS	HyperText Transfer Protocol Secure
JSON	JavaScript Object Notation
KML	Keyhole Markup Language
kVA	Electric power unit
NICT	New Information and Communication Technologies
PV	Photovoltaic
SFTP	SSH File Transfert Protocol
UC	Use Case
UDP	Urban Data Platform
SaaS	System as a Service
TRL	Technology Readiness Level
WAF	Web Application Firewall
webSSO	Web Single Sign On
ZIP	File format for archives

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1. Executive Summary

mySMARTLife project aims at defining an Innovative Urban Transformation Strategy in order to tackle the main city challenges througt a smart city governance, new technologies and citizen involvement. Among these challenges, the implementation of an energy transition policy is gaining more and more importance in city strategies since citizen engagement is growing fastly on that subject. To achieve energy efficiency, it is necessary to decrease energy consumptions, to improve energy management, and to increase the share of renewable energy in the energy mix.

In the field of electrical power, to achieve energy savings, efficiency and development of renewables, European institutions have asked to electrical distribution system operators (DSO) in charge of electricity infrastructures to deploy smart meters. The objective is to be able to monitor more precisely consumption and production activities by being as closely as possible to users, to develop new services to provide users with information on their consumption and to create new services on the markets that facilitate and support the energy transition. In France, 20 millions out of 36 millions planned electric smart meters have been deployed so far by Enedis, the main DSO of the country. In the City of Nantes area, it is up to 140 000 smart meters that have been installed.

If smart meters are already commonly used by Enedis to monitor the electricity grid and facilitate the integration of renewable energy sources like solar power plants, the main services designed for final users are still to be created to achieve the full potential of this new infrastructure. The actions 15.Smart Metering and 45.Energy datalab initiative of the mySMARTLife project aim at setting the conditions for the development of numerous innovative new services for users based on electrical data. This project is called Energy Datalab.

To do so, Enedis has implemented a new data platform to facilitate the sharing of this data and the emergence of innovative use cases (UCs). The platform allows its user to easily visualize the geographic position of smart meters, to plot electric production and consumption curves and to share it with third parties under specified conditions.

The platform has been experimented with Nantes Metropole public equipment and buildings fitted with smart meters. A methodical approach has been implemented to design new use cases based on electric data that deeply involved Nantes Metropole departments and local innovative SMEs. Based on Atlanpole[1]'s expertise, this approach included in particular a strategy to communicate towards innovative SMEs, to ideate upon news use cases and technologies and to support partners in the implementation of experimentations.

[1] local innovative cluster, third party of Nantes Metropole in mySMARTLife project

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This work has lead to the description by Nantes Metropole of 14 new UCs and to many associated experimentations to test their feasibility and potential value. In a very concrete way, these UCs aim at reducing the electric consumtion of public equipments and contribute to the improvement of local energy planning, for example by optimizing the deployement of solar power plants. Every UCs has been precisely documented in this report to facilitate their replication.

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2. Introduction

2.1 Purpose and target group

Deliverable 2.11. Energy Datalab is linked to “action 15. Smart Metering (8000 Smart Meters) and Energy data lab” and “action 45. Energy datalab initiative”.

These actions aim at collecting electrical data thanks to smart meters deployed by Enedis (ERD) on Nantes Metropole area and exploring the process of transforming raw data into useful services to support energy transition of smart cities.

To reach this objectif, a data platform has first been set and connected to Enedis’ information system so Nantes Metropole can have access to the electric consumption and production curves of a selection of 300 public facilities.

A link has then been set between this platform and the Urban Platform (see deliverable D.2.8) in order to implement a first use case.

Thanks to the work of Atlanpole, local innovative partners have been identified and use cases sought with Nantes Metropole team in order to develop other new use cases mostly aiming at a better management of the electricity consumption of public equipment and energy savings.

Finally, aggregated electric data from the area contributed to Nantes Metropole territorial energy planning, and towards a better implementation of energy transition public policies.

In total, from energy optimization to territorial energy planning, 14 use cases have been designed and are described in the report.

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

- **Part 3** : Regulatory and technical environment of the project
- **Part 4** : Designing new services based on electric data
- **Part 5** : Contribution of electric data to territorial energy planning

2.2 Presentation of main partners

Enedis[2]

[2] https://www.enedis.fr/

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Enedis manages 95% of the electricity distribution network in continental France. This network belongs to local authorities on their territories (French municipalities or groups of municipalities), which subcontract to Enedis as an operator through a public service delegation. Thus, Enedis has two major public service duties.

Service continuity and quality: managing nearly 1.4 million km of electric lines, Enedis is responsible for continuous public electricity service. To fulfil this role, the company operates, maintains and develops the network. Enedis also invests in modernising and securing the network, particularly against extreme weather conditions.

Non-discriminatory access to the distribution network: in compliance with regulations, Enedis ensures that users have transparent, objective and non-discriminatory access to the network. The company also guarantees the confidentiality of commercially sensitive information handled, having developed a code of conduct for this specific purpose.

Enedis has opted for new technologies and investments optimisation to meet the energy challenges. To prepare and support this major technical shift, Enedis is investing in numerous demonstrators in France and Europe. Their aim is to design tomorrow's « smart grids », solutions combining electricity and NICT. The Linky smart metering system is a core element of this new system.

Key figures:

- 36 million customers
- 38 700 employees
- €14 billion in revenue
- 1.4 million km of electrical network managed

Nantes Métropole

Created on January 1st 2001, Nantes Metropole is a public body comprising 24 municipalities, representing a territory of 52,336 hectares and over 600 000 inhabitants. Its areas of competences are very broad and include public transport and mobility, environment, energy planning and urban development, digital infrastructure and economic development including innovation. Nantes Métropole has an annual budget of over 1,2 billion € and 3500 staff. Mrs Johanna Rolland is President of Nantes Metropole and Mayor of the city of Nantes.

As Lighthouse City, Nantes Metropole is the leader of the workpackage 2 (Nantes demonstration site). In collaboration with WP 2 partners, it will implement several actions: full electrical 24 m bus line, smart EV charging stations, data lab energy, greener company fleets, citizen engagement in renewable energies, energy retrofitting support, urban platform and associated services for citizens.

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Atlanpole[3]

As the technopole and BIC (Business and Innovation Centre) for the Greater Nantes economic and University area, Atlanpole plays a key role within the main multidisciplinary area of innovation in Western France.

Atlanpole is accredited by the French Ministry of Research as the science based business incubator for the whole region Pays de la Loire. As the reference point of contact for two thematic French Tech networks (CleanTech and HealthTech), it fosters the emergence, creation and development of innovative companies, start-up companies and of small and medium sized enterprises.

As a member of the French National Innovation Network (Retis), the European Business and Innovation Centre Network (EBN) and the International Association of Technopoles, Science Parks, incubators and areas of innovation (IASP), ATLANPOLE has been awarded ISO 9001 certification.

2.3 Contributions of partners

The following Table 1 depicts the main contributions from participant partners in the development of this deliverable.

Participant short name	Contributions
ENEDIS (ERD)	Overall content to sections 1, 2 and 3. Overall review
NANTES METROPOLE (NAN)	Overall content to sections 4 and 5
ATLANPOLE (Third party)	Overall content to sections 4.2

Table 1 - Contribution of partners

2.4 Relation to other activities in the project

The following Table 2 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.

Deliverable Number	Contributions
D2.8	Improved Services in Nantes Urban Platform
D2.16	Open Specifications Framework

Table 2 - Relation to other activities in the project

[3] https://www.atlanpole.com/accompagnement/

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3. Regulatory and technical environment of the project

3.1 The smart meters network infrastructure

The Energy Datalab operates power consumption and production data from the Enedis' connected meter grid. In this first section we describe the technical context of the creation of this wide network of meters and the regulations associated with data processing.

3.1.1 Deploying 35 million smart meters in France

With the European Directive n° 2009/72, which created common rules for the European electricity market, the European Union advised the member states to deploy connected meters for 2020 if they don't claim for a negative economic impact of the measure

In France, several regulations voted between 2005 and 2010[4] state that 100% of the meters in France are to be connected before December 31st of 2024.

As the main electricity grid manager in France, Enedis (former ERDF), is responsible for the deployment of these connected meters. It implies to install 35 millions of devices between 2015 and 2021 over the houses, companies and public equipments. These meters are branded Linky meters.

The main goal with the connected meters is to support the development of renewable energies, the electric mobility and the evolution of the electricity consumption, while keeping the electricity grid safe and continuous.

In July 2019, close to 20 millions connected meters have been deployed in France.

[4] Notably the 13th July 2005 Law establishing the energy policy directions, the 2009 Law to enforce the Grenelle de l'Environment and the 31st August 2010 Decree about metering equipment for public electric networks.

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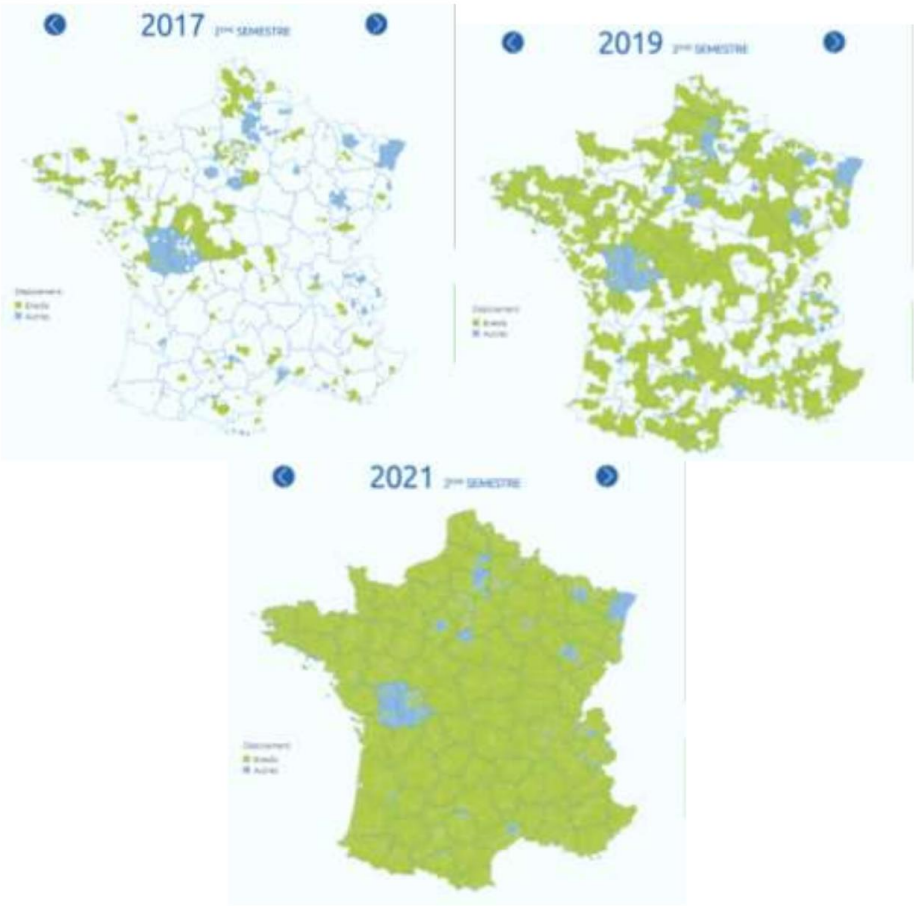

Figure 1 - Map of the connected meters deployment's forecast. The Enedis scop of action equipped with Linky meters is in green. The non-equipped areas are in white and in blue, the action scopes of the other electricity distributors.

Focus on the Ile de Nantes Area

In July 2019, there were 13.000 meters installed on the Ile de Nantes area on a total of 15.400 meters. This is over the 8.500 meters announced in mySMARTLife project

3.1.2 Smart meters infrastructure and data specification[5]

The Linky connected meter is able to send electricity consumption and production data to Enedis Information System and to receive specific commands remotly.

The meter communicate with the Enedis' Information System thanks to a data concentrator located on the electricity sub-station managed by Enedis. The Powerline technology helps to create a link between the

[5] https://www.enedis.fr/linky-compteur-communicant

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connected meter and the concentrator, related himself to the Information System of Enedis by a GPRS link. The global operation of the communication system is monitored by a supervision agency.

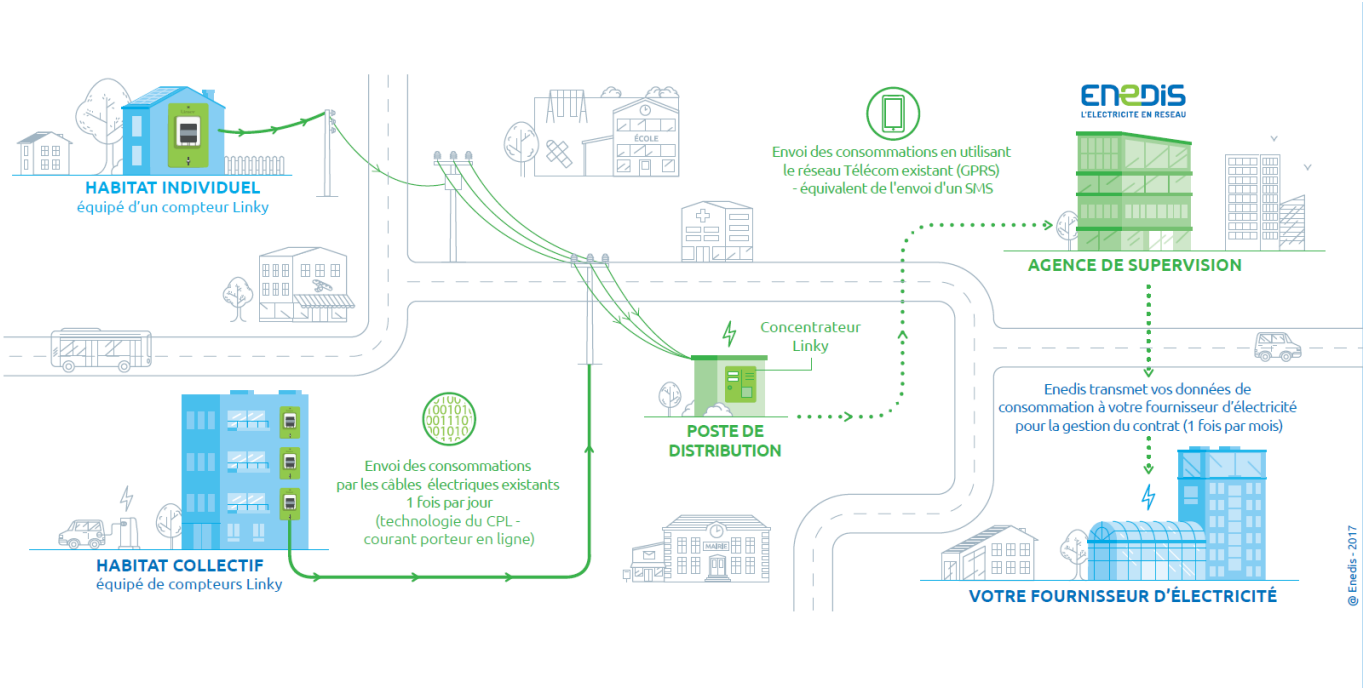

Figure 2 - telecommunication architecture of smart meters network

There are two types of meters depending on the electrical power range :

- Meters named « less or equal than 36kVA »
- Meters named « more than 36kVA »

Connected meters can measure the electrical power consumed or produced every 10 or 30 minutes (depending on the meter). We call load curve the succession of power measurement over a period of time. The functionalityallowing to download the load curve is only available if there is a customer agreement (see part. 3.1.4).

Once the load curve collection is activated, the data measured and uploaded to the Enedis' Information System are the following ones :

- consumption or production index of peak and off-peak hours;
- load curve ;
- power peak of the day.

3.1.3 Security of the Linky Information System

Data are end-to-end encrypted, from the smart meters to the Enedis Core Information System. Audits conducted by ANSSI, the French national Information System Security Agency, allow Enedis to test the

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reliability of smart meter's infrastructure security system in order to avoid potential intrusions and cyberattacks. For security reasons, security measures implemented on the smart meters grid are confidential.

3.2 The Regulatory Framework on a data perspective

There are two laws in France that frame the ability of the grid system operator to share the data to public authorities and consumers: The Green Growth Energy Transition Law (GGETL) and the Digital Republic Law.

On August 18, 2015 the GGETL, that frames the provision of electric consumption data to consumers, public authorities and real estate owners and managers, specified that:

- The grid system operator must give the access of real-time consumption data to the consumers
- It must give real estate owners and managers access to the anonymized consumption data of inhabitants
- It must provide public authorities with total consumption per year per district, number of meters per building and electrical production data per economic sector.

To complete this scheme, the French State passed on October 7th, 2016 the Digital Republic Law that allows an open-access for the energy consumption data, more specifically data like consumption and production curves linked to several profiles. Those datas will be accessible in an opened and reproducible format that could be reused in an automatic treatment system. Data are anonymized if related to smart meters under 36 kVA i.e. most of private individuals.

Enedis gives access to those data, and some others accross the Open Data Gate[6], like energy production and consumption, the power supply quality, the electric mobility, the electricity grid infrastructure and the electricity market. That is up to 59 data sets that are in open acces.

[6] https://data.enedis.fr/pages/accueil/

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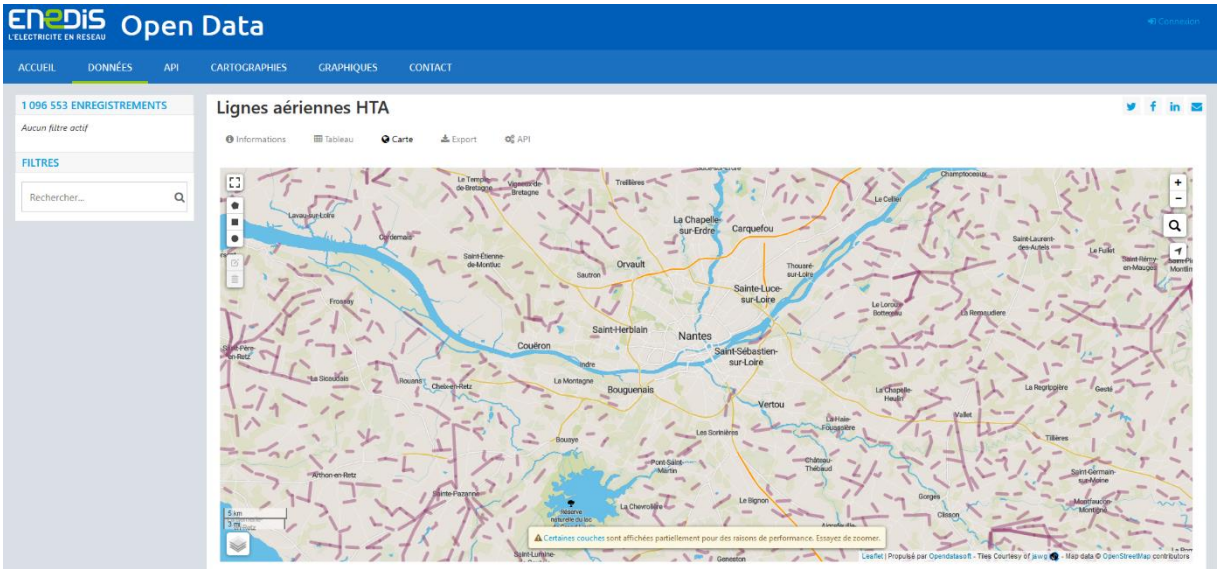

Figure 3 - Open-data map of the high voltage distribution grid in Nantes área (available on data.enedis.fr)

3.2.1 Personal data protection

The French Data Protection Act of January 6th 1978, related to computing, digital files and freedom, explains on the article 6 that a personal data processing must :

- Have a final goal that is determined, loyal and lawful ;
- Collect only relevant data and proportionally to the final goal ;
- Respect the right to be forgotten, by storing personal data during a limited time that is necessary for the processing goal ;
- Ensure safety and confidentiality for data ;
- Ensure people rights about their personal data : information, accessibility, correction, objection and a right to decide what their data will be turned to after their death

The european General Data Protection Regulation (GDPR) enforceable since 25 May 2018, comes to enhance people's rights, create new directions for Data Controllers and aligns the protection of data inside the European Union. The article 5 of the Regulation lists 6 principles to follow when it comes to personal data processing :

- A lawful, loyal and transparent processing ;
- Having a final goal determined, explicit and legitimate to collect them. They must not be processed in an incompatible way with the initial process ;

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- The data collected must be adequated, relevant and limited compared to the goal of the processing; They must also be updated and exact, and the ones which are not must be corrected or deleted ;
- The storage of the datas is only during the necessary duration of the process ;
- Processed the way to ensure their safety and condidentiality.

When it comes to data from connected meters, the laws require not to share the customer's production or consumption data with another player without the customer's agreement. In the Energy Datalab project, a particular attention has been given to this topic in order to make sure that Nantes Metropole could control at any time the third parties' access to the consumption data of public equipment.

3.2.2 Protection of Commercial Sensitive Information

The Commercially Sensitive Informations (CSI) are informations that, if shared, could impede the rules about free and fair competition, and the non-discrimination, in accordance with articles L111-73 and -81 (Energy Code) and Decree n°2001-630 of July 16th 2001, that refers to decree n° 2011-1554 of November 16th 2011.

The CSI can be :

- Information related to the registered powers, the energy consumed or produced, the quality of the electricity collected by metering or any other measure made by the distributor about electric facility and user's facilities;
- The characteristics of production, furniture or consumption;
- The conditions of sale from each supplier;
- The identity of each contracting parties;
- The contractual dispositions;
- The payment terms;
- The contact period and all the access or furniture protocols;
- The informations sent to prepare and apply the contracts and protocols;
- The dispositions of the protocols fort he access of public transport and distribution grid.

Enedis is required to preserve the confidentiality of those informations. Some of those data processed during the Energy Datalab project, more especially consumption and production data are CSI. Those dispositions involved a particular attention in the securising process of the access and transmissions in the project's scope, as developped in the current deliverable.

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4. Designing new services based on electric data

The particulariy of the Energy Datalab project is to invest in the local dynamic innovative ecosystem to design and experiment new services based on electricity consumption and production data to support the territorial Energy Transition scheme.

In that perspective, we implement platform strategy enrolling a data provider, Enedis which rely on its network of 13 000 smart electricity meters on the Ile de Nantes area, a public equipment manager, Nantes Metropole, and several innovative stakeholders able to develop such services. For this project, Atlanpole helps us to interact with these players and to mobilize them.

The collaboration between all these stakeholders made it possible to design and develop many use cases that are detailed in the following section.

4.1 Elaborating an electric data platform strategy in Nantes

When this action was being developped, Enedis, Nantes Metropole and Atlanpole made the hypothesis that to maximize the value of electric data within innovative services, the best solution was to share these data with innovative players capable of implementing new technologies at the crossroads of digital and energy sectors. According to that hypothesis it is thanks to the plurality of players, of their area of interest and of their technical skills that we will be able to achieive a virtuous ecosystem for the benefit of Energy Transition.

The Energy Datalab can be seen as an interface between data stored within Enedis Information System, Nantes Metropole, owner of public equipment and third beneficiaries in charge of developing innovative services. It has to ensure, in particular:

- the security of stored and exchanged data
- the monitoring of access to data sets
- a facilited access to data sets to allow their exploitation
- a high level of quality concerning the provided data

In this section, we describe the technical choices made to comply with these expectations.

4.1.1 Project perimeter and data specification

Enedis and Nantes Metropole chose to build the Energy Datalab platform around electric consumption and production data of Nantes Metropole public equipments. This experimentation field has been chosen to opt for a unique equipment manager to simplify consent acquisisiton and to concentrate on the need of one specific player. The “public equipments field” gives a very wide range of nature of equipments such as public pools, gymnasium, public lightnings, public libraries,

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The variety of equipment is an important criterion as it defines the possibilies to design new services to optimize their electricity consumption or production. Electrical profiles are very different from an equipment to another and based to the characterisation of these profiles from collected data it is possible to imagine specific solutions for each type of equipment. The variety of energy profiles multiply the possibility of use cases and so enhances the capacity during the project to design and test several new services.

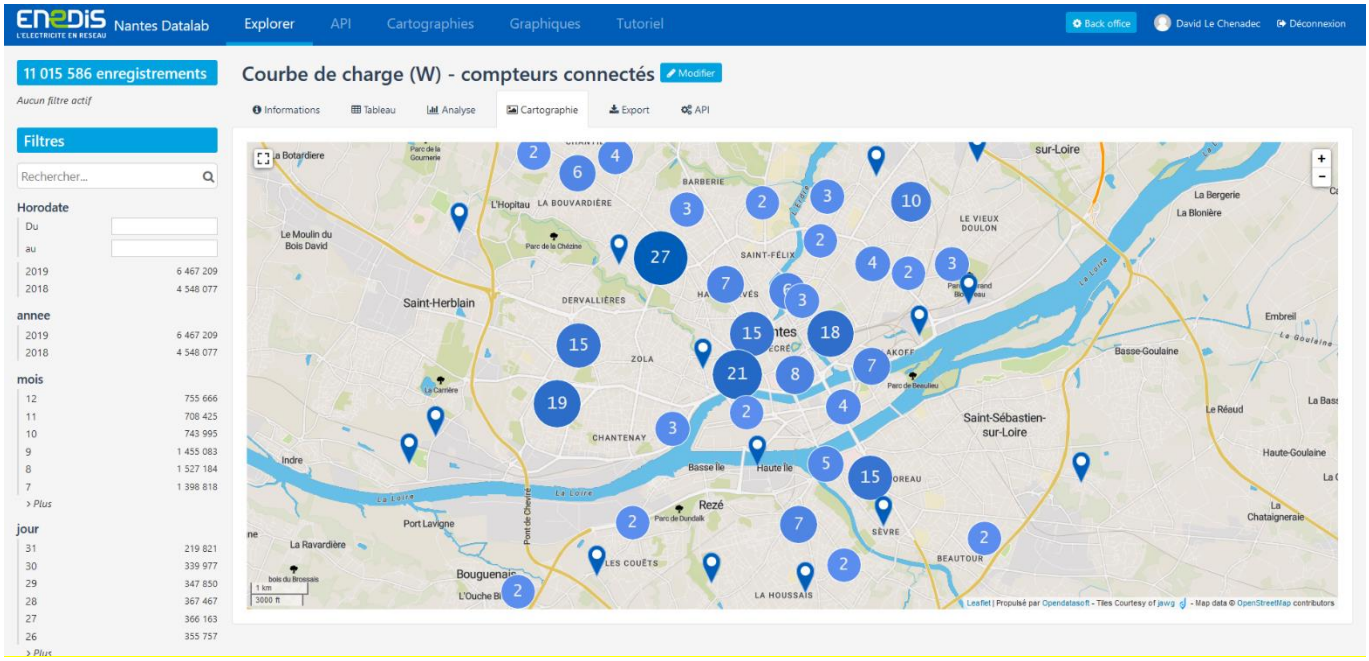

Figure 4 - geographical representation on the Energy Datalab platform of the Nantes Métropole's 300 equipments fitted with electric Smart metering and connected to the platform

Moreover, electric consumption and production data concerning selected public equipment doesn't include personal data. That facilitates the reuse and the sharing of this data in line with GDPR. Nonetheless, this data still is Commercial Sensitive Information that is protected by the European and national regulation on competition. That means that this data still is confidential and its digital treatment requires a high level of security.

4.1.2 Platform specification – providing a safe and efficient user interface

In order to implement the Energy Datalab platform rapidly to concentrate on the definition of use cases, we used the OpendDataSof framework, under licence. This framework has been customized by Enedis developpers to comply with the specific needs of the project. A particular attention has been given in the choice of the framework to the quality of the user interface to access to the data, visualize it and share it.

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Using a SaaS solution for the platform allows to benefit automatically from the last technical release and to stay, specifically concerning the user interface, at the state of the art. It also allows a continuous update of the legal terms and conditions of the service according to the changing regulation.

Enedis and Nantes Metropole are also familiar with the OpenDataSoft platform as it is the solution they both use for their Open Data platform. Two main features differ in the closed data version: the access control service and the monitoring of third parties access to certain data sets.

4.1.2.1 Description of the data visualization feature

When the aim is to develop new services based on a great amount of data, the first dificulty is to understand the nature of the data, what they represent and what they are standing for. It is the first step before imagining their uses. To do so, the platform includes different feature to manipulate the data in order to shape a mental representation of it.

Description of data sets

The data made available in the Energy Datalab platform are mostly technical data related to the electric consumption and production. It is particularly necessary to describe precisely the content and the mean of every data field of the data base. For that purpose, the platform offers a specific interface giving this information and also the information context on it, for exemple, how the measure has been done.

The description of the data sets is also critical for developers connected to the platform through an API as it defines the architecture of their proper data base and the way they download the data. A change in the data set model will most of the time imply disfunctions within the downstream service.

To prevent service providers connected to the platform from this kind of consequences, the platform allows them to subscribe to alerts about change in the data set description or data set architecture.

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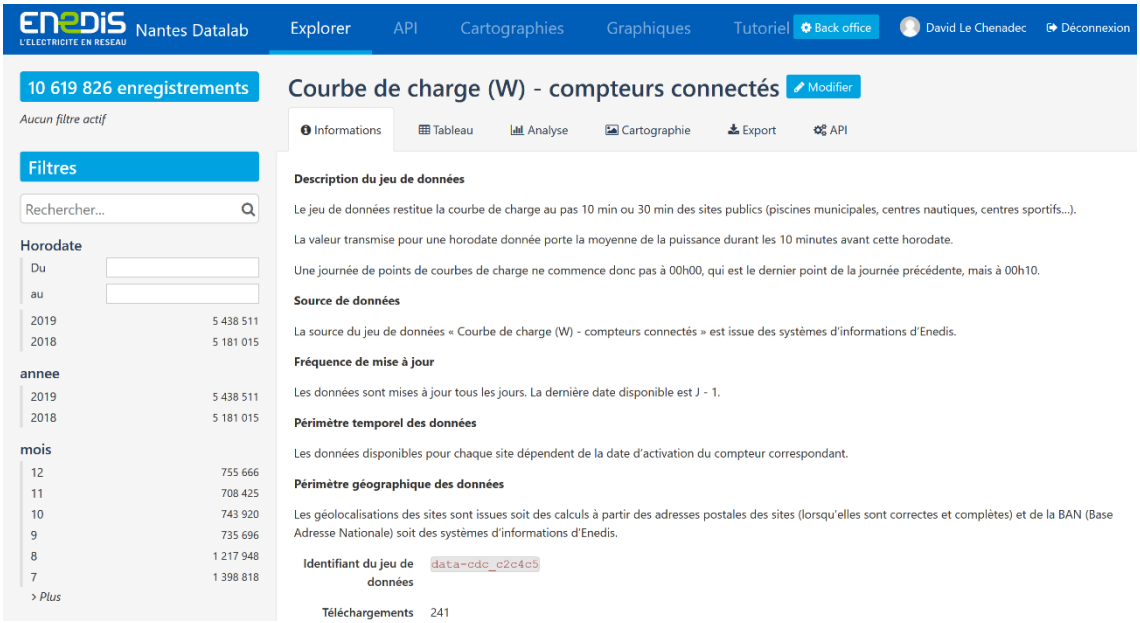

Figure 5 - interface for the data set description on the Energy Datalab

Data visualization

For each smart electric meters it is possible to plot the consumption or production of the equipment i.e. the average electric power every 30 minutes periods. It is possible to choose the temporal coverage of the representation and to overlap curves from multiple meters to make comparisons.

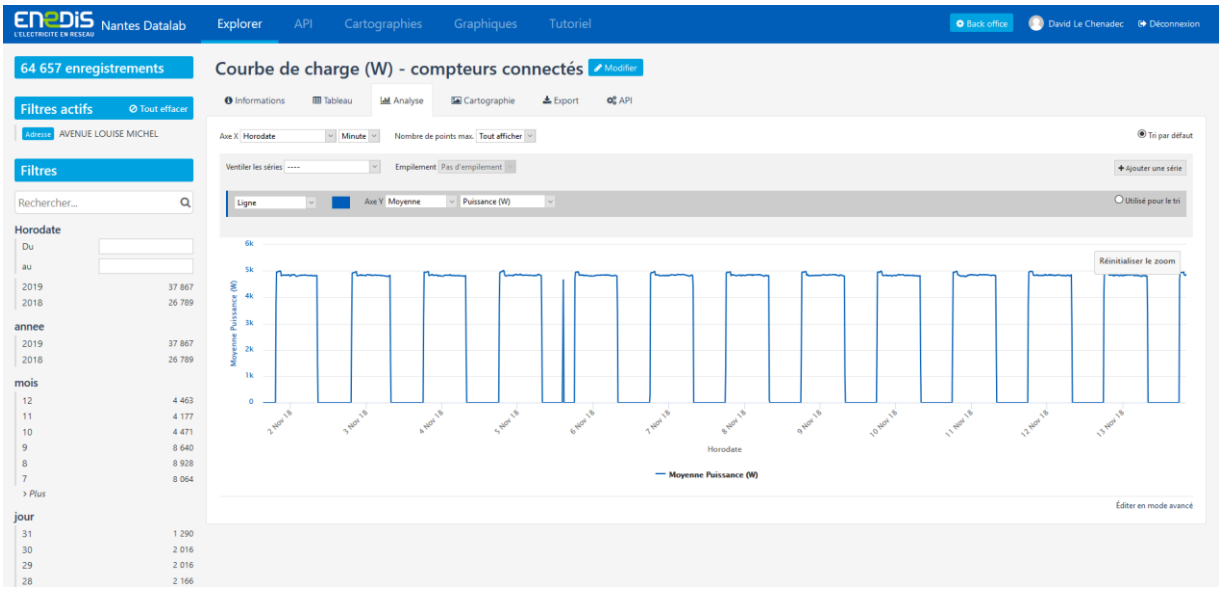

Figure 6 **- Data visualization on the Energy Dalab platform of the electric consumption of a public lighting electric box. We can easily observe the day/night cycles.**

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Filtres and scalability

A particularity of the platform's characteristics is that it has to be able to treat a great amount of data. For the Energy Datalab action, only 300 smart electric meters are included but Nantes Metropole manage thousands of equipments on its territory. Therefore, the solution is able to adress scalability issues. It is especially the case on the Open Data implementation of the solution by Enedis.

To explore this high amount of data, more than 11 millions entries, Enedis' team has worked on the filtres features in order to select subsets of data following several criterion, such as:

- temporal coverage

- meter's unique ID

- adress

- consumption vs production

Data treatments

Even if it's not the first expected feature, the platform allows a basic level of data treatment by implementing simple mathematical formulas, as for exemple : mean, max, min, standard deviation, percentile. These treatments make it possible to identify simple paterns to emphasize subsets on which it will be interesting to conduct further analysis. For exemple it allows to highlight some categories of equipments with typical consumption shapes showing differences between week days and week end (tertiary buildings, schools etc.) or night and day (public lightnings etc.).

Nonetheless, the services developed by innovative partners within the Datalab Energy action implement highly advanced algorithms. In that case, these algorithms run on external platforms that integrate more advanced calculation tools. For these specific treatments to be effectively implemented it is necessary to allow their interconnexion with the Energy Datalab platform. These sharing features are described in the following sections.

4.1.2.2 Description of sharing features

Description of sharing interfaces

The platform allows innovative partners to download data sets via different format, statically or dynamically.

Statically i.e. by downloading them manually, it is possbile to gather the data in a file in the following formats :

- csv
- JSON
- xls
- geoJSON

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- Shapefile
- KML

It is therefore possible to use filtre options, described in the previous section to download only specific datasets and to limit the size of the outcoming file.

The static downloading feature is systematically used by innovative players to identify the usefull subsets of data and experiment quickly their algorithms without having to implement a complex processing scheme to treat data on a continuous flow.

When the service providers want to integrate the data in its service for the exploitation phase, he needs to access data automatically at regular intervals. This dynamic access to the data is possible thanks to API natively embeded in the platform. This API requires to use specific commands in the source code of the service developped by the third party. To facilitate this operation, a code generator is available on the platform to provide the right commands according to a specific demand of a subset of data.

Third party access control

It's necessay to log in to access to the platform. A control panel allows platform's administrators to visualize all the accounts that have access to the data sets. It is possible to add and remove user's access or limit the access to only specific subsets of data that have been determined by a filtre feature. It is also possible for visitors to ask for an invitation on the platform. Invitations are moderated in the control panel.

The access control is a crucial feature as it allows the equipment's owner, Nantes Metropole, to monitor in real time who has accesss to its data in line with regulation on business confidentiality and GDPR, if the owner was a private individual.

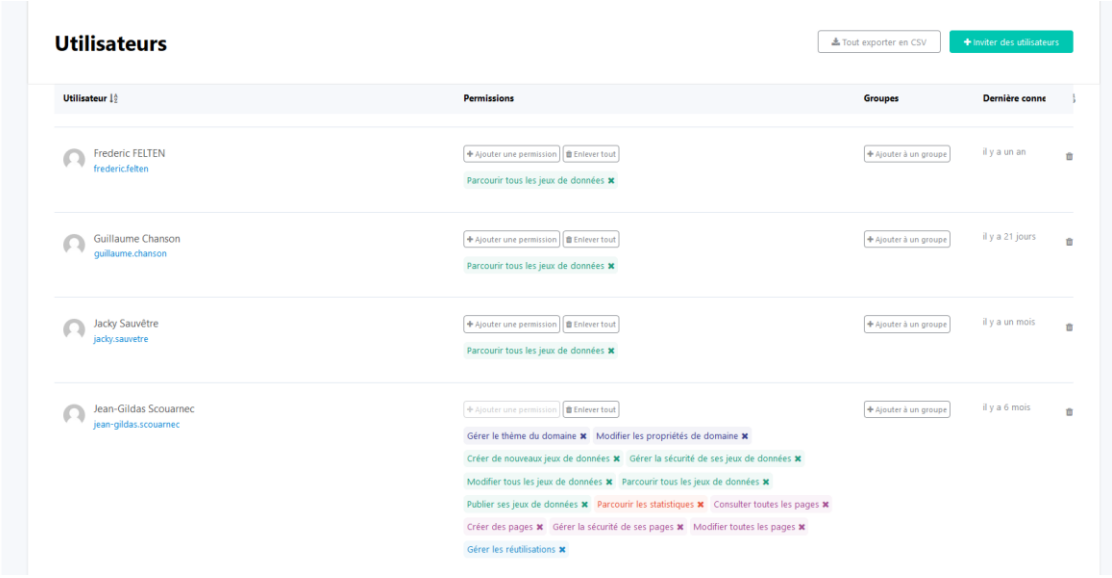

Figure 7 - Energy Datalab's interface for the third party access monitoring

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

4.1.3 Enedis' Information system architecture for the Energy Datalab

The main goal of the implementation of a link between Enedis' information system and the Energy Datalab platform is to guarantee reliability and security. In this section we describe the architecture choosen to reach this objective.

4.1.3.1 Description of the functional architecture

On a technical point of view, the project consists of gathering every day electric data stored in Enedis Information System to transfer them on a dedicated server in charge of making specific treatments on data sets and generating an archive file that will be transfered on Energy Datalab servers hosted by our partner.

To do so, two data lakes are called in the Enedis' information system respectively for data coming from low power electric meters and high-power electric meters.

The dedicated server is able to run calculation on original data to generate new data sets. For exemple, it calculates for each meter the daily consumption by making the difference between two successive measures. It is also natively possible to calculate the average consumption by square meters for buildings as far as the surface data is known. More complex calculation could run if needed for some specific use cases.

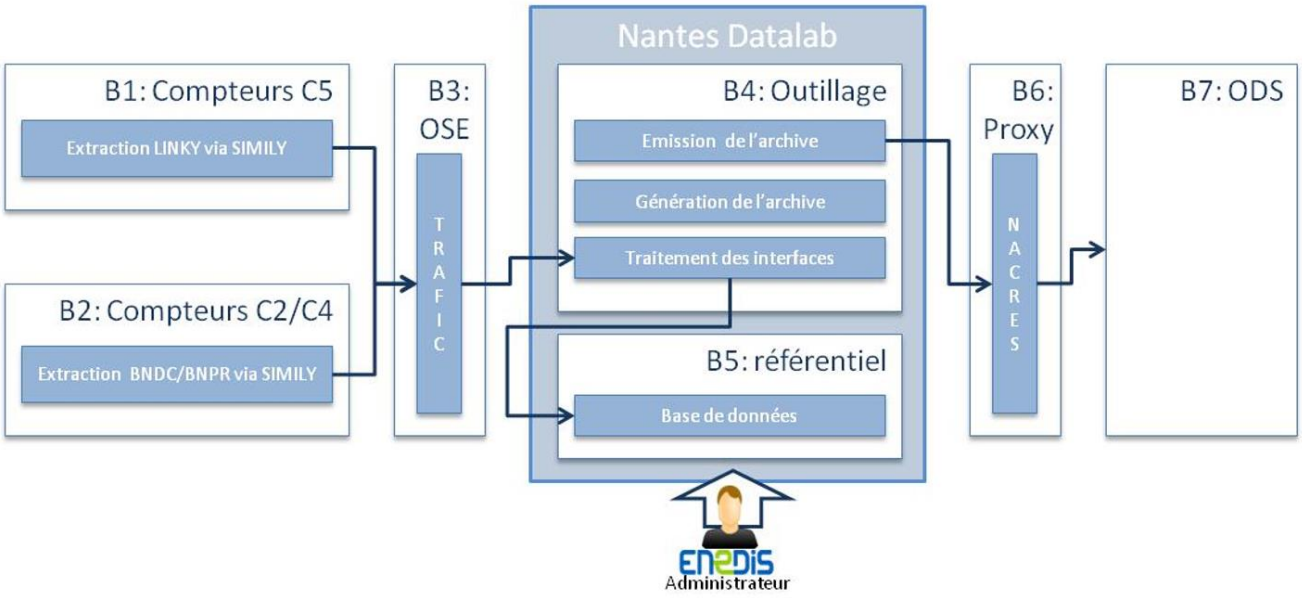

Figure 8 - functional architecture diagram of the solution in Enedis' Information system. ODS stands for OpenDataSoft, the platform's hosting operator.

Some administration features have also been implemented :

- Daily archiving of all consumption and production data
- A use interface for administration of the application accessible only by Enedis' Information System team
- Alerting in case of anomalies

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Moreover, a proxy server guaranties the separation between Enedis Information System and the partner's servers hosting the Energy Datalab platform.

4.1.3.2 Description of the technical architecture

The main objectif of the choosen architecture is to ensure the security of data and servers. To achieve this goal, two fundamental principles are applied :

- the physical separation of servers hosted internally, on which relies the Information System, and public internet. A proxy server plays that role.
- the encryption of communication between servers using SFTP

To optimize physical ressource management, virtual servers are systematically implemented.

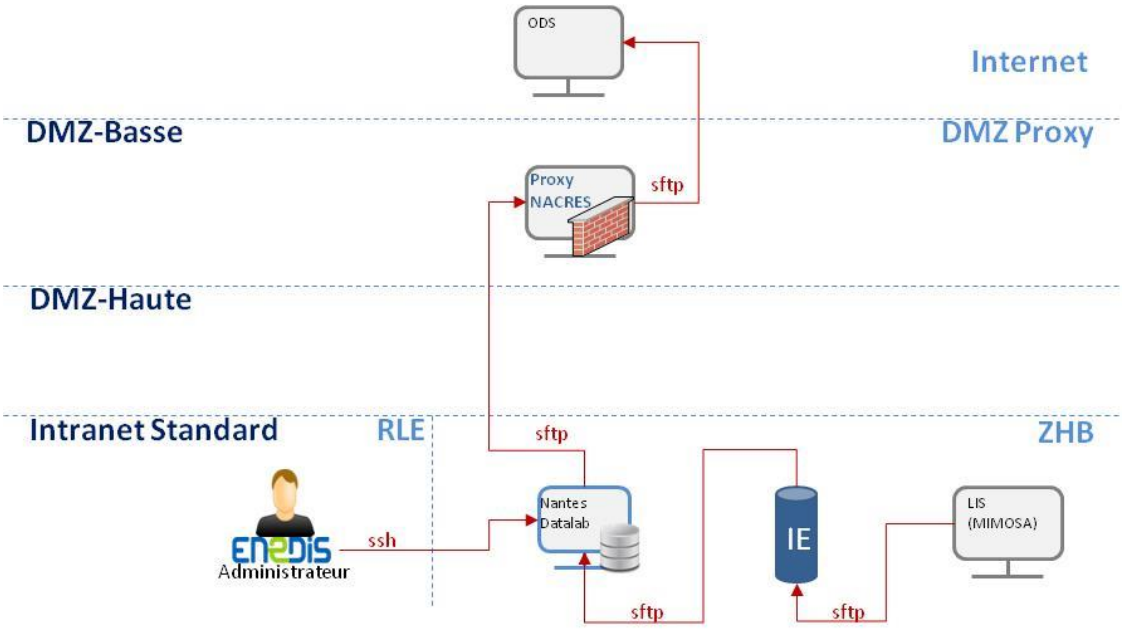

Figure 9 - technical architecture diagram of the solution. ZHB stands for Internal Hosting

Data are extracted form Enedis' Information System in JSON Format into 4 seperated files containing respectively:

- electric power curves for low power smart meters (inferior to 36 kVA)
- electric power curves for high power smart meters (superior to 36 kVA)
- electric index low power smart meters (inferior to 36 kVA)
- electric index for high power smart meters (superior to 36 kVA)

The dedicated servers transform these 4 files into 8 JSON files containing respectively:

- electic power curves for low power smart meters (inferior to 36 kVA)

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- electic power curves for high power smart meters (superior to 36 kVA)
- electric daily consumption or production for low power smart meters (inferior to 36 kVA)
- electric daily consumption or production for high power smart meters (inferior to 36 kVA)
- electric annual consumption or production for low power smart meters (inferior to 36 kVA)
- electric annual consumption or production for high power smart meters (inferior to 36 kVA)
- electric daily consumption or production by square meter for low power smart meters (inferior to 36 kVA)
- electric daily consumption or production by square meter for high power smart meters (inferior to 36 kVA)

These files are then inserted in ZIP files transfered in SFTP towards platform's servers.

4.1.3.3 Security of the system

The solution has been elaborated according to a security by design approach with respect to four principles: integrity, traceability, confidentiality, availability.

To garantee integrity of the solution, authentification is made on local servers using webSSO protocols. Technical measures are implemented to complete this scheme, a firewall, a WAF and a, Anti-DOS solution are implemented. On the organisational side, a process has been elaborated to manage server's update, incident management, backups, security audits and reversibility of actions.

To guarantee traceability every connexion and disconnexion, data consultations and modifications are logged.

To guarantee confidentiallity, every data flow is securized with HTTPS protocols. Data and logs are also end-to-end encrypted. Data encryption keys are specific to each hardware equipment and encryption algorithms are regularly optimized.

Availability aspects have not been made a priority as the project is experimental so a normal level of availability has been implemented as for non critical activities.

Furthermore, as mentionned in the 1.1.3 part, audits conducted by ANSSI, the French national Information System Security Agency, allow Enedis to test the reliability of smart meter's infrastructure security system, on which relies the Energy Datalab's infrastructure. The goal is to avoid potential intrusions and cyberattacks.

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4.1.4 Interoperability with the urban platform and monitoring

What is the Urban Platform?

The Urban Platform 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.)”.

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)” (cf. D2.16).

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.

As for Nantes and in the context of mySMARTLife, the Urban Platform designates the ICT subsystem which:

- gathers measures from various data publishers (eg. an IoT supervision system);
- allows Urban Platform service providers to perform transformations of the data;
- provides ways for users to consult and access the data;
- and applies regulations on the data access (cf.D2.8).

A strong focus of the Urban Platform is on constraints to ensure data interoperability: open specifications and open APIs apply to the means by which data are exchanged (inbound and outbound), which the interoperability schema binds together; furthermore, to share the same concepts of Urban Platform architecture, an architecture framework was defined by the three demosites despite the potential differences in their respective implementation. OGS’s SensorThings API was chosen as both the data & API technical specification for all three demosites.

Practically speaking, new services are developed on Nantes’ Urban Platform to take into account 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.

Integration of Energy Datalab into Nantes’ Urban Platform

Four adapters were developed to fetch the data provided by ENEDIS, 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.

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

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.

Incoming data	Protocol	Format
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
Meters reference table	File/CSV	Proprietary

Table 3 - description of incomming data

Data in the urban platform	Observation nature	Format
Power load curve	Measurement	SensorThings API
Daily energy consumption	Measurement	SensorThings API
Yearly energy consumption	Measurement	SensorThings API

Table 4 - description of data integrated in the urban platform

4.1.5 Monitoring

The Energy Datalab is an ICT action which aims at providing Nantes Metropole with rich data on public buildings and public lighting equipment electrical consumption. Notably, load curves for 300 smart meters are shared through the Energy Datalab platform, and all of the main datasets from the Energy Datalab have been integrated into Nantes' Urban Data Platform extension as it was described above.

As the platform is running, different KPIs are followed to monitor this platform. As part of mySMARTLife project, and because the Energy Datalab action looks at both providing Nantes Metropole and third-part stakeholders with - notably – load curves to experiment with new use cases, several KPIs have been pre-

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selected for the monitoring phase of the project. The monitoring phase is an important part of the project. It provides the necessary raw material for carrying a precise evaluation of this project, keeping track of performance, further helping to understand the impacts one intervention can bring. As part of mySMARTLife, a whole work package is dedicated to it (WP5).

As for this deliverable and at times of writing, the table below lists the KPIs which have been selected for the monitoring of the Energy Datalab platform. The KPIs listed below are part of a larger list of KPIs for ICT monitoring, which was shared and established collectively with all three lightouses cities. The table details how the monitoring has been thought to be proceeded, as this work is part of the WP5 T5.3 and for which an interim version of the deliverable (D5.3) is due by M36, the final one being for M48. It is likely, therefore, that they could be updated with a few changes.

Objective of evaluation	Indicator	Description	Formula
Performance of the Energy Datalab platform in terms of data integration	Data privacy	This indicator represents the level of compliance of the urban platform with the GDPR in a likert scale as indicated in the next column.	Likert scale: Not at all – 1 — 2 — 3 — 4 – Very high 1. Doesn't follow any regulations/laws on protection of personal data 2. Follows minimum requirements on protection of personal data according to GDPR 3. Follows full requirements on protection of personal data according to GDPR 4. Follows local/national regulation that are more restrictive that GDPR
	Number of data publishers	Number of data publishers that publish data into the Energy Datalab Platform	# of publishers
	Number of sensors integrated	Number of electrical smart meters that are publishing data into the Energy Datalab platform	# of electrical smart meters
Performance of the Energy Datalab platform in terms of new capacities / innovation gained	Number of services deployed	Number of services that have been developed from the Energy Datalab	# of services developed
	Number of accesses to the Energy Datalab platform	Amount of new accesses generated due to the new services developed in the project.	# of API calls
	Storage capacity	Under the new concepts of big-data, the amount of generated data (size) is an indicator about the digitalization of the city, then the capacity of the system is analysed in terms of data volume.	total volume of data
	Availability	As typical performance indicator, the availability is very important and it is measured as percentage of time withouth failures within an established temporal scale	# of hours working / # of total hours

Table 5 - Energy Datalab monitoring KPIs

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4.1.6 Technology Readiness Level of the Energy Datalab platform

The Energy Datalab platform has been evaluated at a TRL 8 as it is a completed and qualified system[7]. It has been proved in the project that the solution runs properly in its final version.

4.2 Gaining innovative third-party commitment

In order for innovative partners to create new services, it is necessary to build relations between players in a trustfull environment. Atlanpole have a strong experience in supporting such kind of conditions. This section describes how to proceed to identify and target the good players and how to give them a business-friendly environment.

4.2.1 Target description

The ecosystem of local innovation in Nantes is organized around public and private structures. Public Incubator and technopole represented by Atlanpole, private accelerators, coworking space, competitiveness clusters work together to offer a support package adapted to the needs of innovative companies: coaching, hosting, networking of skills, technological expertise.

The role of the competitiveness clusters is to support innovative companies and research laboratories to set up and develop collaborative innovation projects. It involves sharing human and financial resources to develop new products and services. Clusters give access to financial resources to develop these projects. In our territory, the Images & Réseaux cluster is the reference center for digital technology. Energy is identified as a structuring axis for the development of innovation.

Nantes is certified French Tech ecosystem at the national level. It is a mark of recognition at the level of the dynamism of the territory for the development of innovative companies. The ecosystem has been structured to develop a support offer for companies from creation to growth in the digital, health, industry, environment and energy sectors. The service offered to companies consists of coaching, mentoring in strategy, financing, intellectual property, business and experimental territory.

Competitiveness clusters and French Tech ecosystems have been identified as the main sources to detect potential partners. The Energy Datalab action makes it possible for innovative partners to be among the first to experiment their solution with actual data. So, to get their attention we offer to them a unique terrain of experimentation.

Energy and environment extend across many sectors. Some of them are particularly dynamic in the Nantes Metropole area. We identified for each of them potential use case families :

- **Building** : energy consumption optimization, retrofiting, maintenance

[7] https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf

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- **Electric vehicle** : energy management, smart charging, charging station
- **Smart Home** : energy demand management, changing behaviours, individual electricity production
- **Smart City** : smart monitoring of public equiment, energy policies.

4.2.2 Approach strategy

To detect potential innovative service providers able to plug to the Energy Datalab, Atlanpole set a strategy based on the complementarity between communcation, ideation and accompanying framework :

- On the communication side, Atlanpole organized plenary sessions, and ran demonstration stands to increase player's awareness about the potential of data and the Energy Transition economy :

Date	Description of the event
07/04/2017	Booth at the Smile2Business event 250 companies, backers and promoters
08/06/2017	Organization of a conference at Web2Day event called "Business opportunities on the energy internet : the SMILE project" with a presentation of the project
12/07/2017	Presentation at the Opendatasoft's webinar
14/09/2017	Participation to a panel at Nantes Digital Week event « Open Data and Housings »
19/09/2017	Booth in the SMILE conference event "Data : what business opportunities?"
29/09/2017	Presentation in internal event Enedis' "Rencontre du Territoire Loire-Atlantique" with managers
10/11/2017	Presentation in internal event at Enedis' "TOP 300 Pays de la Loire" with 300 managers
15/05/2018	Plenary presentation at « ODS Talks - Without sharing of data, no energy transition »
17/05/2018	Pitch about the Datalab, part of the Nantes CityLab program, in front of economic and institutional leaders for the birthaday celebration of the CityLab. Event also open to public
13/06/2018	Presentation of the Public Lighting use case of the Nantes Datalab at the Web2Day
07to09/06/2019	Booth at Web2Day event, 3 days digital exhibition in Nantes
19/09/2019	Presentation of Nantes Metropole Use Cases in the project during the Data Day event organized by Enedis
11/10/2019	Participation to a television event within the Innovation Week in the City of La Roche-sur-Yon (France) mentionning the project

Table 6 - List of communication's event

This communication activity and workshops permitted to identify companies with whom further exchanges have been organised leading in certain case to new use cases. We can list :

- SETUR, energy engeneering office
- EDGEMIND, data science startup

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- AKAJOULE, energy engeneering office
- SUNSHARE, solar energy platform
- DATA PLAYER, data platform provider
- EMBLOCK, blockchain startup
- RHUMB CONSULTING, consultancy studies
- KUZCO, energy demand management startup
- NAM. R, data science startup
- ENERGIENCY, energy savings startups for industries

Focus on the profil of an innovative service provider : Edgemind

Edgemind, that was created in 2014, is located in Nantes and develops predictive maintenance solutions, mobility simulation, industrial systems simulation and business data recovery. It is in this context that the company EdgeMind wanted to work with data from Energy Datalab to explore the valuation of business data energy consumption buildings of the city of Nantes. Here are some examples of data valuation:

• operation detection ;

• Anticipation of system operation (predictive maintenance) ;

• Strategic and operational steering assistance.

This work enabled Edgemind to deepen its knowledge of the machine learning algorithm in the context of building electrical energy consumption to develop its energy offer.

Edgemind has developed a data clustering application to visualize operating anomalies. This application is used in the test phase by Nantes Métropole. (see paragraph 4.4.6 debajo de to learn more about this use-case)

On the ideation side, we organized workshops to meet up with service providers and the needs of potential customers :

Date	Description of the event
19/09/2017	organization of a workshop at the « Salon de la Data » event called "Datalab Energie workshop : how it works ?"
26/04/2018	Hackathon organised with Nantes Metropole and Atlansun[8], to design new Use Cases toward the development of Photovoltaïc production

[8] Solar energy cluster

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07/12/2018	Energy Datalab workshop at Atlanpole dedicated to explore the needs identified by Nantes Metropole concerning electric consumption optimisation for public buildings, to which technical solutions have not been found yet
12/06/2018	Participation to a workshop organised by the urban planning authority (SAMOA) to work with interdisciplinary experts on the subject of sensory energy data for public awareness

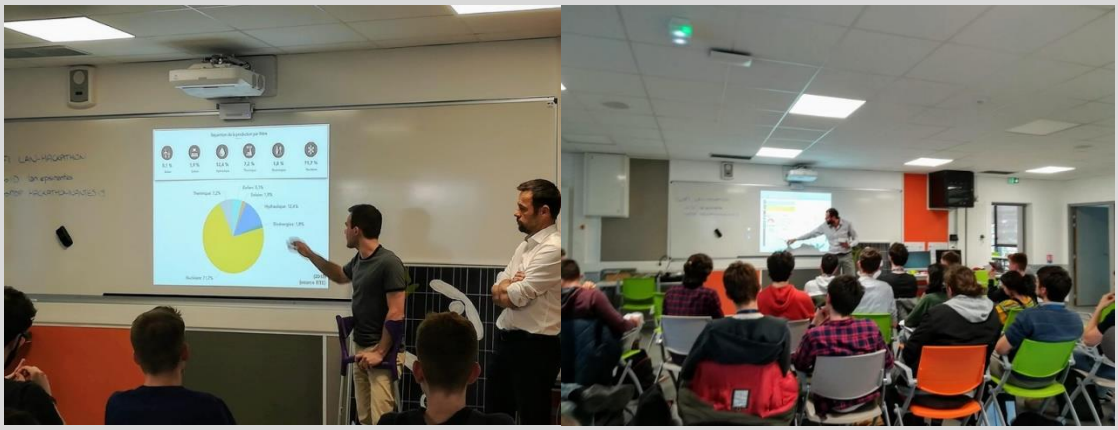
Table 7 - List of Ideation events

Figure 9 – Energy Datalab workshop on December 7, 2018 in Atlanpole

Focus on: the participation into the French first Hackathon on solar energy (26-28th April 2019 in Nantes)

Together with Atlansun, the French wide-west cluster of solar energy companies, EPSI (IT engineering school on the Isle of Nantes); Enedis, Atlansun, and Nantes Metropole actively contributed to the first French solar hackathon. The hackathon aimed to mix students from the digital field with experts from the solar energy. In the context of energy transition, communication and raising awareness is one of the main challenges, and this is why such events are important in order to find and/or improve innovative solutions towards a global energy systemic transition.

The energy data lab partners collaborated once again to propose one of the 5 challenges of the weekend: “How to use electricity when it is green?!”



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

On raising awareness, our team of students invented a communication-based strategy, focusing on the non-aware audience, which is often excluded from the “usual” communication channels; taking advantage of communication levels which are often used by the advertising economy to target them.
They eventually picked up the “coup de coeur” prize of the mentors.

- On the accompanying framework side, Atlanpole, Nantes Metropole and Enedis sponsored a call for proposal that allowed beneficiaries to access to a national financing arrangement dedicated to innovation called CADO[9]

To offer support to innovative service providers, we worked in close collaboration with the Images & Réseaux competitiveness cluster, which piloted the CADO call for projects to financially support the experimentation of innovative projects in the field of smart cities. We therefore take advantage of this opportunity to promote the Energy Datalab in the CADO call for projects. Thanks to this call for projects, we identified a stakeholder to conduct an experiment in the field of public lighting: the Interactive Data Light project (see paragraph 4.4.1 debajo de for more details about this use-case).

4.2.3 Provide support to experimentations

Atlanpole is the reference incubator for supporting innovative companies in the Nantes Métropole area. Atlanpole gives a support offer over 5 years for the creation and growth of companies. The coaching takes the form of individual and collective coaching on the following topics: business strategy, financing, intellectual property, international development.

In the Energy Datalab project, Atlanpole accompanied services providers specifically to help them accessing to national funding scheme and to meet public decision makers. Atlanpole also help Nantes Metropole and innovative partners in defining agreements to frame their relationship in particular about the definition of the service provided, conditions in wich data from the City are shared, financial aspects and intellectual property.

4.3 Designing use cases

4.3.1 Use case exploration methodology

In coordination with the Urban Platform data use case research, a five-step methodology was experimented to design new use cases.

[9] Challenge pour l’Accéleration du Digital dans l’Ouest, operated by Pôle Images et Réseaux, a competitiveness cluster dedicated to digital innovation.

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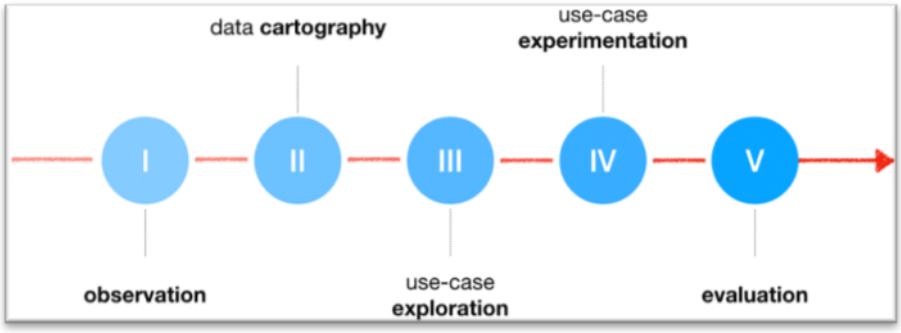

Figure 10 - use case exploration methodology

Observation: a step to bring mutual understanding through the sharing of the different stakes, projects, cultures.

Data cartography: data are often scattered in services and silos, a comprehensive data cartography allowed us to share the same vision of the raw material we could work with.

Exploration: the idea here was to think how could data make the use cases we have imagined possible, where can data contribute to our ideas and public policies, assessing to what extent one use case is feasible.

Experimentation: this step aims at producing a minimal viable product (MVP) in order to assess each use case opportunity value, iterating over the use case itself sometimes, and keeping track of the progress to make sure original hypotheses could be evaluated properly afterwards.

Evaluation: the evaluation phase, finally, thanks to some follow-up of indicators and criterion of success, can be conducted thouroughly and collaboratively to decide, for instance, whether or not such prototype should be replicated widely.

4.3.2 ESPRESSO framework to define use cases in a standardised way

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 within ESPRESSO[10]: 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

[10] ESPRESSO project ("systEmic Standardisation apPRoach to Empower Smart citieS and cOmmunities") is a 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.

identifying gaps and weaknesses in the framework of available standards. 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

4.4 Energy Datalab services

Starting with the methodology described above, Nantes Metropole used the data made accessible by the Energy Datalab platform to design use cases both internally, looking at how data can contribute to energy public policies planning, and externally, working with Enedis and Atlanpole to animate the energy & digital regional ecosystems.

Three years later, a handful of use cases were set up.

4.4.1 UC#01: Interactive Data Light

Born from the 2016 CADO 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.

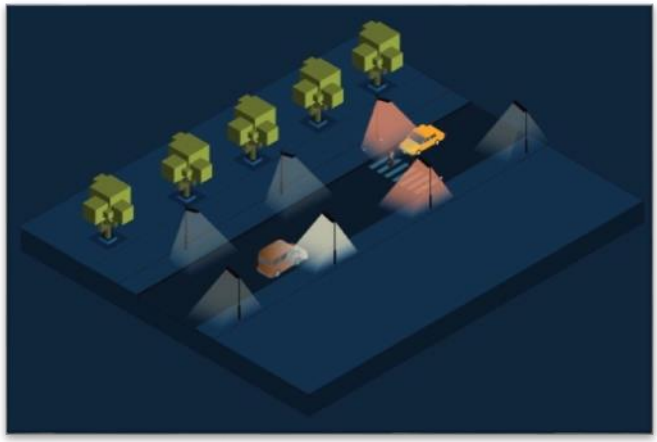

Figure 11 - InteractiveDataLight illustration

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

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.

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

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 12 - InteractiveDataLight public lighting mat

4.4.2 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. Often, 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 the SMILE ecosystem of services and is currently experimented in other territories (eg. Brittany). This use case is described in the appendices in ESPRESSO UC#02 sheet.

4.4.3 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.

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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 a 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).

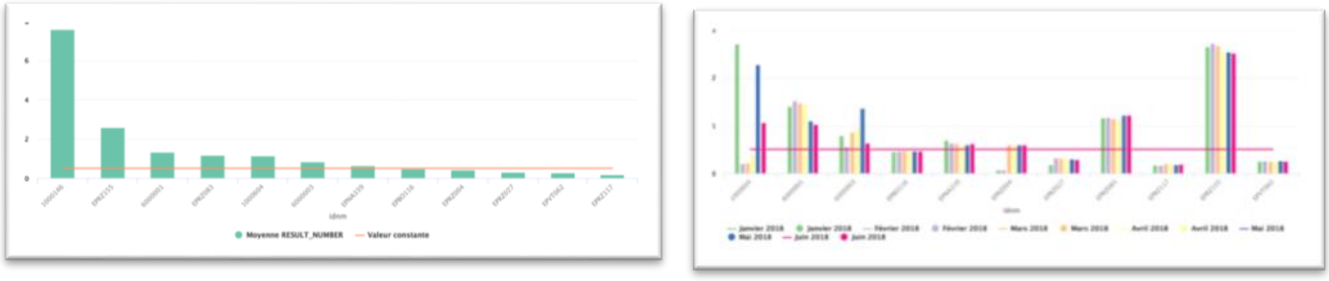

Figure 13 - public buildings (left) and public lighting (right) least optimised electrical contracts

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 in the appendices.

4.4.4 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.

4.4.5 UC#05: Detection of irregularities in electrical consumption baseline phenomena

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 it is, or insulated, and therefore can contribute to the global public buildings energy 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 the highest energy savings opportunities;

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based on the consumption baselines which can be retrieved from the electrical load curves provided by the Energy Datalab.

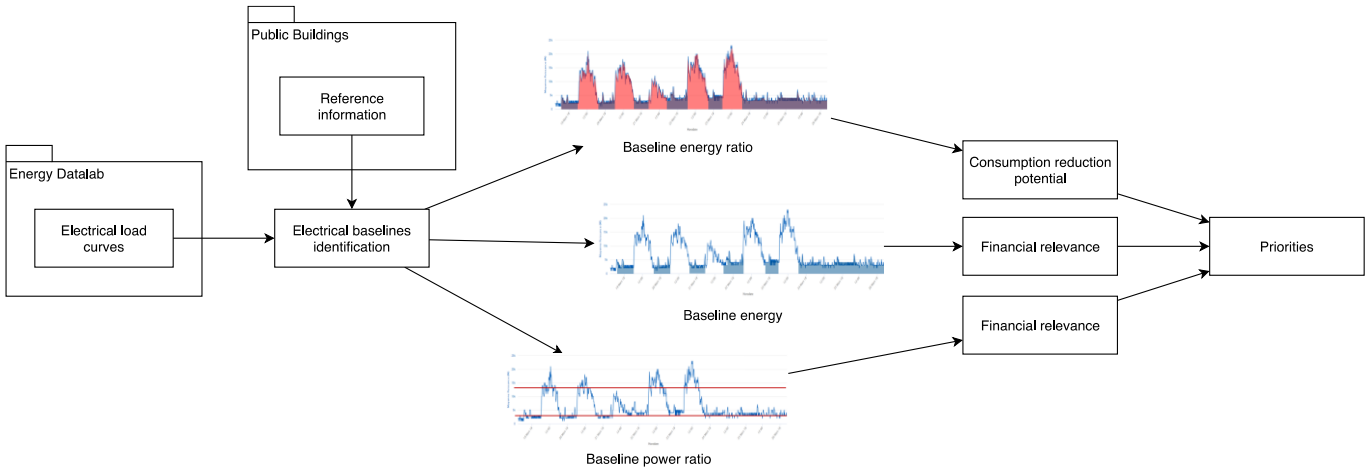

Figure 14 - UC#05, consumption baseline analysis process

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.

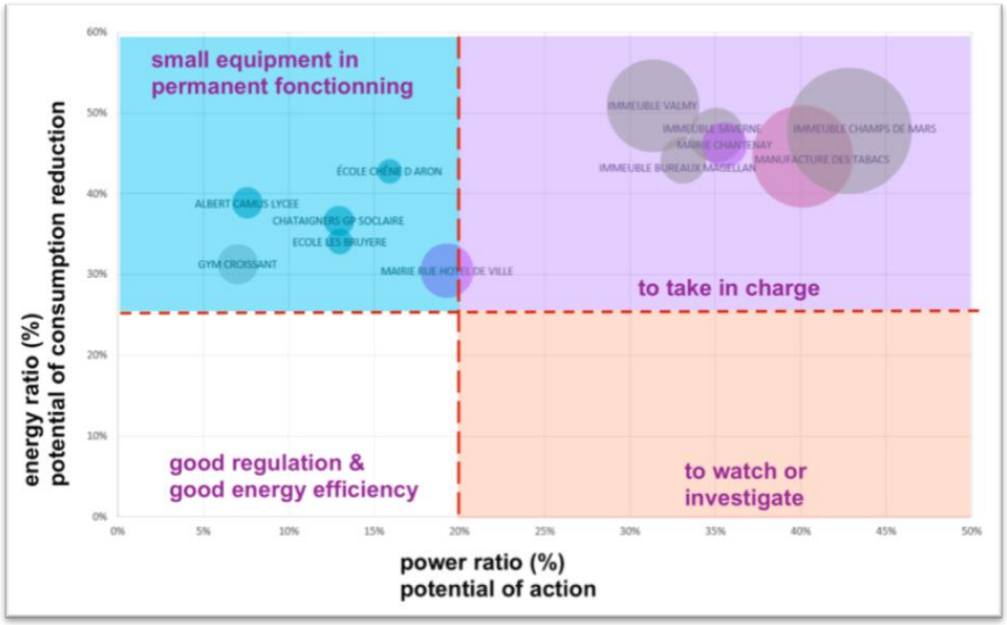

Figure 15 - UC#05 visualisation view, public buildings electrical energy optimisation radar

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4.4.6 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.

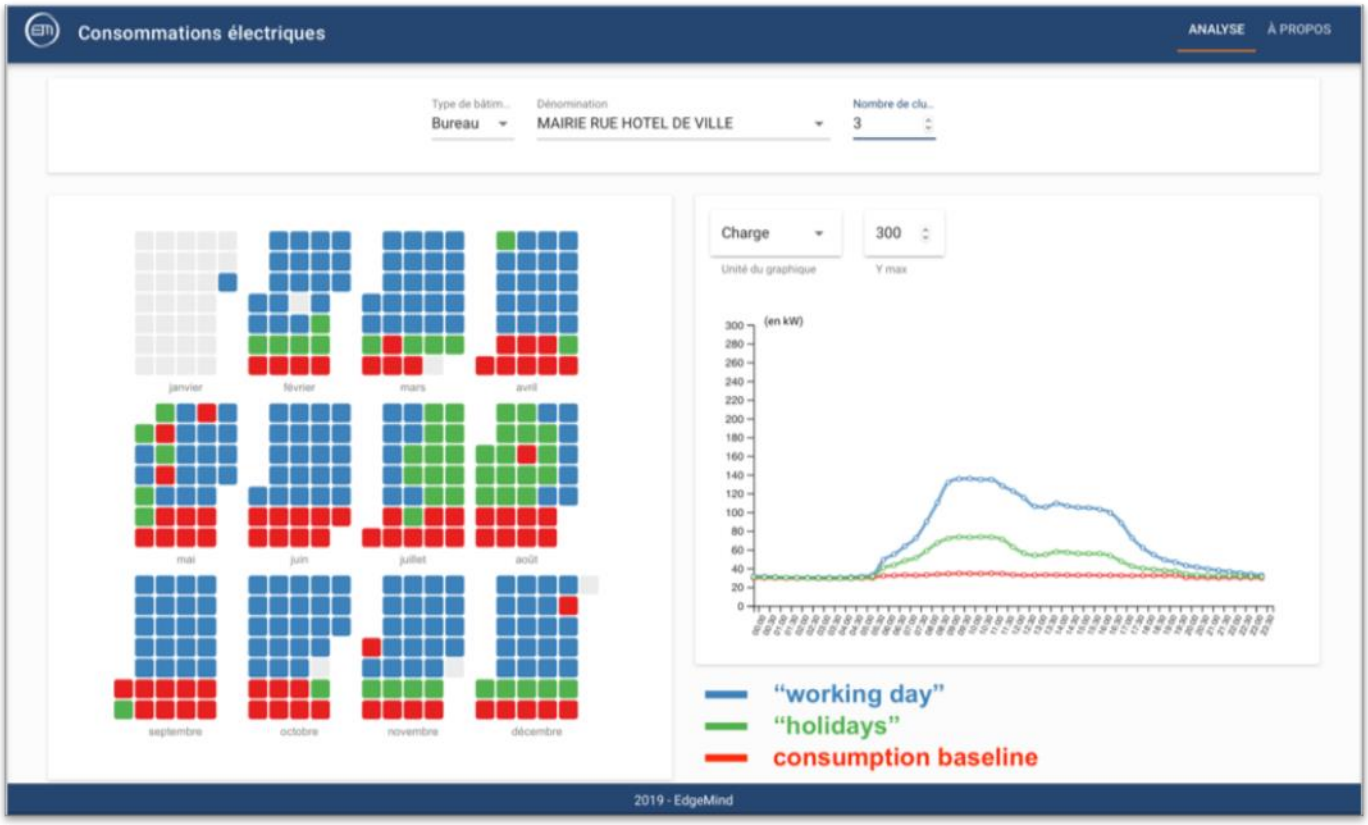

Figure 16 - building's three typical daily electrical behaviours

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.

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5. Contribution of electric data to local energy planning

In this section we develop how electric data can help in the decision process of local energy planning by first detailing Nantes Metropole energy planning policy and Nantes Metropole Master Plan and then presenting the different use cases elaborated thanks to local energy data.

5.1 Nantes Metropole energy planning

Nantes Metropole has launched several procedures to accelerate the energy transition on its territory and to provide it with a framework and set quantified objectives.

The “PCAET”, a Territorial Air Energy Climate Plan (“Plan Climat Air Energie Territorial” in French) is a territorial sustainable development project that aims to fight climate change. It is built around two main axes: climate change **mitigation** and **adaptation**. The three main objectives are the following: halve the level of greenhouse gas emissions of the area for 2030 compared to the 2003 level; triple the renewable energy production between 2008 and 2020; reduce the territory's vulnerability to future climate change. To reach these objectives, Nantes Metropole has followed 5 orientations:

- Reducing the greenhouse gas emissions on the territory
- Adapting to climate change
- Acting in co-responsibility with local stakeholders and networks
- Understanding and innovating to anticipate future actions
- Monitor, measure and evaluate the Climate Plan.

Nantes Metropole roadmap for energy transition constitutes the mitigation part of the PCAET. This roadmap was created following the **Great Debate for energy transition,** that took place in 2016. Over 50 000 citizens and stakeholders of the area participated to help to build the objectives of Nantes Metropole regarding the energy transition. An independent and citizen-based Commission was created to ensure the transparency of the debate and its proper progress. Several modes of participation were possible: different workshops, stakeholder seminars, the share of feedbacks, a website where anyone could contribute, and a call for applications organised in 6 communities to experiment and find new solutions. The diversity of subjects covered by the Great Debate is quite wide: development of renewables, energy retrofitting, mobility, energy savings, teleworking and coworking places, nature and vegetation in the city, reducing waste, developing sustainable and local agriculture, etc.

After this 200-day debate the Commission provided a summary of the exchanges and contributions of this Great Debate. The Commission proposed a list of 12 themes including 60 actions. Nantes Metropole teams worked based on these proposals to draw up a framework document: a **roadmap for energy transition**.

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This roadmap for energy transition gathers 33 commitments on the topics mentioned above. To name a few:

- The first commitment aims at investing 100 million euros by 2030 for the energy retrofitting of buildings including increasing the investment for the retrofitting of public buildings, an investment programming over several years, implementation of financial aids for owners and communication and information campaigns.
- Reduce the electrical consumption of public lighting by one third in 2020 compared to 2016
- Enhance 100% of the available roof in Nantes Métropole by installing solar power plants or green roofs.

At a largest scale, a regional air climate and energy plan also exists: it sets regional orientations and objectives to reduce greenhouse gas emissions, manage energy, develop renewable energies, adapt to climate change and prevent and reduce air pollution.

These quantified targets cover a wide variety of topics. The issue lies now in deploying a set of actions to achieve them. But what type of scenario to choose? Which one would be the best for each subject? A structured energy planning of the territory is required to answer these questions and to reach the quantified targets.

5.2 Nantes Metropole Energy Master plan

5.2.1 The approach

The implementation of an Energy Master Plan came from the need to link the energy policy of the Metropole and the various objectives of the documents mentioned above to the energy choices and required scenarios to achieve these targets. It is intended to manage and plan energy consumption and production as well as to ensure the proper management and development of energy networks (gas, electricity, heat). This is a cross-disciplinary project that deals with various subjects related to the energy theme: renewables, power and gas grids, district heating, urban planning, mobility. To define this Energy Master Plan, the idea is to process energy data to identify opportunities and steer local public action. Nantes Métropole commissioned the Urban Planning Agency of the Nantes Region to carry out this study, which first aim was to determine how to reach the Climate Plan objectives. In 2018, an important work of data collection and experimentation on the latter and their cross-referencing was carried out on all the themes covered by the Energy Master Plan. Then a work has been conducted with each Nantes Metropole department concerned to set objectives in line with their work and to ensure that they adopt the undertaken work. The Energy Master Plan is structured in two main parts:

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- **The diagnostic**

The diagnostic consists of describing the energy state of play of the territory, on all the subjects related to energy: mobility, renewables, grid, … To do so data were made available by Nantes Métropole and the grid operators like Enedis for electrical data. Thus, every subject studied is mapped to visualize directly the link with the territory.

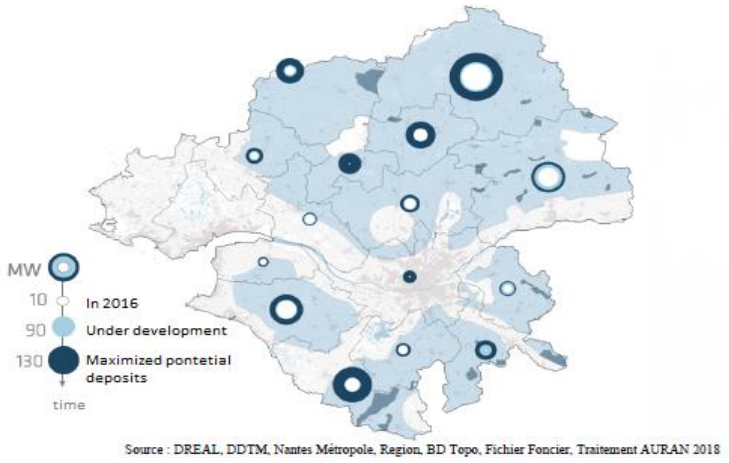

Figure 17 - Extract from the diagnostic – Estimation of sites by intermunicipality for wind energy production

A state of play is carried out on the energy needs of the metropolis, as well as on the renewable energy production. On the figure ***18***, the total energy needs on Nantes Metropole area are estimated at 12948 GWh.

The same work is done on the renewable energy production. The results show that 98% of the renewable production is from renewable heat, and the remaining 2% are renewable electrical production. It can be explained by the important development of the district heating networks.

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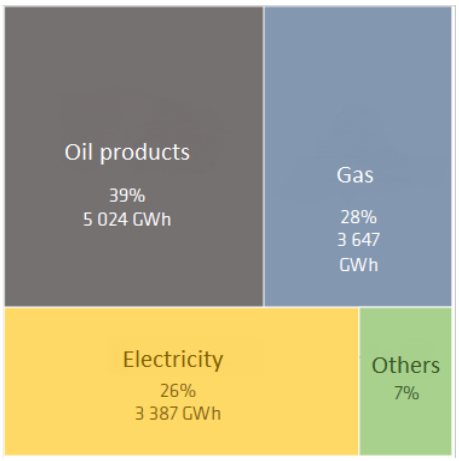

Figure 18 - Distribution of the energy needs on Nantes Metropole area
Source: AURAN

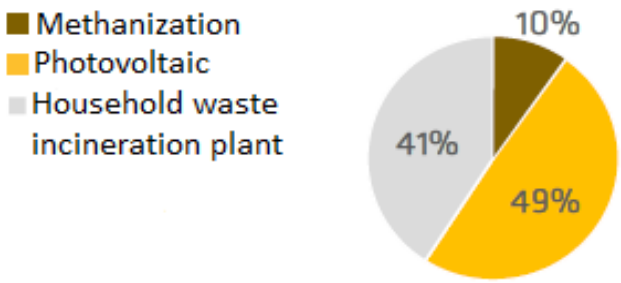

Figure 19 - Distribution of the renewable electric production on Nantes Metropole area
Source: Auran

Thanks to the diagnostic, the energy challenges of Nantes Metropole area have been identified in light of the needs and the available resources. These challenges have been classified into three main categories in which 10 operational challenges have been highlighted.

I. The identified potentials for renewable energy production and local recovery	II. The levers of energy efficiency, energy savings, and energy demand management	III. Energy networks supporting the energy transition at local level
A. The massive development of renewable electricity production B. Strengthen the spread of renewable heat C. Launching innovative territorial synergies D. Supporting the development of emerging technologies	E. Improving the energy efficiency of buildings F. Make urban development a major element of the energy transition G. Support new uses and new motorisations	H. Implement local governance of the energy public service I. Secure the energy supply at local scale by including renewable productions J. Coordinate network and territorial planning

Table 8 - Classification of energy challenges

For each operational challenge, the different levels of action have been listed. For instance, renewable electricity production, we have 4 levels of action: major roofs – large roofs – medium roofs – parking sites. For each lever of actions, quantified development potentials have been defined. To continue with the same example, for medium roofs, 1910 sites with a potential installed power between 100 and 500 kWp have been identified, and for large roofs, there are 161 identified sites with a potential installed power between

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500 kWp and 1 MWc. This work being done, the priority issues have been defined so that the second phase of the Energy Master Plan may start.

- **The scenarios and the definition of orientations**

Having defined the main energy issues and possible actions on the area of Nantes Metropole, some scenarios and orientations may be developed. Their objectives are the following:

- Meet the area's future energy needs
- Anticipate trends in energy consumption
- Plan the energy supply of the area
- Reduce the environmental impact of its use
- Develop renewables in the area.

Three baseline scenarios have been defined: business as usual scenario ("Fil de l'eau"), median scenario, maximized scenario, as shown in the figure 22 below. The three upper curves represent the evolution of the energy consumption over the year for each scenario, and the three lower curves are the evolution of renewable production.

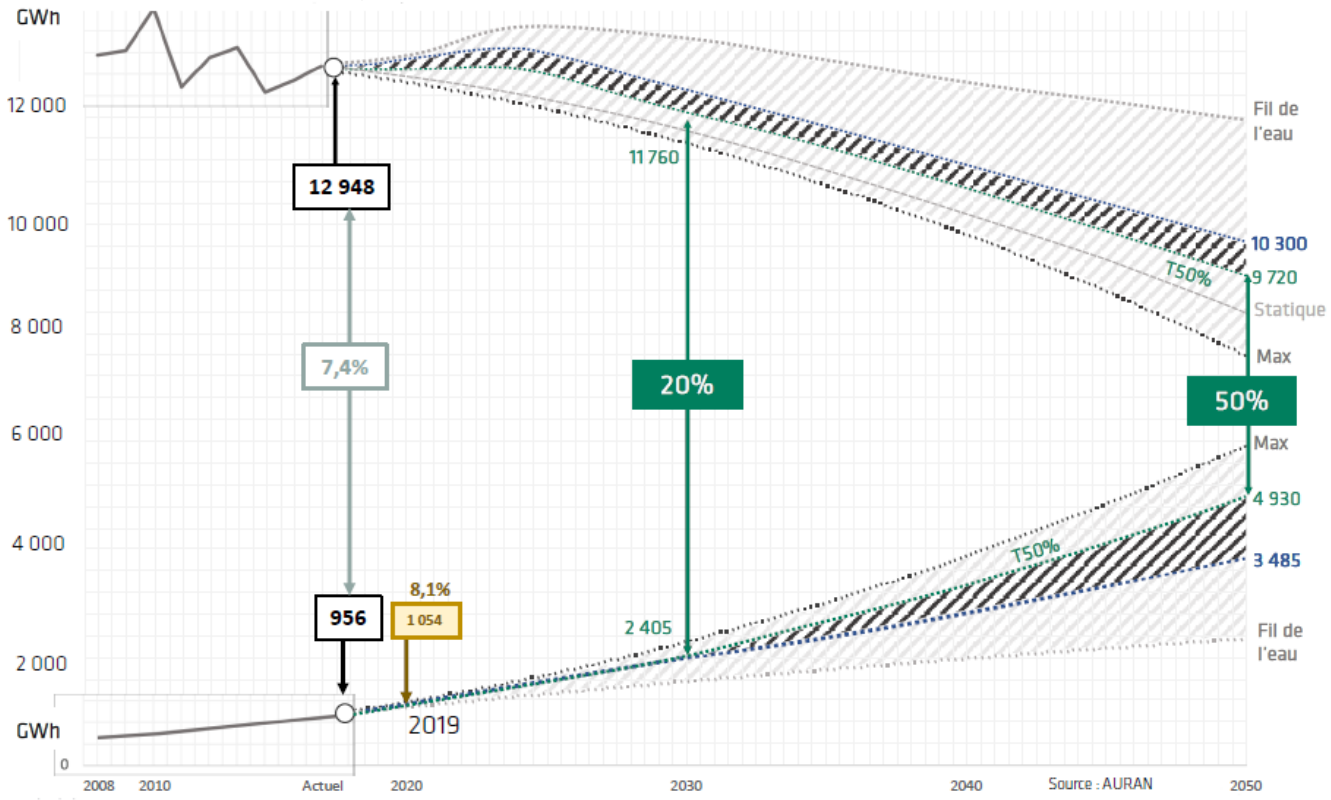

Figure 20 - Spectrum of the "energy possibilities" on the area of Nantes Metropole
Source: Auran

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On the basis of these three scenarios and by modulating the latter, two plausible scenarios have been developed in conjunction with different departments of Nantes Metropole. The first one named “Boost Plan” scenario, reflects voluntary energy choices but without major disruptions. The second one is called “Horizon 2050” and focuses on the target of 50% of renewable and local energy by 2050. These two scenarios aim at implementing appropriate action plans with regard to the objectives set.

For each operationnal challenge, strategic orientations are defined and an operating procedure is described. The latter focuses on three main parts: actions related to a direct intervention of the metropolis, actions linked to the support for local stakeholders and actions dealing with regulations on the area.

The Urban Planning Agency of the Nantes Region will provide for each topics the data required for the implementation of actions. For instance, regarding the solar power, they will provide the biggest roofs of Nantes Metropole that have been targeted for implementing a solar power plant.

The point is to get energy transition scenarios forming a strategic energy vision at different time frames (2030, 2050). To do so territorialized guidelines intended to constitute a shared reference base will be implemented.

5.2.2 Connection with Tecnalia work

Within mySMARTLife project, Spain's leading centre for applied research and technological development Tecnalia is leading two subtasks focused on an energy assessment of the area selected by Nantes Metropole, the Island of Nantes, and more widely on the energy scenario development at the city scale. These are subtasks 1.4.1 and 1.4.2.

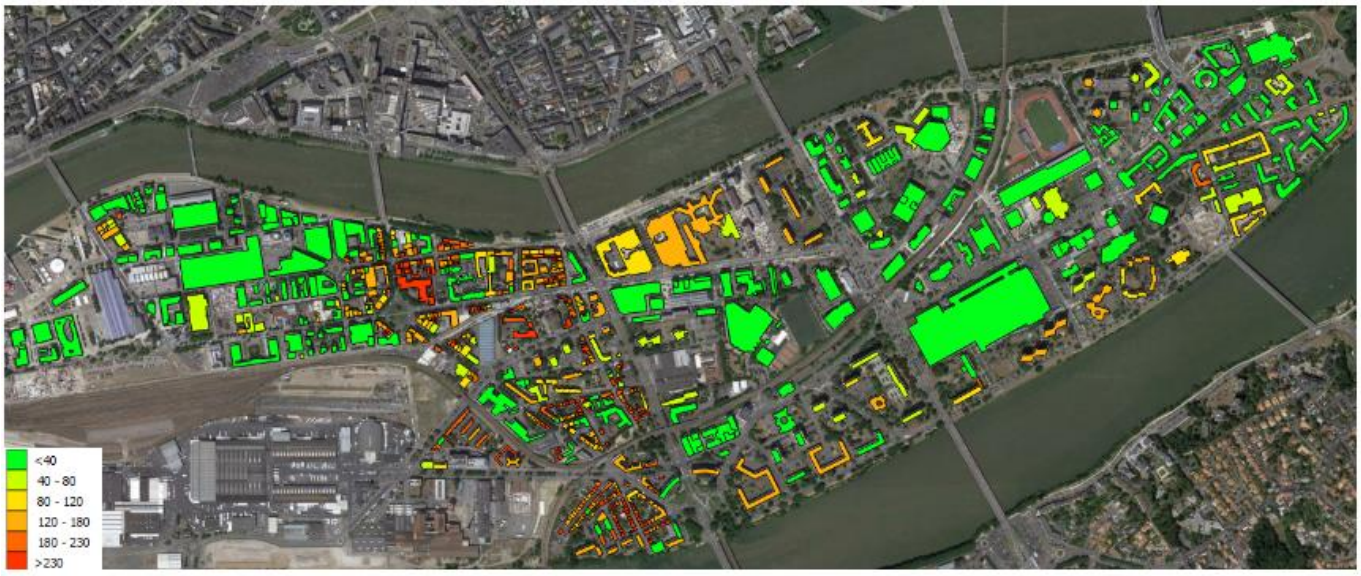

Figure 21 - Heat demand (kWh/m²) on the Isle of Nantes
Source: Deliverable D1.12 Description of 3D models for each pilot, Tecnalia

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First Tecnalia has set up a 3D model at city scale, established in a way that the energy demand analysis can then be carried out. The buildings are modeled and mapped, including all the information needed for this analysis.

The energy demand analysis is intended to assess the energy demand of the building stock. To do so, the characteristics specific to each building is taken into account. The results of the analysis give the hourly energy demands and the electrical consumption for each building. A mapped representation is provided to give a quick understanding of the analysis.

After having carried out this first analysis, a simulation of the energy demand for the next 10-20 years, at the city scale is provided. The latter does not only concern the building need, but includes all kinds of energy demand such as industry and mobility. A base year is defined, using different tools such as a Leap.

Scenarios are then simulated to provide city planners with an assessment tool to conduct the local energy and urban planning policies. It comprises a Business as Usual scenario which will be the reference scenario, and two alternative scenarios. The first one, called "mySMARTLife interventions replication" is based on the actions undertaken within mySMARTLife project and their expected impact on the city. The second scenario, "mySMARTLife intervention scenario" evaluates the evolution of the city as in the case of the first scenario but includes the actions implemented within mySMARTLife project time frame. Finally the third one is called „mySMARTLife interventions replication scenario ", in which it is considered that the actions of mySMARTLife project will be replicated at larger scale in Nantes and the other cities of Nantes Métropole.

Thus, the goal of this work is quite similar to the Energy Master Plan. The collection of data from Nantes Metropole territory is required before starting the development of the work undertaken by Tecnalia. The latter collected data including the following:

- The energy consumptions of the various fuels (natural gas, coal, oil, biomass)
- The energy production on the territory and their type (photovoltaic, solar thermal, biomass)

The data were mainly collected from the database BASEMIS® performed by Air Pays de la Loire; Nantes Metropole Public Lighting Department also helped gather data.

This data collection process enabled Nantes Metropole to initiate the work related to the Energy Master Plan. Indeed, the same data were required for both Tecnalia work and Nantes Metropole Energy Master Plan.

5.3 Local energy data for territorial energy planning

With regards to the law for energy 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

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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 activities, which, within mySMARTLife, was done through the energy data lab initiative.

For this section, the detailed work is scoped with the perimeter of such local energy data, and with the purpose of contributing to the territorial energy planning activities, as part of the global energy transition public policies.

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 masked for every address if, cumulatively less than 11 measurement points are referenced there and if the overall annual energy consumption of this adresses is 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 energy transition public policy planning, and implementation.

5.3.1 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, much more is 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 real estate qualificative dataset 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.

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Many issues were raised, matching real estate 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 that will be presented are as much opportunities to leverage on the territorial 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.

5.3.2 UC#11: Energy-intensive buildings identification

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

1. Real estate data, which can provide estimates of energy consumption profiles per building and/or parcel (via data such as the construction year, area, use of the building...);
2. Local energy data, which provides annual consumption for each source of energy, taking into consideration GDPR concerns and, therefore, being available for only biggest buildings (e.g. 11 households or more living in). 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 recommandations.

This helps Nantes Metropole public policy planning providing insights on the territorial sectors to have most-likely energy-intensive buildings, therefore, helping to plan resources allocation more efficiently.

ESPRESSO description for this use-case can be found in the appendices: ESPRESSO UC#11.

5.3.3 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 energy efficiency point of view in the first place. This use case would mix inputs from the ongoing UC#10:

- Real estate 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.

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- 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 project (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 & real estate data can contribute to these public policies implementations.

ESPRESSO description for this use-case can be found in the appendices: ESPRESSO UC#12.

5.3.4 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 the necessary insights:

- With the territorial energy data, for each address can be highlighted the evolutions in terms of energy consumption
- Besides this, Nantes Metropole accompanies some of the 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. This use case is described in the specific ESPRESSO sheet: UC#13 in the appendices.

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

To implement the territorial planning, public policies are translated 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 a way in which regulations can be implemented onto the territory and throughout the concrete actions. On the topic of energy and energy 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 manipulation, comparing above energy consumption with local rules and energy targets (which are prescribed per geographical zone) would provide a first assessment of these compliances.

ESPRESSO UC#14 in the appendices describes this use case.

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

A key aspect of energy 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, encouraging the replacement of fuel oil heating systems in houses and buildings 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 or other low-emitting energy source systems. This can be done from the territorial real estate and energy datasets 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 energy poverty. To do this, energy poverty profiles can be estimated from the work done in use cases #11 and #12, as well as to cross this with some demographic information.

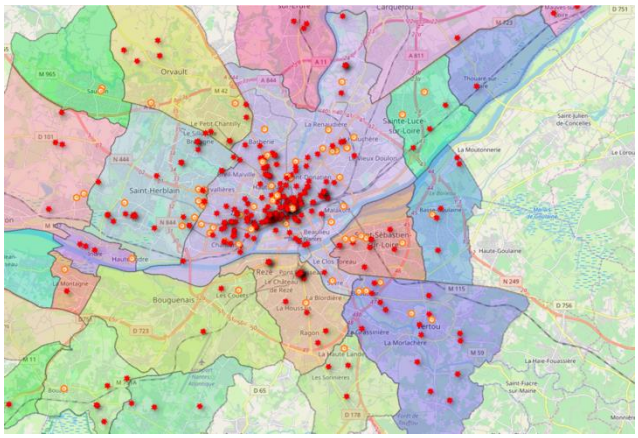

Figure 22 - premises estimated without any gaz nor electricity connection to the grid

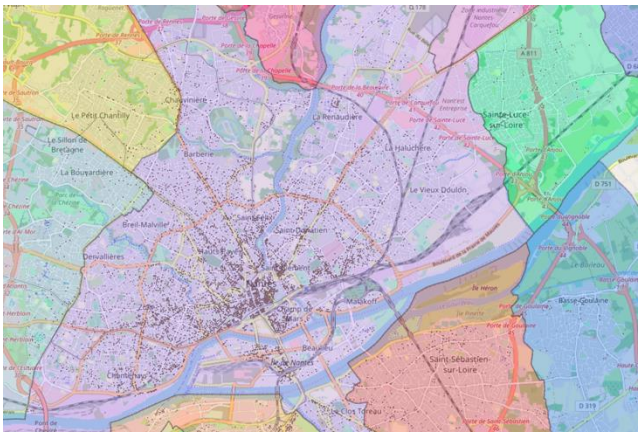

Figure 23 - territorial repartition of households presumed to be more sensitive to energy economical variations

This use case requires, therefore, a transversality on all energy sources and real estate 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:

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

Where there can be a consequent difference between the Gas/Electricity annual consumptions and consumption estimates, and that, thereafter, we can, from the real estate data, estimate of the presence or

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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. ESPRESSO UC#15 in the appendices describes this use case.

5.4 Exploitation of the solar cadastre: the data behind

The solar cadastre is a web platform developed by In Sun We Trust for Nantes Metropole[11]. 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 potential solar energy production of any rooftop on the Metropole area. After having selected a rooftop and answered a few questions regarding the characteristics 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.

Behind this website, the raw data provides very interesting information at the square meter scale such as: shadowing, azimuth, inclination, monthly producible, etc. This is very rich and could contribute to use cases beyond the website. Applying the data exploration methodology, data science works went further around the valorisation of solar cadastre raw data with 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 24 - extract of solar cadastre raw data

[11] Nantes Metropole solar cadastre online platform: nantes-metropole.insunwetrust.solar

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

5.4.1 UC#20: public buildings solar energy production diagnosis

Nantes Metropole ambitious energy transition public policy has set the goal of reaching a 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 use case is detailed in the appendices: ESPRESSO UC#20.

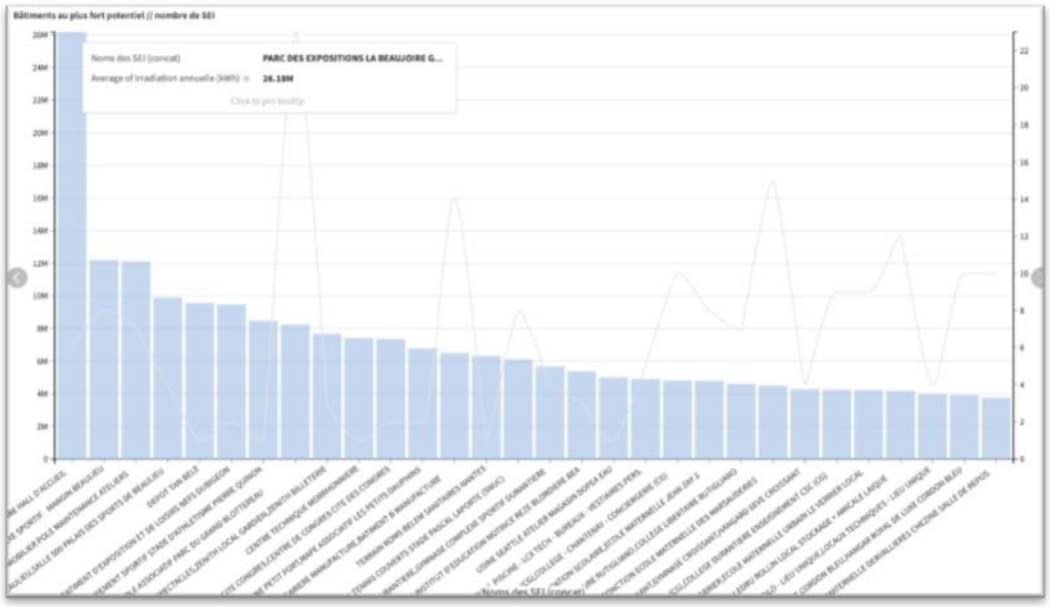


Figure 25 - public buildings diagnosis of solar individual self-consumption potential

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

Nantes Metropole energy 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 etc.

While the solar platform allows people to assess solar opportunities efficiently, working with solar cadastre raw data can provide insights on territorial energy 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 the appendices: ESPRESSO UC#21.

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

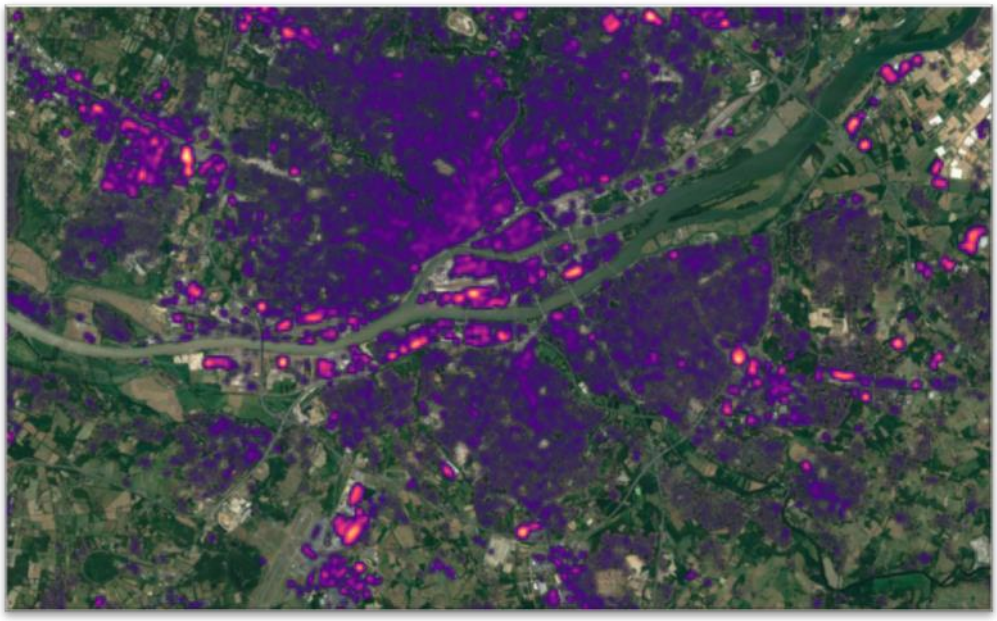


Figure 26 - territorial diagnosis of collective solar electrical self-consumption potential

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

6. Conclusions

Energy Transition is one of the main challenges for the City to tackle climate change and give answers to citizens' expectations. The Energy Datalab action aims at contributing to the Energy Transition by setting the conditions for innovative solutions to arise in order to decrease electric consumption, optimize energy efficiency, and foster renewable electric sources.

The action showed that from data produced by connected smart electric meters, through the ambition of finding new use cases, exploring the possibilities data open, leading collaborative experimentations, it was made possible to gather an ecosystem of innovative players which eventually led to the creation of new services, for themselves as well as their customers/citizens. A particular attention was given to the quality of interactions between the different players to facilitate the matching between specific needs and technical solutions. A trusting environment is essential for players to involve themselves into such initiative. To achieve this goal, Enedis built a data platform to provide electric data that maximize data quality, give full control to customers to decide the way they share their data, and provide efficient APIs to ease technical integration by service providers.

From data to build new use cases, or the other way around, finding ways to implement use cases with data, the Energy datalab initiative opened the doors for Nantes Metropole to explore data use cases in several fields of application: electrical load curves use cases, solar cadastre for PV development, local energy data for territorial energy planning.

Through the regulatory context in the field of energy moving towards more open data and partnerships, and with regards to the public policies and data contribution to their implementation, fourteen use cases were imagined, designed, and prototyped by Nantes Metropole and several innovative stakeholders. Use cases tackle a wide range of challenges from a very technical solution for public lightning efficiency to contributions to territorial energy policy. The most advanced use cases were even experimented, often in partnerships with local companies so as to leverage on the crossing of capabilities between, for instance, expertise in digital services and territorial energy policies. This first iteration provided interesting feedbacks which, eventually, allowed the Energy datalab partners to improve their use cases; each use case was finally described in a specific sheet using the ESPRESSO use case framework.

The Energy datalab initiative proved, through the different works conducted within the mySMARTLife European project, different ways the electrical data and, more globally, a collaborative approach around energy can contribute to the implementation of the Energy Transition public policy on the territory of Nantes Metropole. In this sense, the Energy Datalab contributed to the city's governance, provided the necessary material for establishing a network of innovative players which fostered the economical development and attractiveness of its territory, and clearly, contributed to the rise of a new way of thinking the energy data services.

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

7. Appendices

ESPRESSO 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.

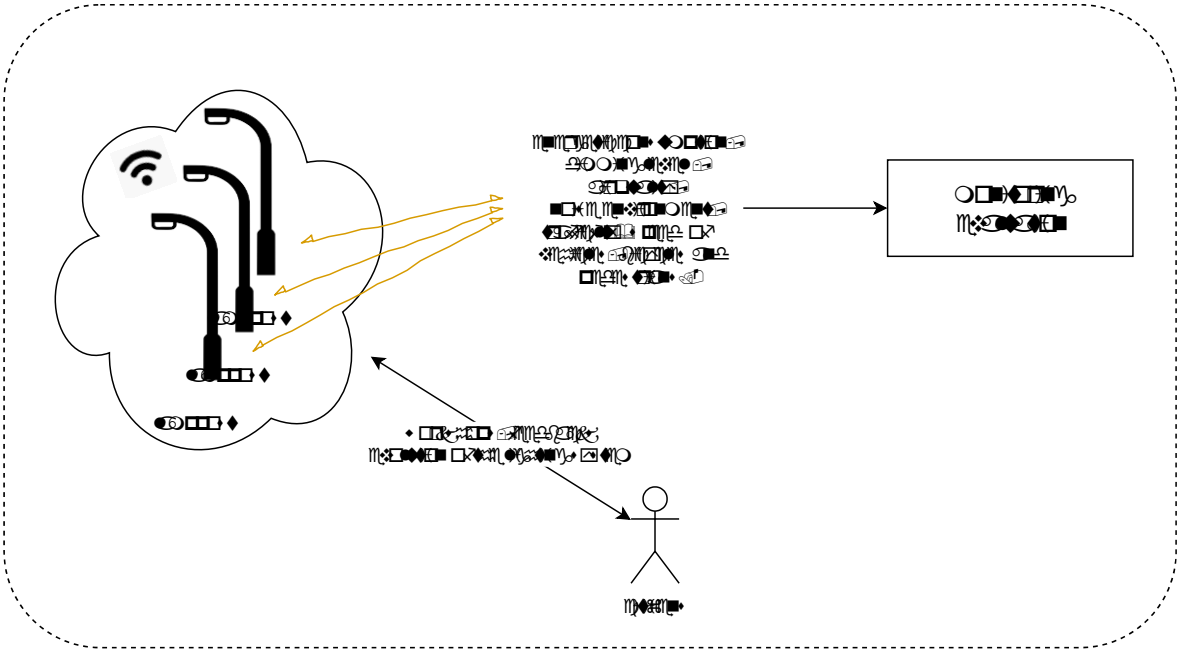
Data was collected on energetic consumption, dimming levels, air quality, noise environment, traffic flux and speed of vehicles, bicycles and pedestrians.

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.

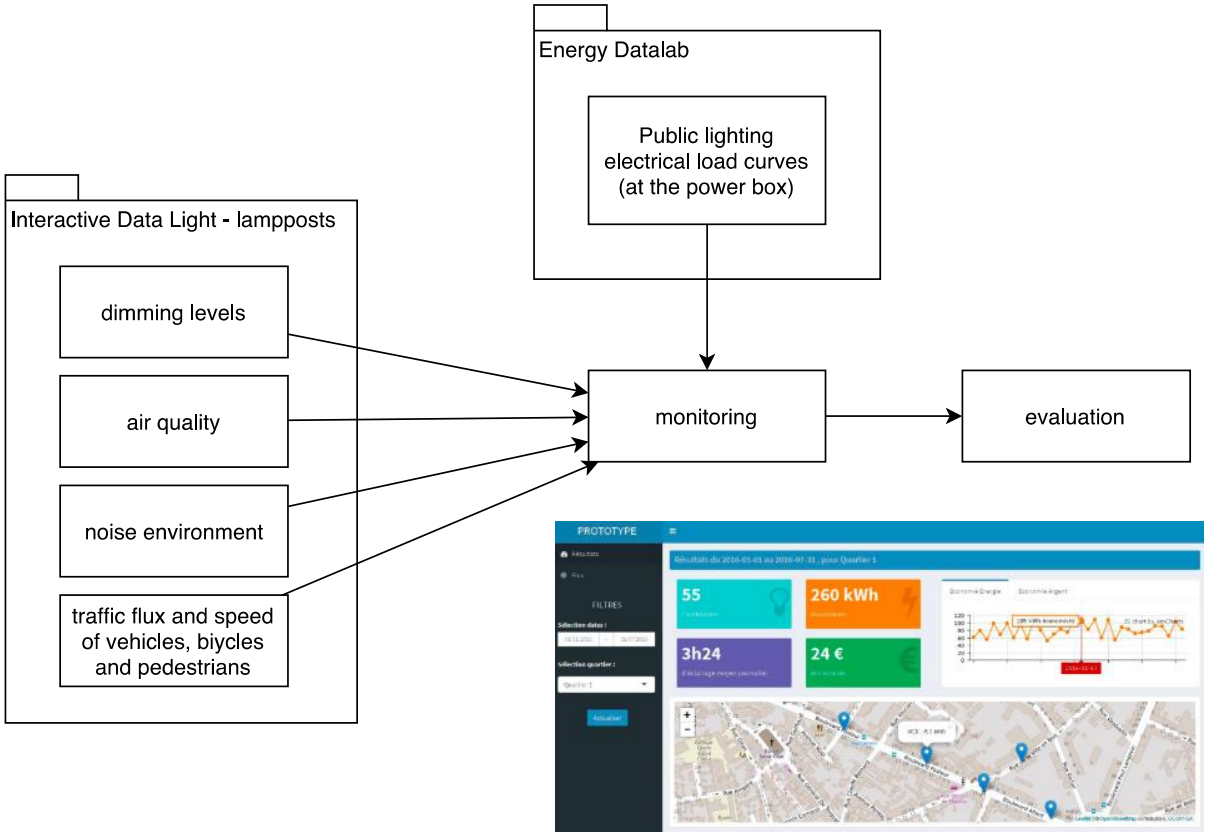
2.b. Storyboard

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

USE CASE 1: Interactive Data Light



2.c. UML diagrams



3. Scope and Objectives

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

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	
4. Actor List and Requirements	
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.

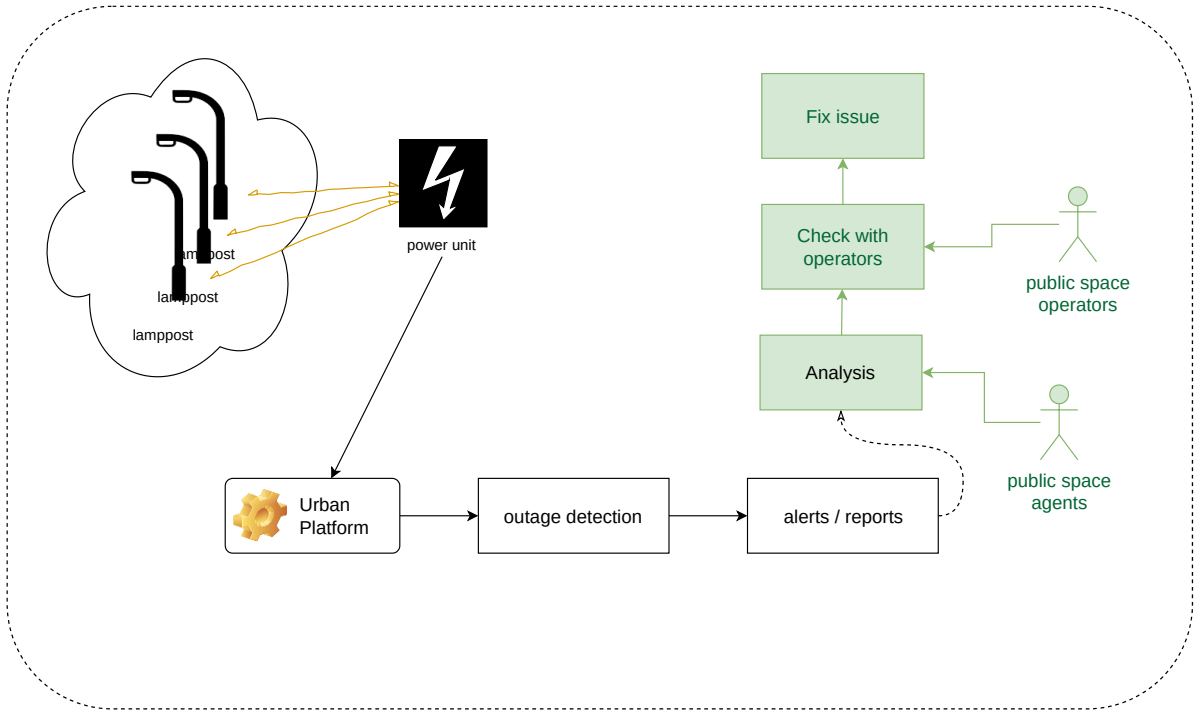
2.a. User Story description

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.

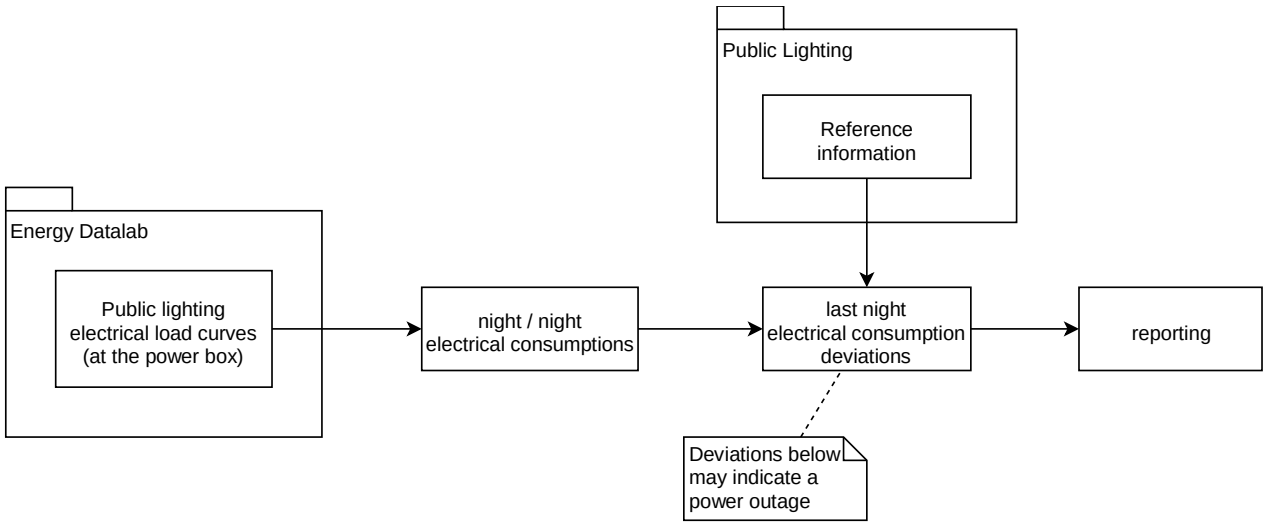
With this new approach based on the monitoring of public lighting power units’ load curves, every morning or so one algorithm can be performed to challenge the load curves and detect any possibilities for a power outage.
With a report of so when it occurs, one issue of this kind can be taken into account 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

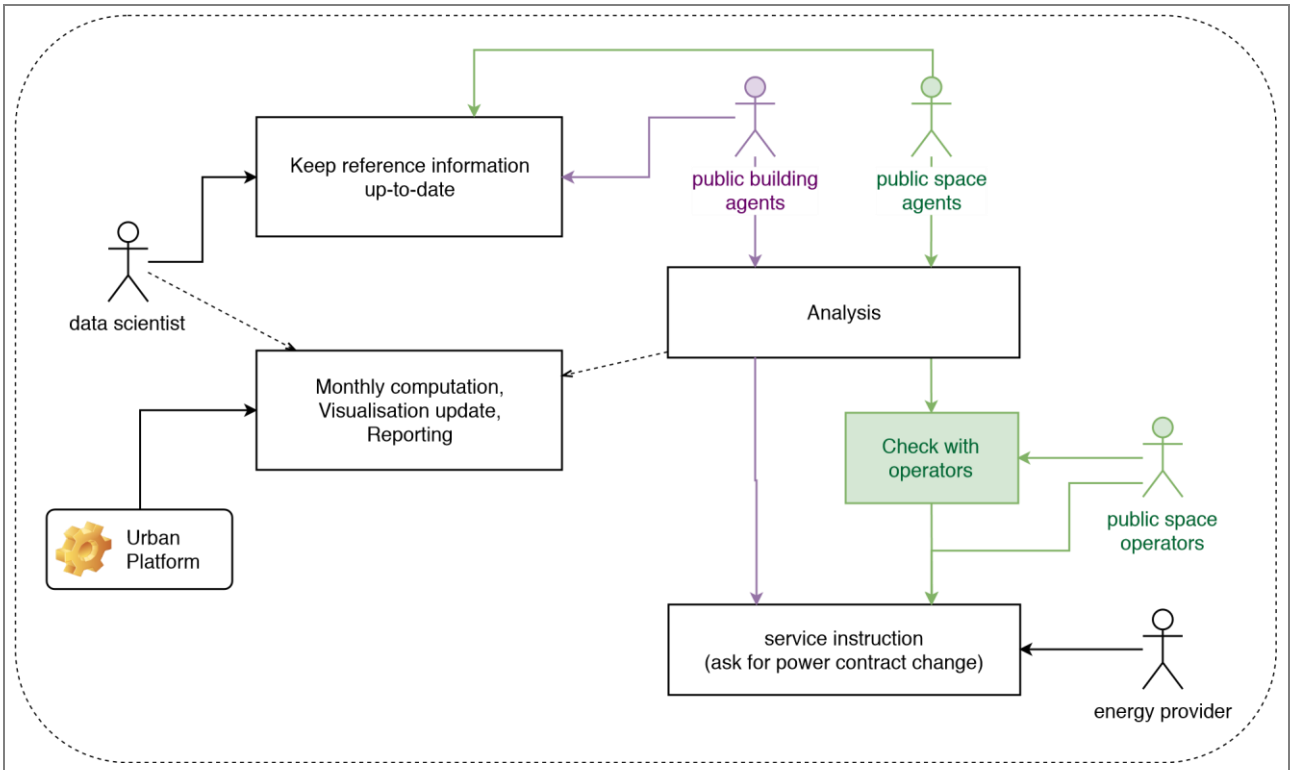
Manually, it is not possible to follow all public equipment electricity contracts. As for NAN it represents more than 800 public building meters and above 2,700 other meters for public spaces.
With the deployment of smart electrical meters all over France, more and more of NAN public equipment electrical 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.



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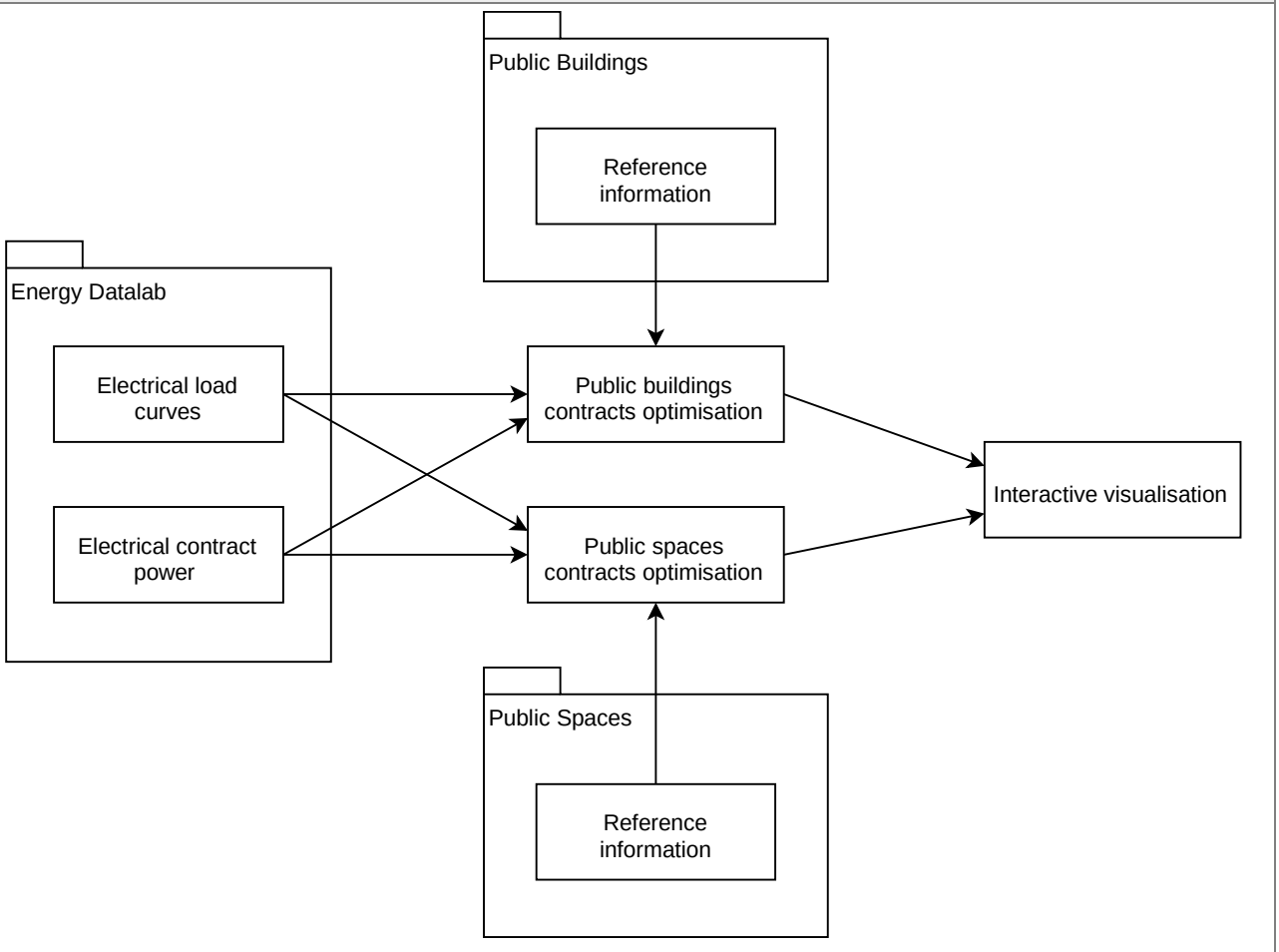


3. Scope and Objectives

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.

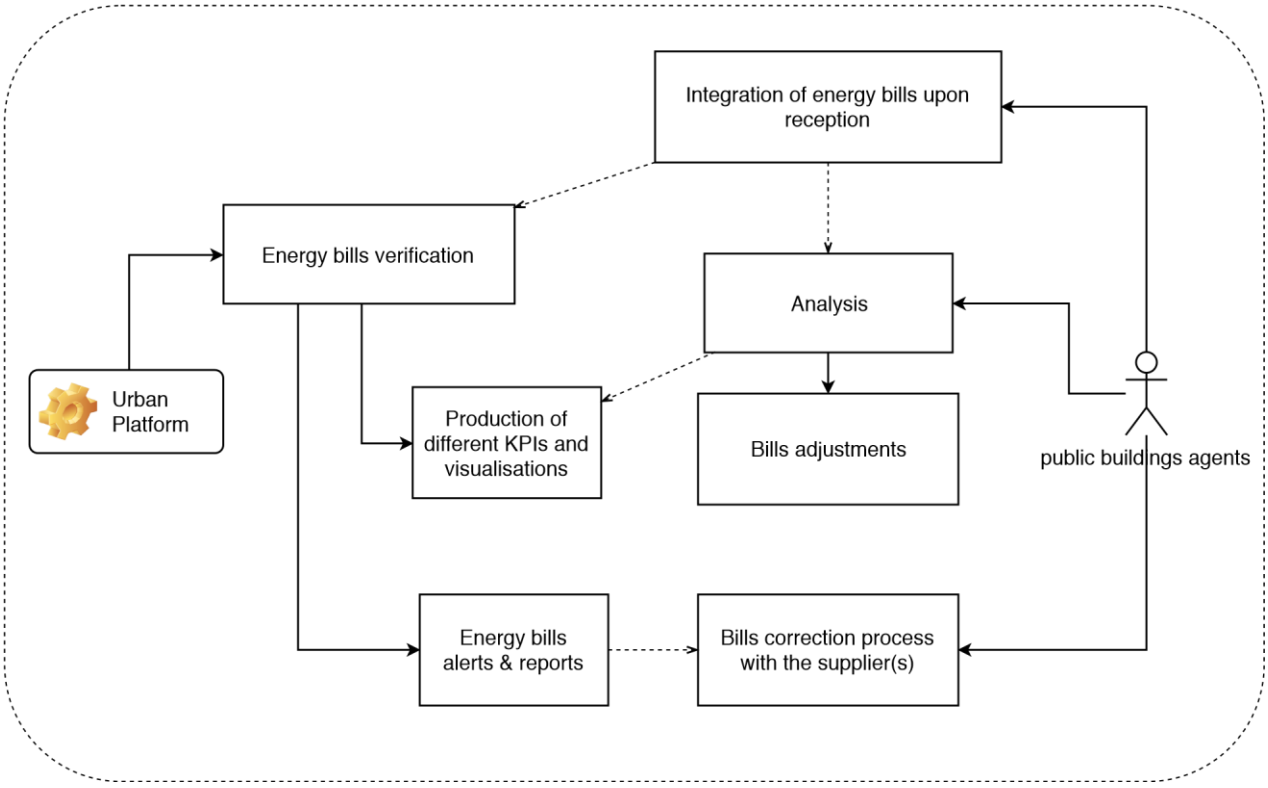
With more and more data available on one side, and the uncovering of data science possibilities on the other; the purpose of this use case is to leverage on these two opportunities to experiment with a new approach to manage the regular energy bills verification loops.

2.a. User Story description

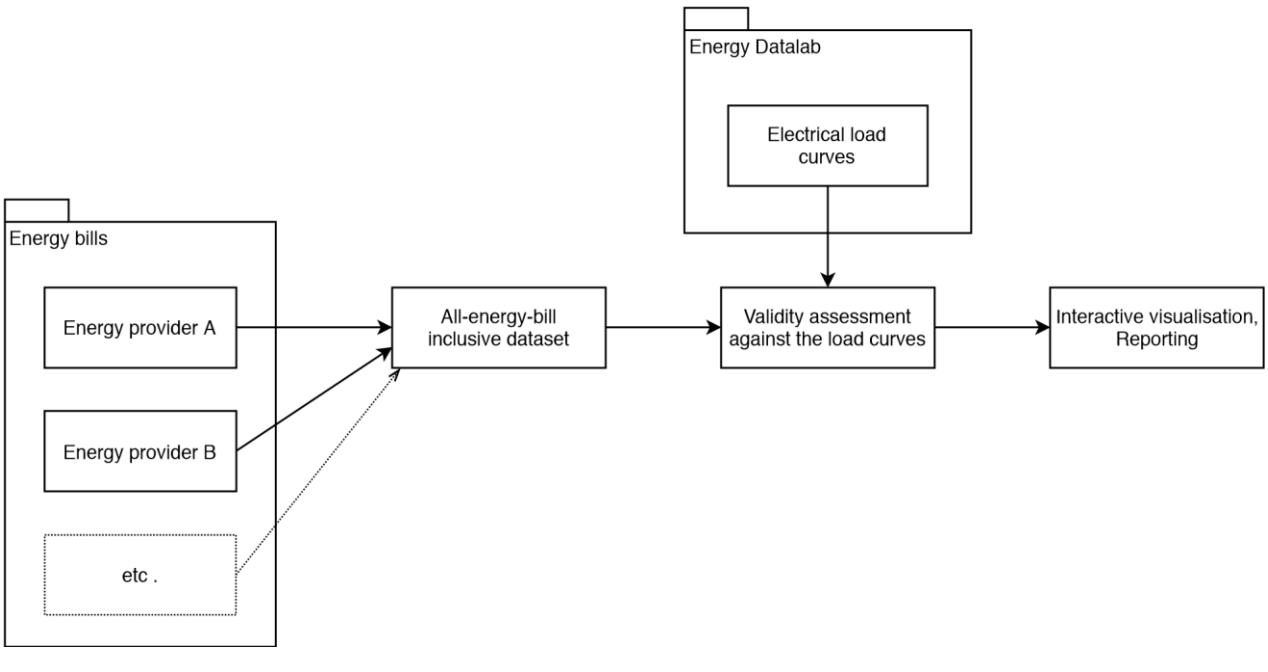
Connecting to the energy providers interfaces, the Urban Platform would integrate the data coming from the regular energy bills. Using a common standard, energy bills coming from different providers would be standardised and therefore made interoperable with each other.
Regularly, agents from the public 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).

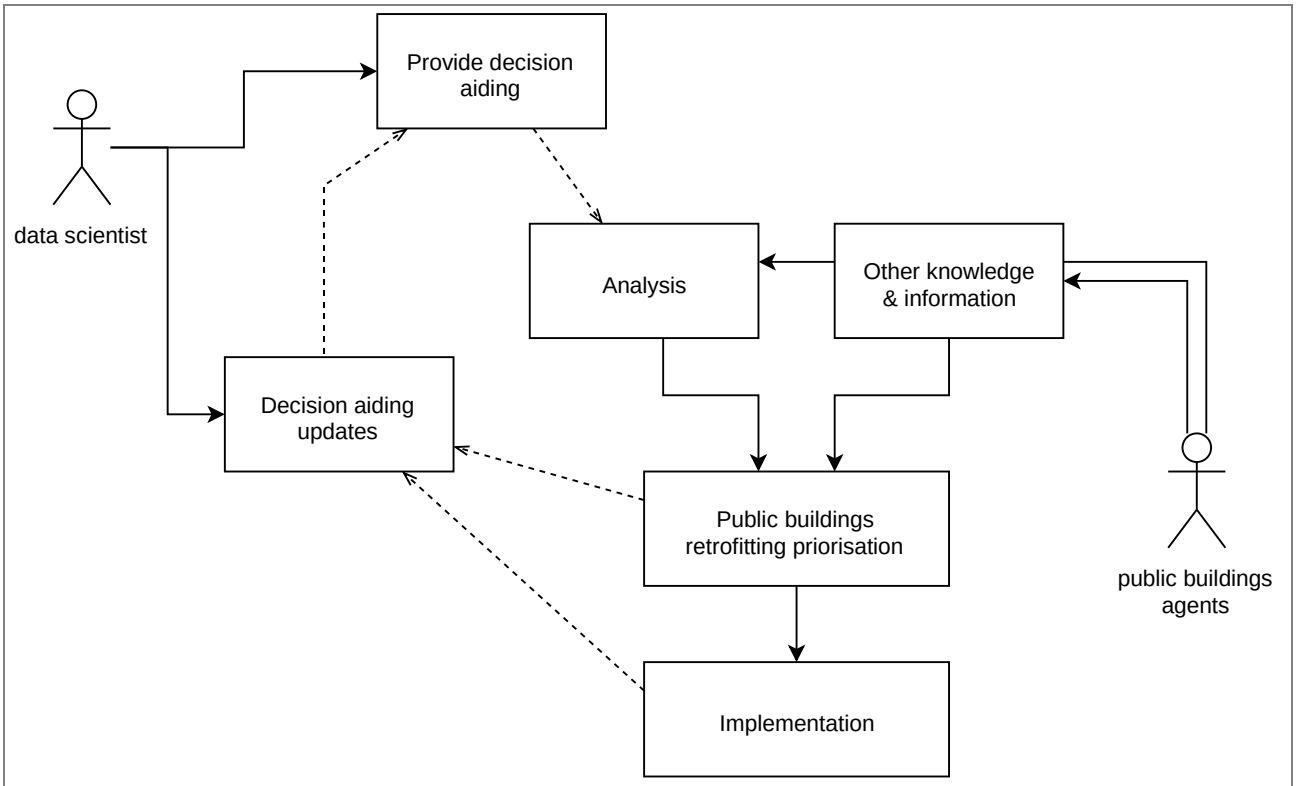
2.a. User Story description

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.

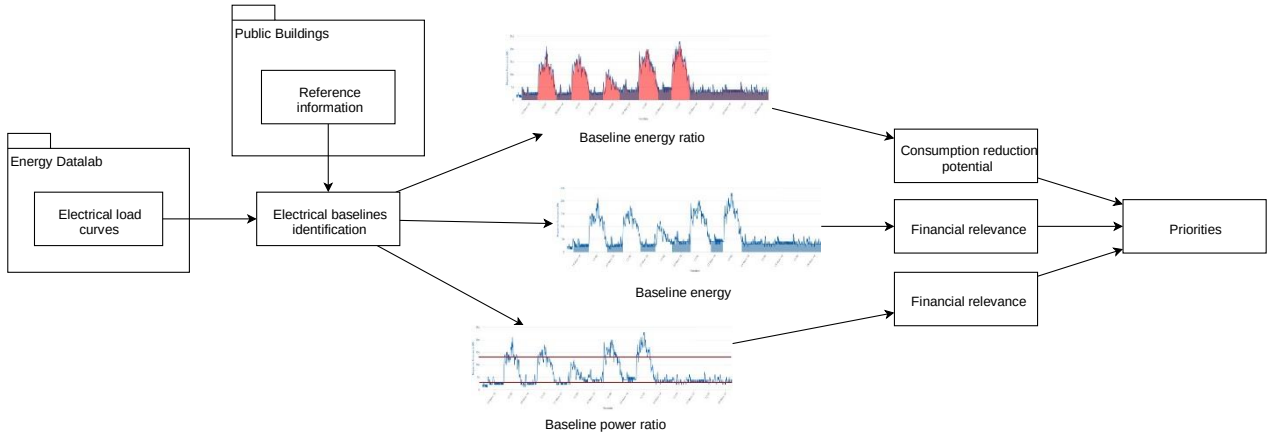
These aspects are crucial to assess beforehand to get a better view at the wide scale of the global public buildings pool, as the first step to help identifying the best sites for retrofitting implementations processes.

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.

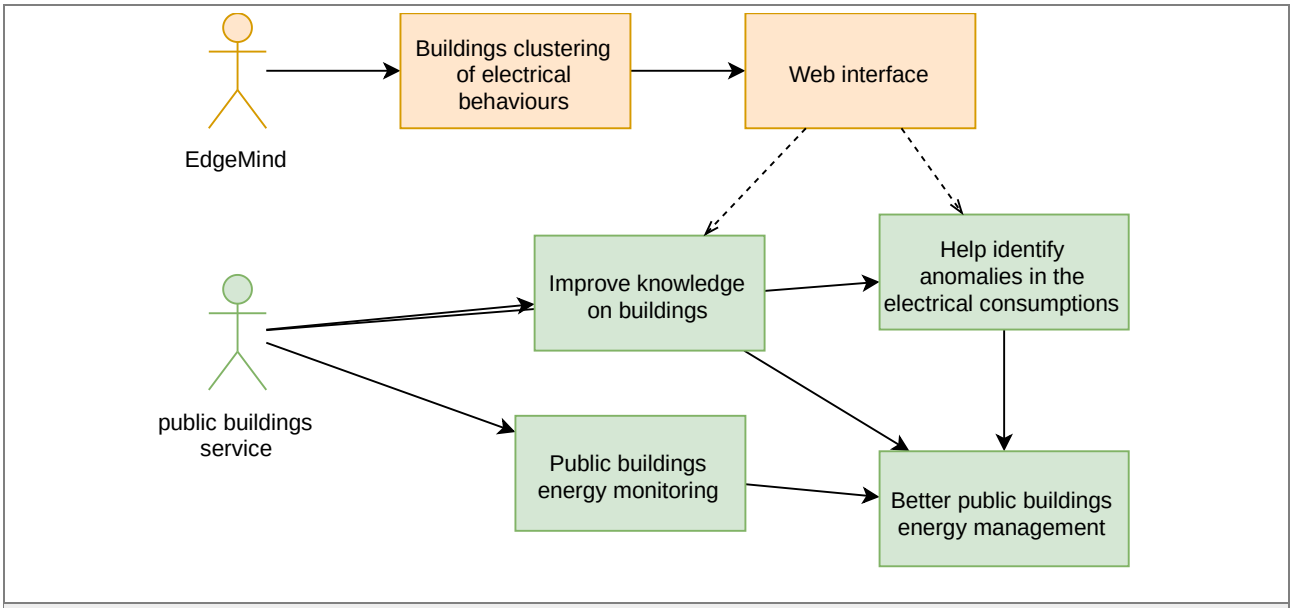
2.a. User Story description

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.

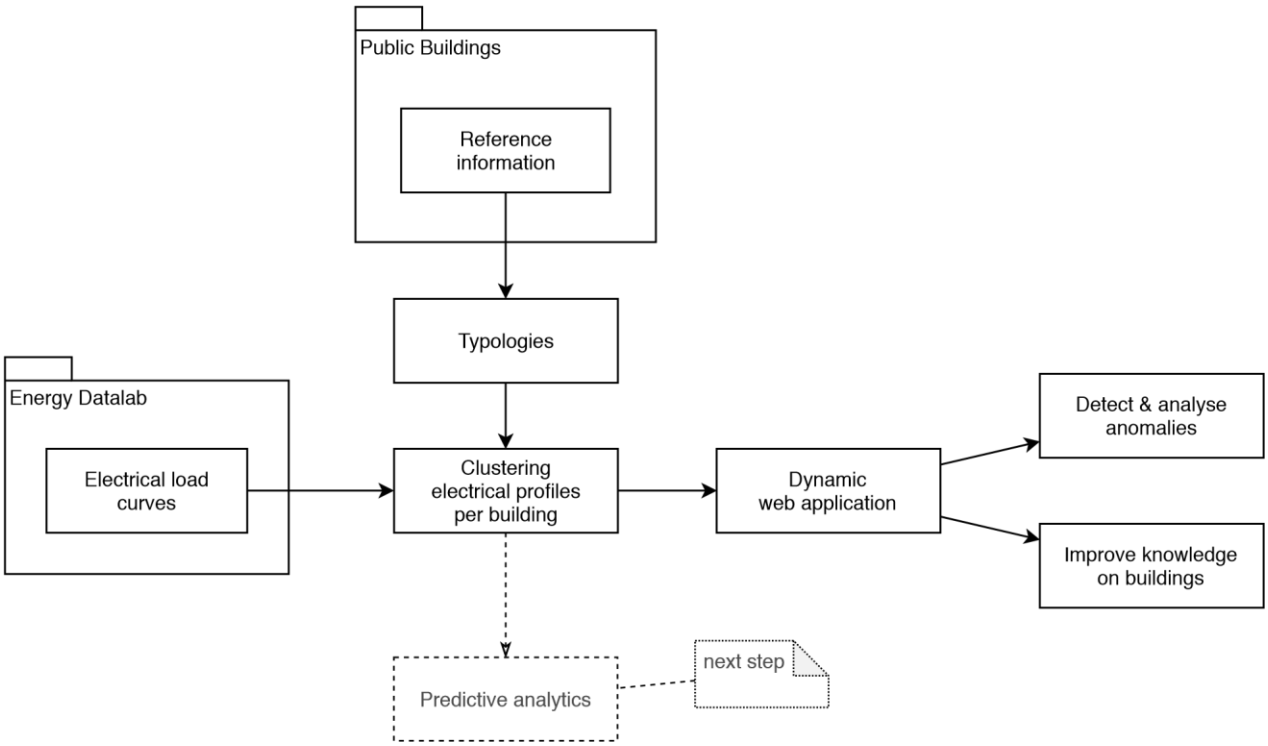
This is great and useful for a service such as Nantes Metropole's public buildings service because it provide a door to open further investigations on these buildings, which is a main stake of this activity because there are many cases to follow at the same time and getting a quick information at a glance 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, 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, 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

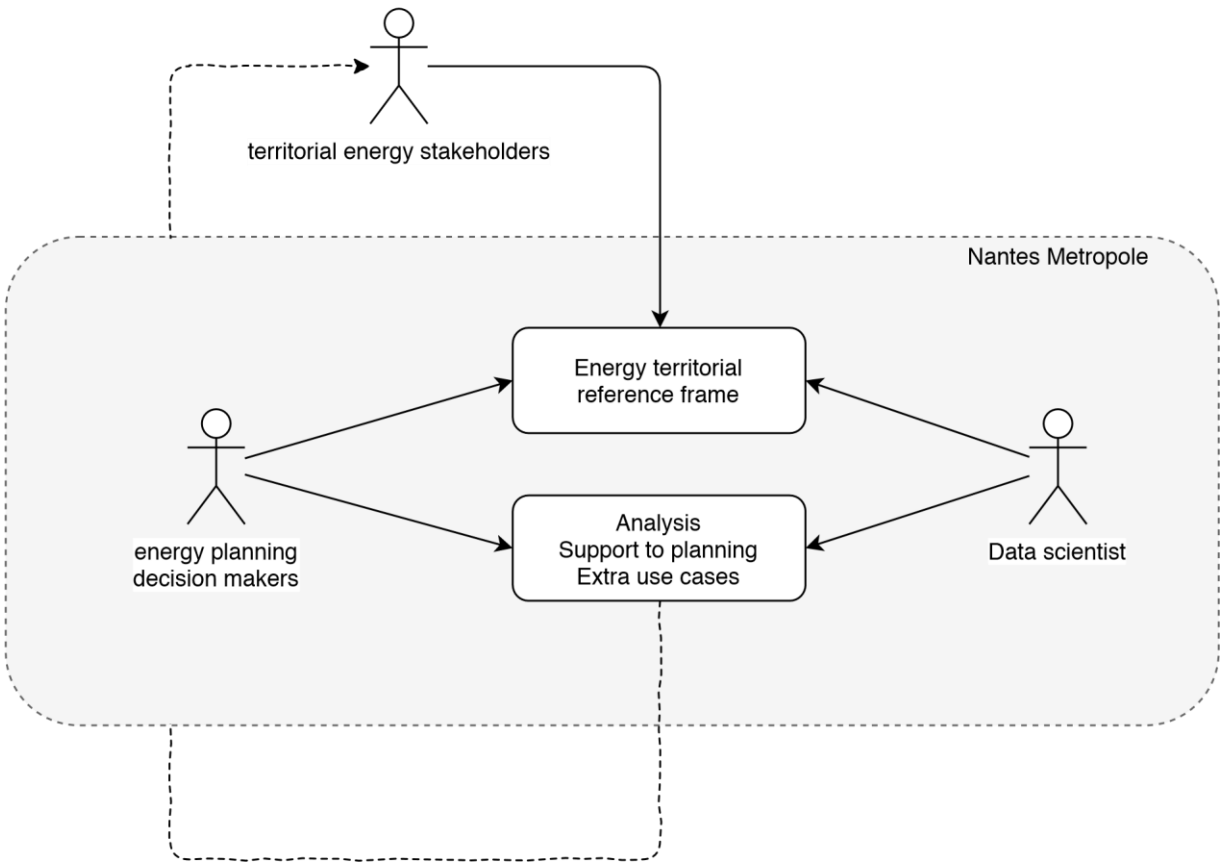
Looking at medium and long term energy planning at the territorial scale requires solid basis for decision making. More and more data are becoming available and notably in the field of energy. Harnessing the decision aiding opportunities of data is a key aspect of Nantes Metropole strategy. Combining 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

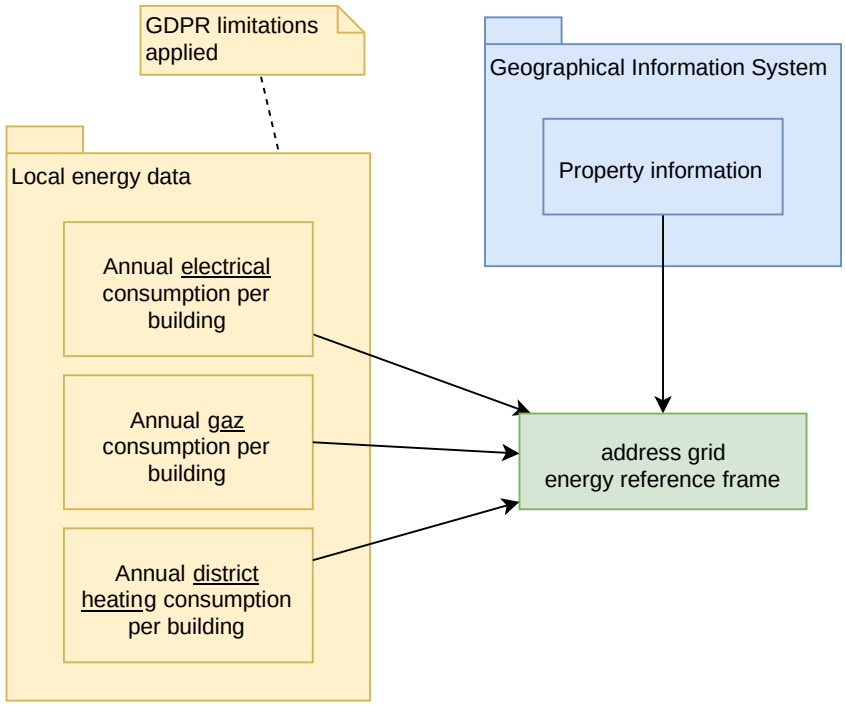
With the recent evolutions of laws and the thriving context of energy, it is becoming more and more easy to work with the territorial stakeholders and notably those of the energy distribution.
Nantes Metropole can gathering the local energy data, providing annual energy consumptions at the address mesh, 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.

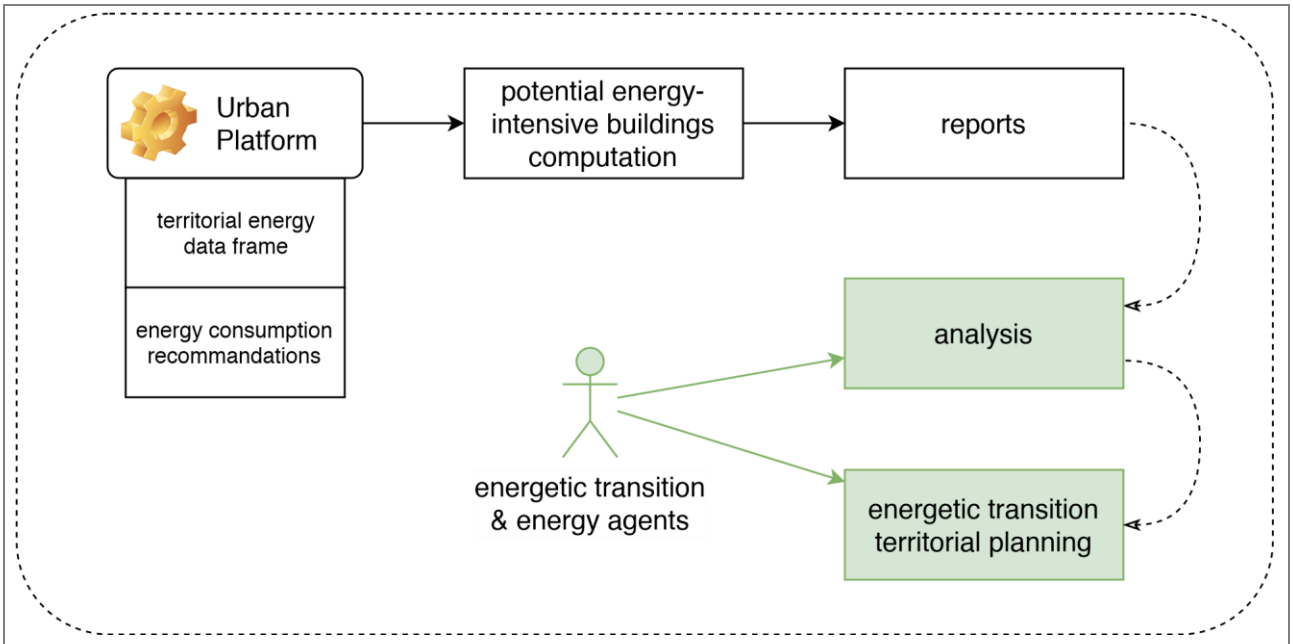
Comparison then can provide the first insights to help directing the energetic transition public resources towards the most energy-intensive buildings.

2.a. User Story description

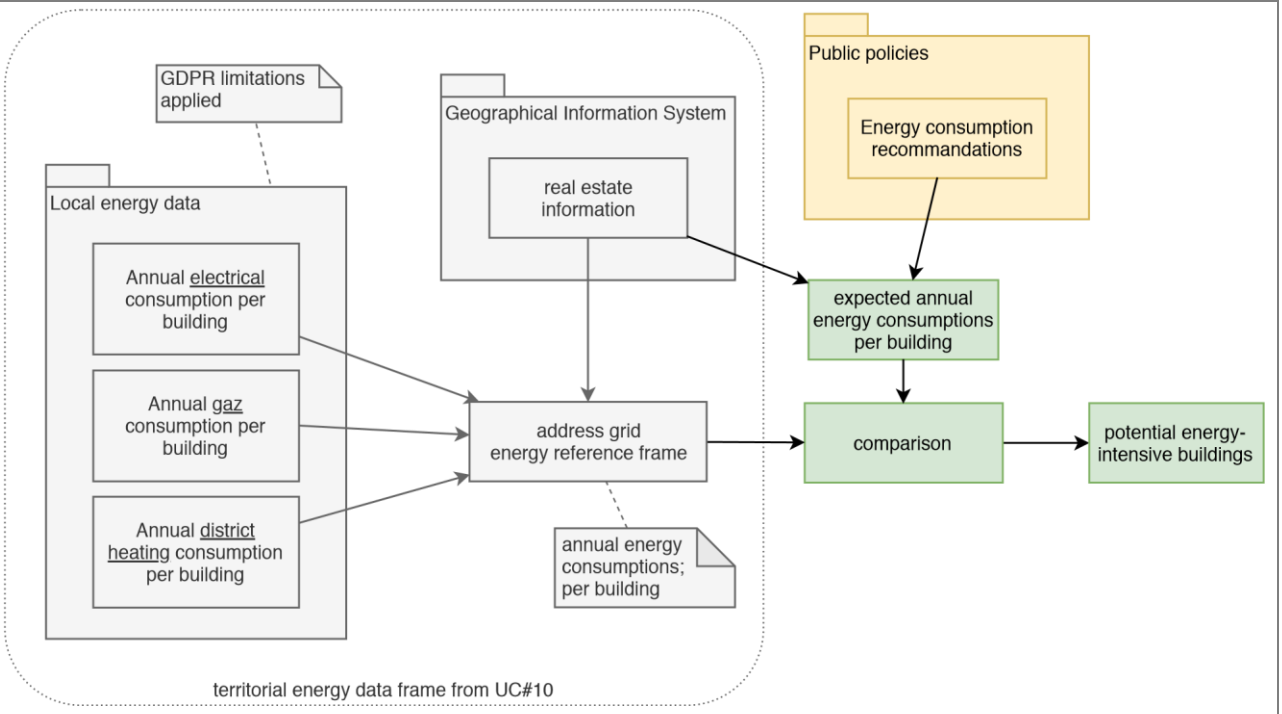
From the territorial energy data frame; the aim of this use case is to support the territorial energetic transition planning through reports on potential energy-intensive buildings. This can become a raw material to contribute a better knowledge of the territory, therefore, it can contribute to this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

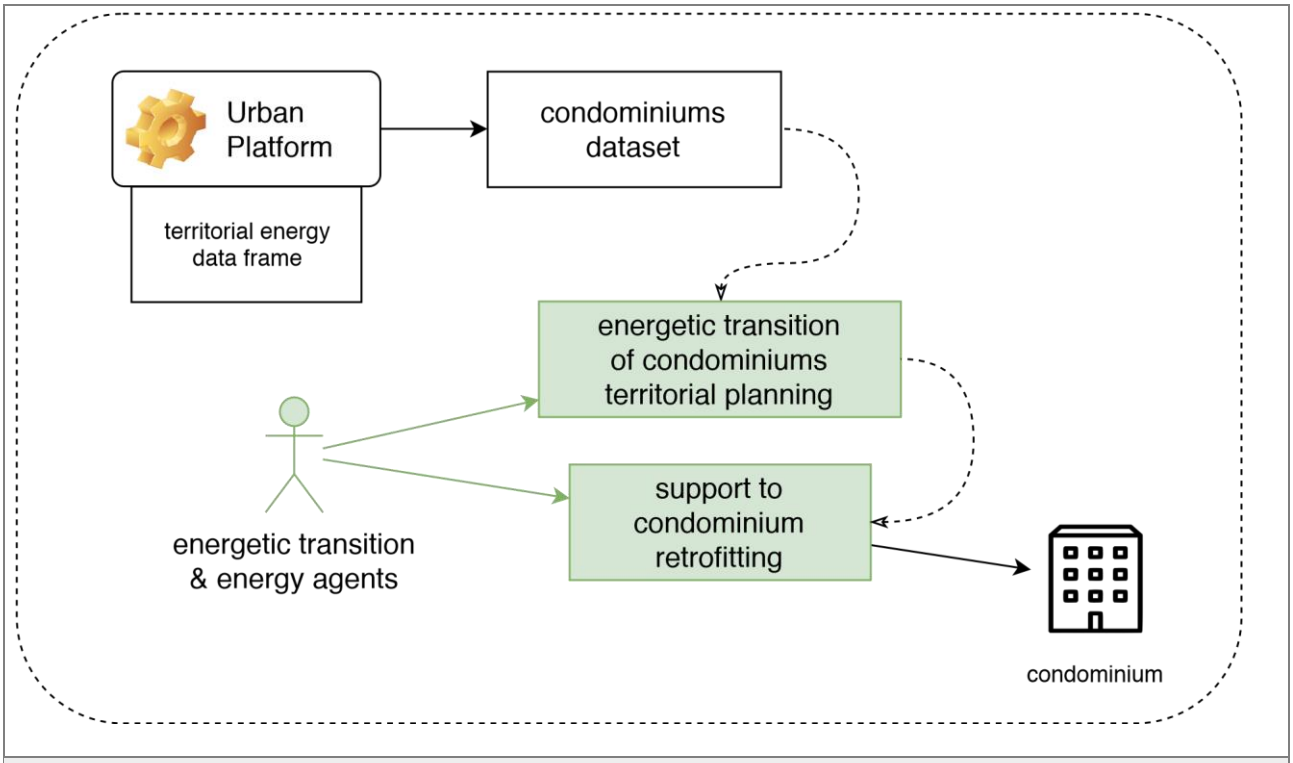
This condominium dataset could help energetic transition public agents working with condominiums, contributing to providing a global view for territorial planning.

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.



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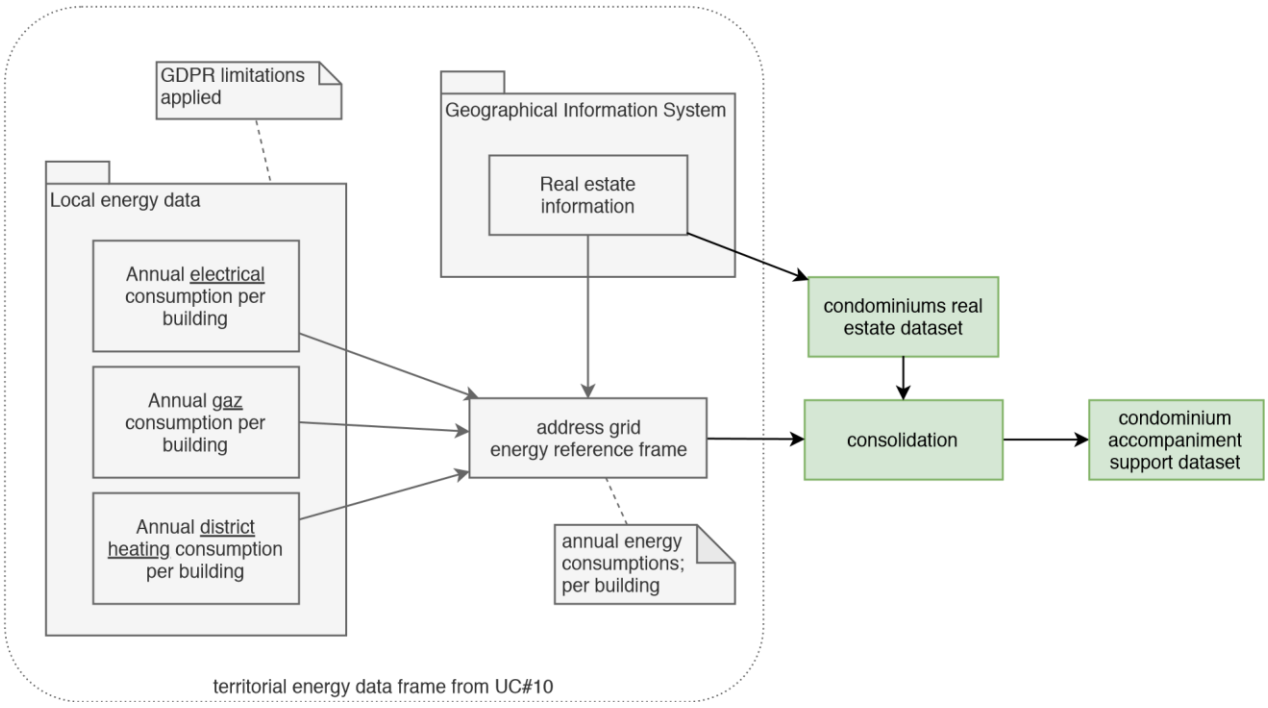


3. Scope and Objectives

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.

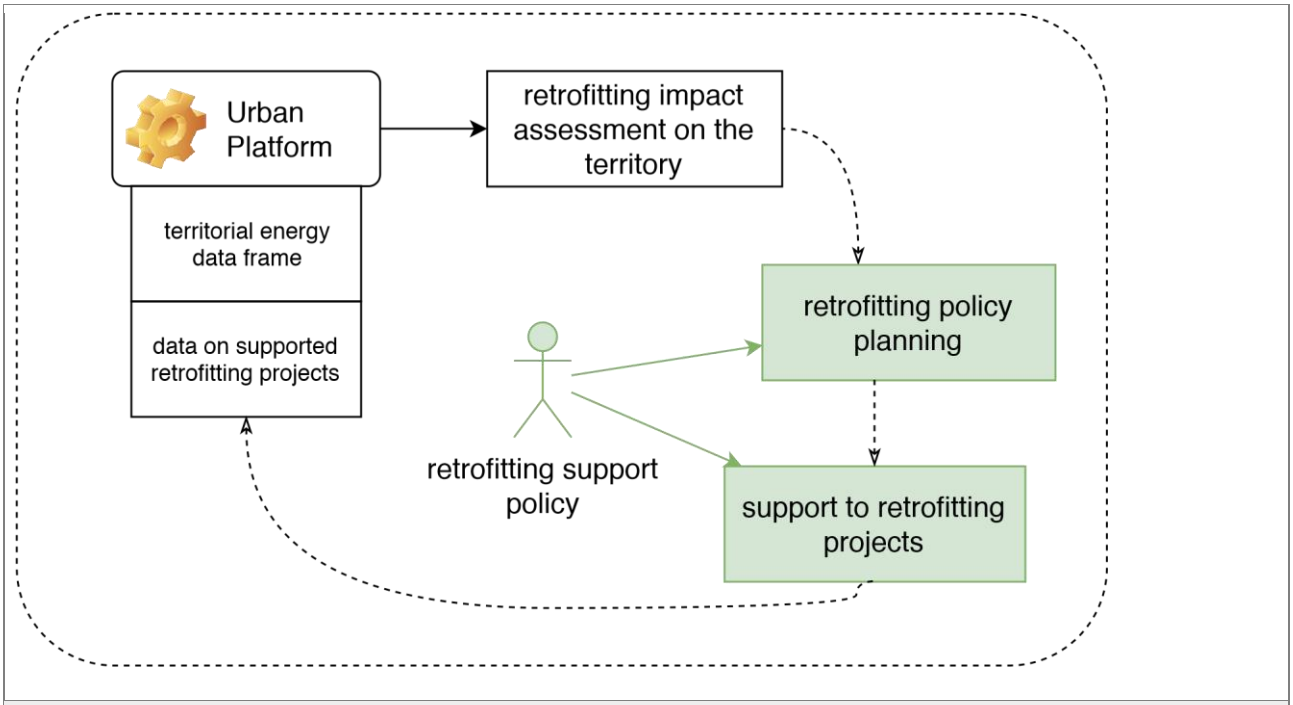
Nantes Metropole already accompanies retrofitting projects, but not all are under this help, and therefore, it is interesting for addressing retrofitting at the global scale to get a territorial vision to contribute to the public policy planning and implementation.

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.



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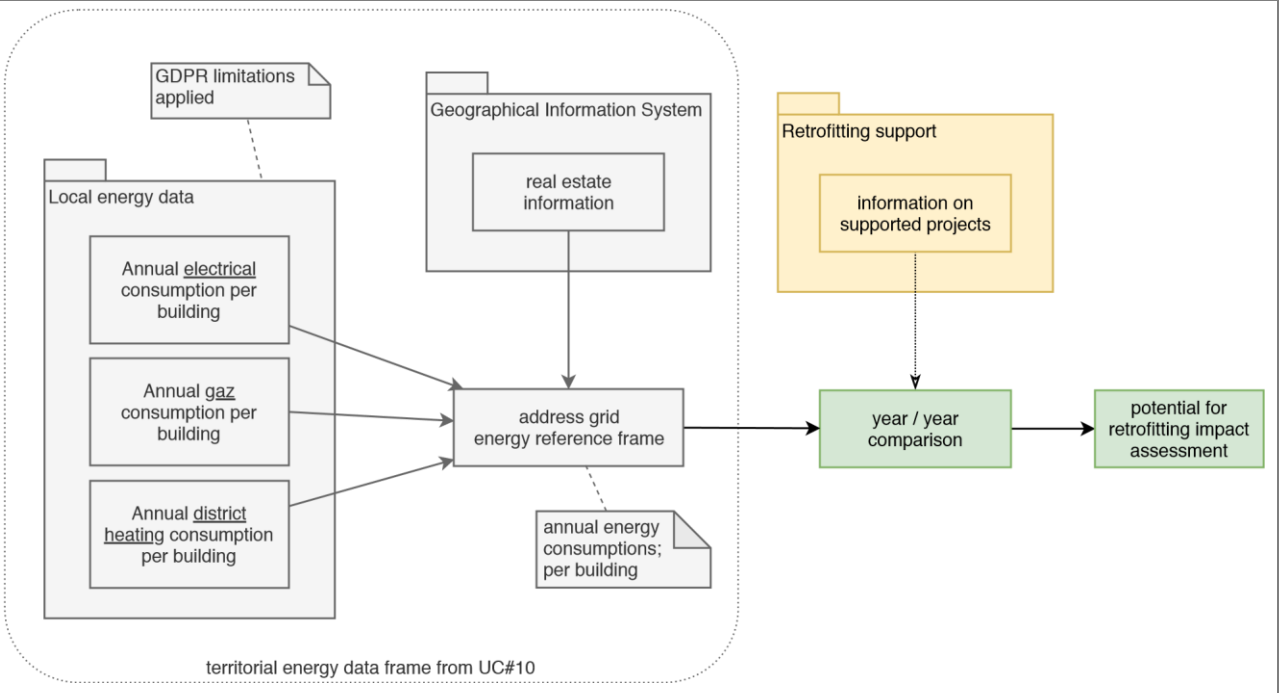


3. Scope and Objectives

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.

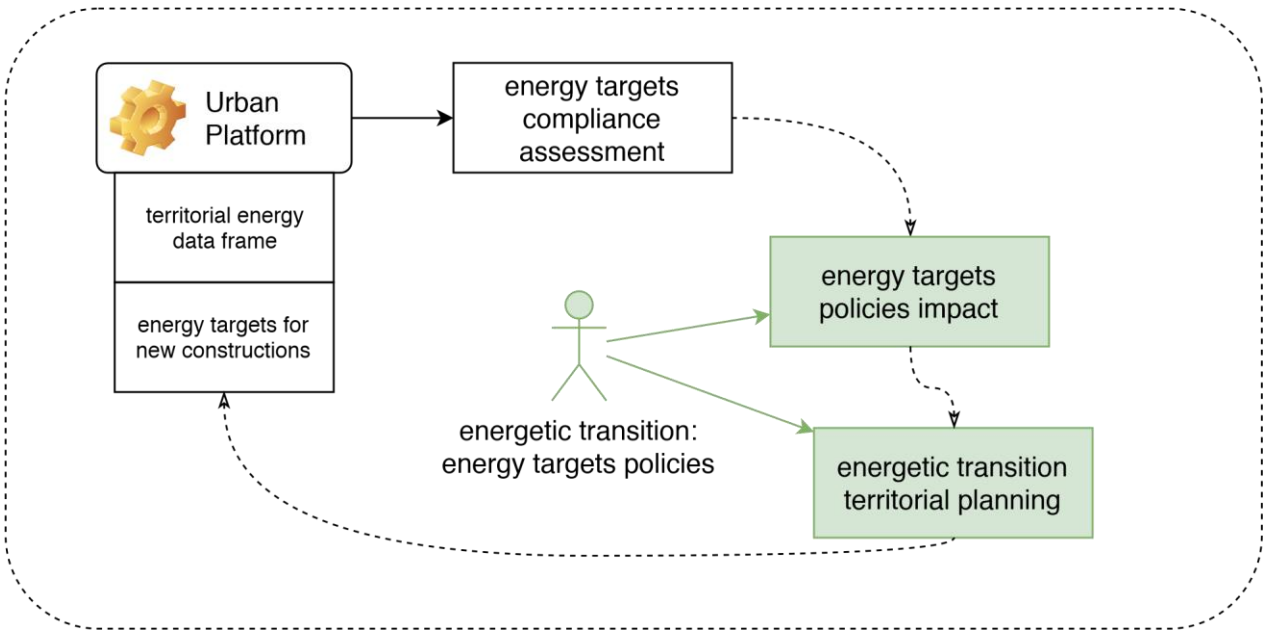
2. Description

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

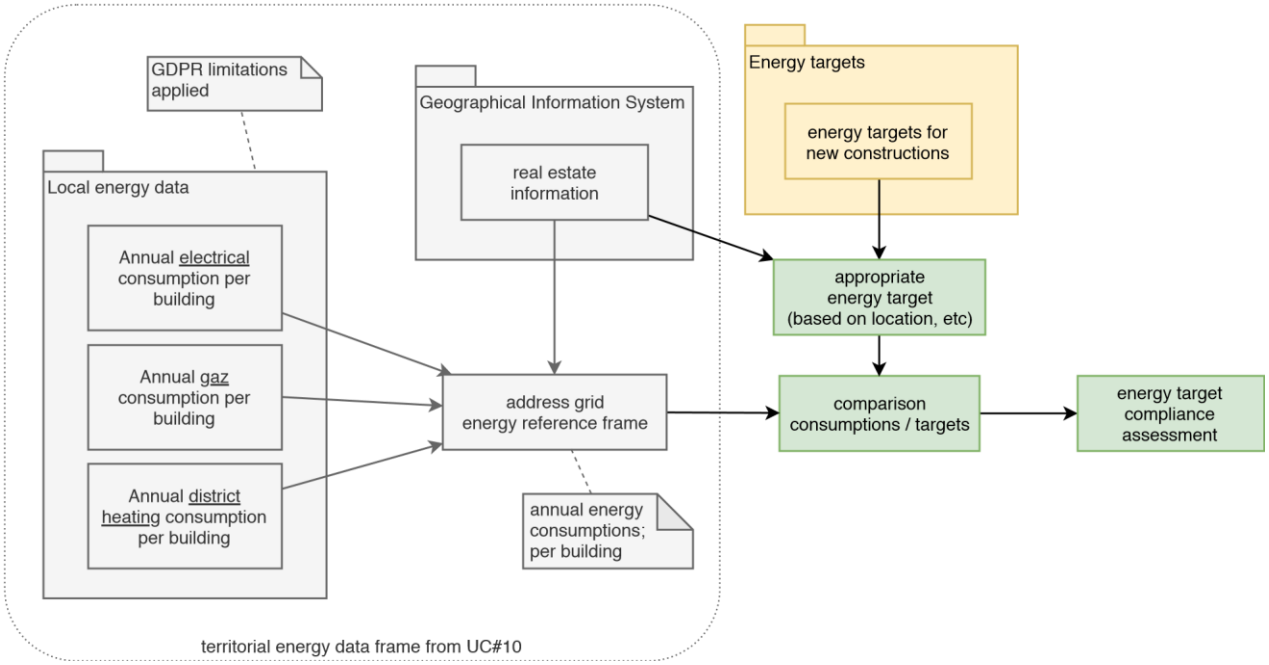
Assessing of the energy targets compliance provides a feedback to this policy planning and more globally, this is one asset to provide a factual support to the energetic transition territorial planning.

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.

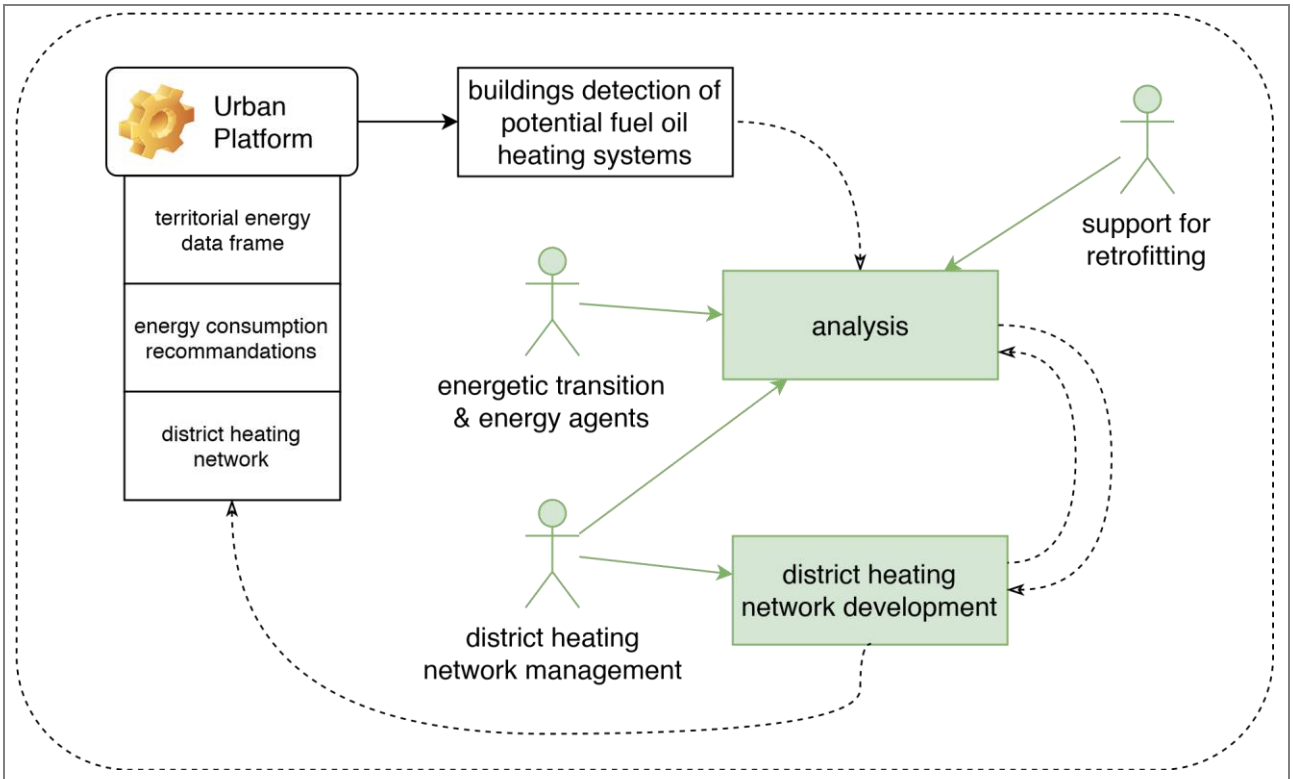
Finally, whether the heating system is central or not to the building is also provided, which can be added on top of the identifications to possibly add one easing factor of social acceptance.

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.



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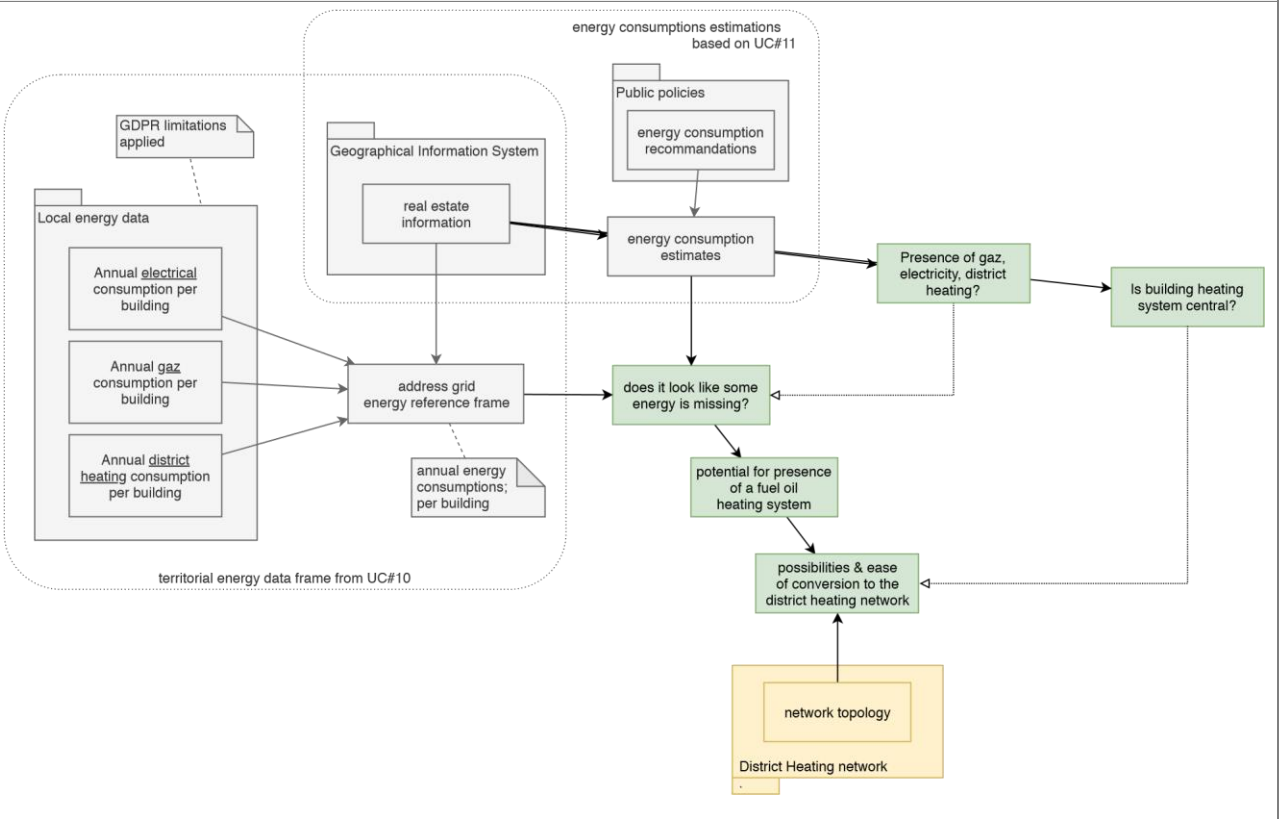


3. Scope and Objectives

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.

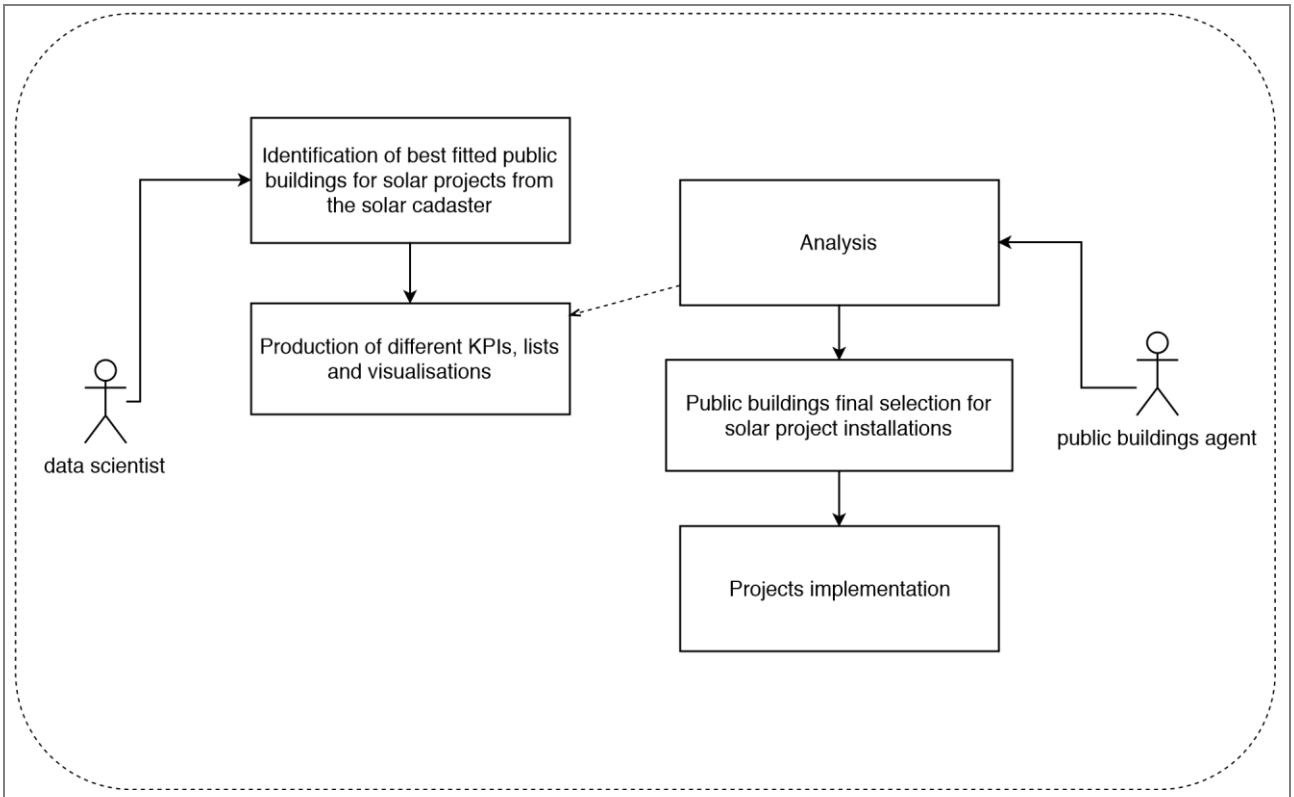
Using data can help identifying the best buildings for this purpose. Selecting the best projects over a panel of 800 buildings can be hard and time-consuming, considering the feasibility studies that have to be conducted over each and every project site. The purpose of this use case is to provide insights to help selecting solar project sites.

2.a. User Story description

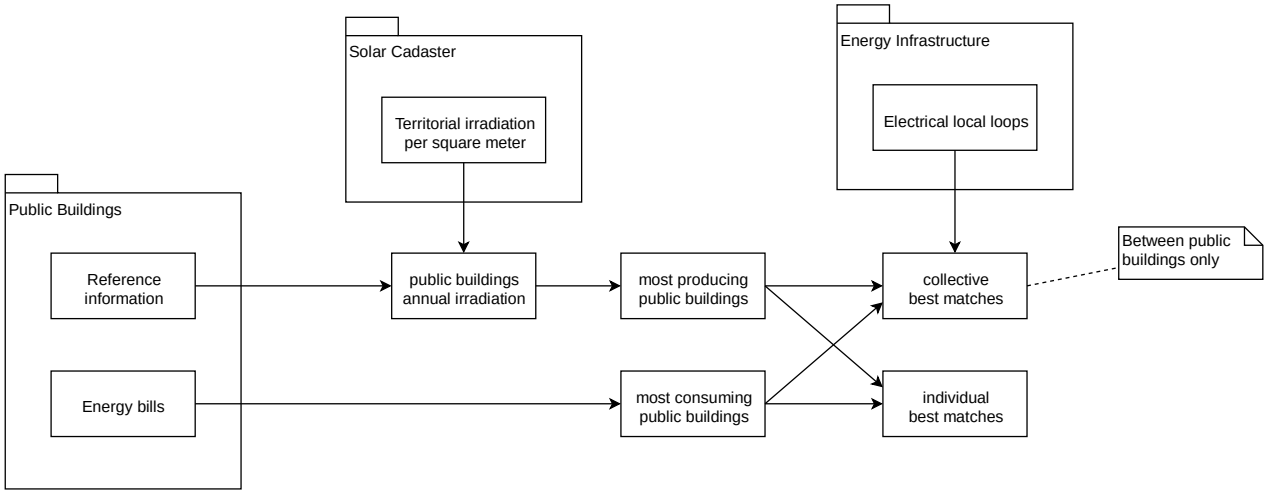
This use case contributes to Nantes Metropole's energetic transition policy of its public buildings, through providing the public buildings agents with raw material as well as analysis on the biggest opportunities for PV plants deployment.

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.

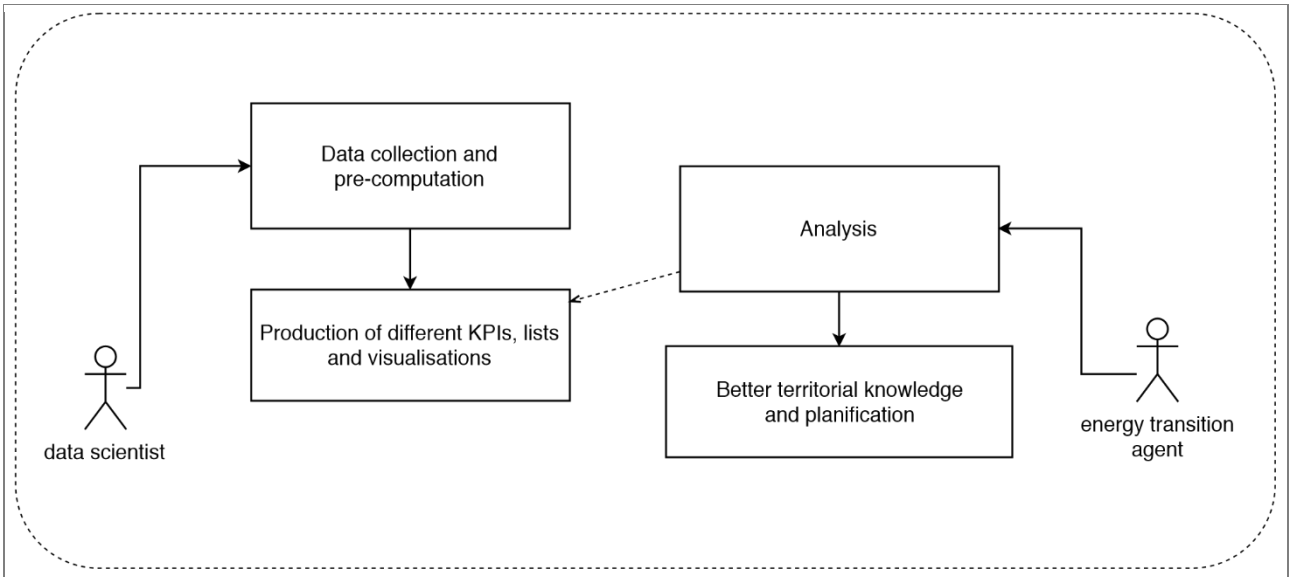
Using data can support this major urban transformation and the purpose of this use case is to bring a focus on how data can contribute to the development of solar energy production at the territorial scale.

2.a. User Story description

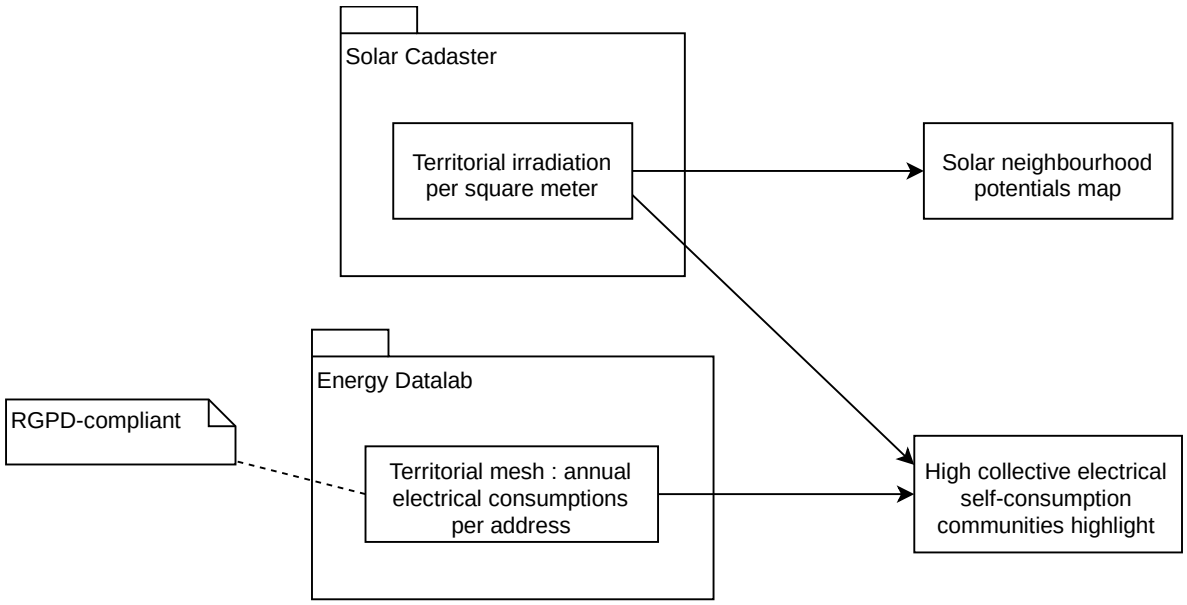
This use case is directed towards the territorial knowledge and planification activities of Nantes Metropole's agents working on the energetic transition public policies, and notably, on the implementation of that of the 100% of rooftops to become useful by 2030 through raw material & analysis of territorial 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.