Ref. Ares(2017)5877903 - 30/11/2017

Deliverable due date: M12 – November 2017 (Interim M8)

D2.1 Baseline report of Nantes demonstration area

WP2, Task 2.1

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	D2.1 Baseline report of Nantes demonstration area
Diss. Level	PU
Status	☐ Working ☐ Verified by other WPs ■ Final version
Due date	30/11/2017
Work Package	WP2
Lead beneficiary	NAN
Contributing beneficiary(ies)	CAR, CER, TEC, NBK
Task description	This task will set and assess, according to WP5, a baseline for Nantes demonstration. Analysis of the district in which the interventions will be implemented with information about the main architectural issues, energy facilities and energy consumption, mobility data and urban infrastructures are necessary for the definition of the baseline and for identifying the improvements potential. More details are needed in the case of the existing urban plans, public procurement and the current citizen engagement strategies in Nantes.

Date	Version	Author	Comment
23/03/2017	0.1	Pierre Nouaille (Cerema)	Draft version (French)
04/07/2017	0.2	Pierre Nouaille (Cerema)	Draft version (English)
12/07/2017	0.3	Estefanía Vallejo (CAR)	Overall review. Section 12.
13/07/2017	0.4	Pierre Nouaille (CER)	New draft updated with firts comments from CAR
20/07/2017	0.5	Pierre Nouaille (CER)	New draft updated and completed
24/07/2017	0.6	Rubén García (CAR)	Overall content alignment and final format (interim version)
18/10/2017	0.7	Pierre Nouaille (CER) and Théophile Mertz (NBK)	Integration of draft version of chapters 7 (NBK), 8 (CER) and 9 (NBK)
24/10/2017	0.8	Pierre Nouaille (CER)	Elements added about environmental characterisation (CER), and table of indicators (city mobilty current status)
21/11/2017	0.9	Pierre Nouaille (CER)	Integration of comments from CARTIF and Nantes Métropole; overall proofreading and corrections for chapters 1, 2, 3, 4, 5, 6, 7, 9
22/11/2017	0.10	Théophile Mertz (NBK) Pierre Nouaille (CER)	Proofreading of chapters 8 and 10 (NBK) and overall content alignment and final format (CER)

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

Copyright notices

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

Table of Content

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

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

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

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

Table of Figures

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

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

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

Table of Tables

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

Abbreviations and Acronyms

Acronym	Description
ADEME	Agence de l'environnement et de la maitrise de l'énergie (French agency for the environment and energy management)
AURAN	Agence d'Urbanisme de la Région Nantaise (Nantes' City Planning Agency)
BASEMIS	It is the inventory tool of the energy consumption and GHG emissions in the Pays de la Loire region
CBS	Cartes de Bruit Stratégiques (Strategic Noise Maps)
DHN	District Heating Network
DGFiP	Direction Générale des Finances Publiques (Directorate-General for Public Accounting)
DOPEA	Name of the water network operator of Nantes Métropole
EPICE	Name of the unit of Nantes Métropole in charge of public lightning and electronic communication infrastructures
GHG	GreenHouse Gas
GIS	Geographic Information System
ICT	Information and Communications Technology
Ines	Institut National de l'Energie Solaire (National Institute of Solar Energy)
INSEE	Institut National de la Statistique et des Etudes Economiques
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
NGE	Nantes-metropole Gestion Equipement is a company created by Nantes Métropole
NRD	Numeric Resource Department of Nantes Métropole
OMEGA	Name of the optic network built by Nantes Métropole
PCAET	Plan Cimat Air Energie Territorial (Local Plan for Climate, Air and Energy)
PDU	Plan de Déplacements Urbains (Urban Mobility Plan)
PEAN	Périmètre de protection des Espaces Agricoles et Naturels Périurbains (Protection perimeters for suburban agricultural and natural areas)
PLH	Programme Local de l'Habitat (Local Housing Plan)
PLUm	Plan Local d'Urbanisme métropolitain (Metropolitan Urbanism Plan)
PPA	Plan de Protection de l'Atmosphère (Atmosphere Protection Plan)
PSD	Public Service Delegation

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

Acronym	Description
RES	Renewable Energy Sources
SAFER	Société d'Aménagement Foncier et d'Etablissement Rural (Land and rural development company)
SEAP	Sustainable Energy Action Plan
SCoT	Schéma de Cohérence Territoriale (Territorial Coherence Scheme)
SEMITAN	Société d'Economie Mixte des Transports de l'Agglomération Nantaise (Public transport operator of the Metropolitan area of Nantes)
SPAR	Schéma de Promotion des Achats Responsables (Plan for responsible public purchasing)
TETRA	Name of the radio network from SEMITAN for security team and waste collection

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

1. Executive Summary

The main objective of mySMARTLife project is the definition of an Innovative Urban Transformation Strategy in which the main lines of the project are depicted; highlighting that all interventions in the city must answer to real city challenges, identified following a city led approach and counting on with the active participation of the citizens through citizens' engagement strategies.

Figure 1: mySMARTLife Project concept

There are four different frameworks in which this Innovative Urban Transformation Strategy is deployed:

- **Technological framework,** in which all the actions foreseen will be delivered in three sectors: Energy, Mobility and ICT.
- **Non-technical framework,** covering the urban plans and business models.
- **Innovation framework,** that are focused in the three pillars of the project, smart people, smart economy and ecosystem.
- **Temporary framework,** that represents the evolution of the project from the city challenges and audits until the evaluation of the performance of the actions, passing through the design and implementation of the solutions.

This Urban Transformation Strategy aims at giving response to in a holistic and integrated manner to the transformation process, following its main phases (City Audit, Design of the Solutions, Demonstration and Evaluation or final assessment), for these priority sectors (Energy, Mobility and ICT) and for the key frameworks of this process, the non-technological framework through the integration in Urban Plans of existing and innovative City Business Models overcoming the financial barriers, and the innovation frameworks, which aim is twofold: technical support to the phases in the sense of existing methods and tools supporting these phases and technologies innovation and integration in each of the priority sectors.

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

This Urban Transformation Strategy, as well as its implementation, demonstration and replication stages, will be depicted and fully described within WP1, while this document aims at covering the implementation of its first phase (Cities Audit) within the Nantes lighthouse city.

In this framework, the D2.1 aims to collect all data and information for the first step of the process: the City Audits and diagnosis. This is a key phase for the process because by an accurate diagnosis it can be identified the priority action lines. It includes the assessment of the current state of each of the fields of study and the identification of the main opportunities and capabilities of the city to meet several strategies that may arise.

After the City Audit (Part I of this deliverable), the baseline values for the demonstration actions will be defined in Part II of this report. Both the results of the Part I on City Audit and Part II on the action specific baselines use indicators (City and Project level indicators) defined in close collaboration with WP5 to summarise the current state in Nantes in the beginning of the project. The action specific KPIs are specified together with the partners involved in the actions. With help of the baseline values, the impacts of Nantes demonstration actions will be monitored in WP5 (during and) at the end of mySMARTLife project.

This deliverable was originally due by month 12. However, at month 12 the deliverable cannot take into consideration the final detail of the interventions, crucial inputs to build a complete reference baseline. Moreover, these final details are especially necessary to be considered to build the energy part of this reference baseline, following de facto standard protocols like IPMVP.

Considering that an Amendment was requested in September (month 10) and that the process of negotiation and approval can still take several months, it was agreed with the Project Officer to submit an interim report at the original due date, month 12, that will include the Nantes City Audit. The final version, including the complete Nantes Baseline will be submitted in month 42.

The related Milestone MS4, which is also in line with these final baseline of Nantes demonstrator area is also requested to be updated, considering on one hand the City Audit reports ready, justified with the interim versions in month 12 and the Final baseline (new Milestone MS13) with the final version of Nantes, Hamburg and Helsinki baseline reports to be delivered in month 42.

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

2. Introduction

2.1 Purpose and target group

This report presents the current state of the Nantes lighthouse city in the beginning of the mySMARTLife project with regard to the demonstration actions that will take place during the project. The report is divided into two parts: Part I Nantes City Audit and Part II Baseline assessment. The first part aims at giving an overview of Nantes Métropole in the beginning of the project and with regard to the main topics addressed in mySMARTLife project. The key characteristics are summarised with help of City level indicators. The second part of the deliverable focuses on the actions that will take place in Nantes demonstration and set the baseline values for those with help of Project level indicators restricted to the scope of the actions (buildings, districts, local energy supply units etc.).

More specifically the City Audit (Part I) collects information from the Nantes lighthouse city and carries out an accurate diagnosis of its current status within the framework of the Urban Transformation Strategy. The data to be collected will cover the three main sectors where Urban Transformation Strategy is focused on: building, mobility, and urban infrastructures including ICT. In addition, it covers the analysis of other non-technical aspects that may affect the project goals implementation. Thus, it covers the diagnosis for seven fields: energy supply, city transportation, suitable urban infrastructures for integration, existing urban plans for promoting low energy districts and sustainable mobility, public procurement procedures, regulations and normative and existing actions for citizens' engagement. The City Audit (Part I) provides the context within which the demonstration actions take place and for which the baseline values and KPIs are set in the Part II of the deliverable. This diagnosis, as well as those developed in D4.1 and D3.1, will also serve as a starting point for the replication plan for the three follower cities, which will be also developed within task 6.1. However, the City Audit (Part I) can be of interest for any reader interested in Nantes ighthous city's current state and readiness with regard to different smart city topics.

The present deliverable is structured as follows:

PART I: Nantes City Audit

Chapter 3: shows the overview and scope of the city audits to be implemented in the three lighthouse cities. This includes the description of the Urban Regeneration model focusing on the city audits, the city characterization scope and the predefinition of the evaluation framework through the indicators.

Chapter 4: shows the characterization of Nantes lighthouse city, collecting information about the following aspects: socioeconomic structure, climatic conditions, urban morphology, land use, green and public spaces structure, environmental issues.

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

Chapter 5: shows the analysis of the existing urban plans for promoting low energy districts and sustainable mobility. In particular, the urban plans that are creating a preliminary context in the city and that will be strengthened with mySMARTLife.

Chapter 6: shows the analysis of public procurement procedures, regulations and normative that may affect the project implementation. Moreover, it is identified the potential for improvement on them.

Chapter 7: shows the existing actions for citizen engagement, focused on the current practices and other initiatives for empowering citizens to be part of the city life, as well as the potentiality for creating an innovative, replicable and effective citizen engagement strategy.

Chapter 8: shows the diagnosis of the energy supply network as well as the potential local energy resources suitable for integration. This information is essential in order to estimate the foreseen contribution of the proposed solutions for improving energy supply facilities. As the main project target is to supply energy by means of systems based on renewables, it is necessary to collect information about the barriers, needs and potential to substitute the existing systems.

Chapter 9: shows the city transportation current status, focused on the mobility city profile and the statistics of internal movements, typology of the public transport, rate of sustainable vehicles, existence and main characteristics of the charging infrastructure for EV.

Chapter 10: shows the diagnosis of suitable urban infrastructures for achieving benefits in a possible integration. Although several specific actions have been planned in the demo sites for the pillar of integrated infrastructures, it has been collected information about the potential that some relevant city infrastructures have to be integrated in order to take advantages about a jointly operation. Information about electrical grids, broadband infrastructure, traffic management systems, and so on, has been analysed.

Chapter 11: City diagnosis conclusions.

Chapter 12: Bibliography and References.

Chapter 13: annex in which all Nantes city level indicators are collected.

PART II: Nantes baseline report

The second part of deliverable 2.1 focused on the Baseline of Nantes demostration area will be completed and submitted in month 42 as it was requested in the Amendment in September (month 10) due to crutial data for the reference baseline construction are still under definition.

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

2.2 Contributions of partners

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

Table 1: Contribution of partners

Participant short name	Contributions
CAR	Overall content to sections 1 and 2. Overall review
CER	Overall content to sections 3, 4, 5, 6, 8.
NAN	Provision of data, indicators and documents
NBK	Overall content to sections 7 and 9

2.3 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.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D5.1	This deliverable provides the overall description of the evaluation framework, and the selection of indicators at city and project level.
D1.12	This deliverable provides the overall description of the 3D models for each pilot.
D2.2	This deliverable will provide the baseline report Nantes lighthouse city and the simulation models of the building stock, energy system, transportation and urban infrastructure.

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

PART I: Nantes City Audit

3. City Audits Overview

3.1 City characterisation

The characterization of Nantes Métropole lighthouse city, and its supporting data collection, provides the citywide integrated documentation and analysis of the current conditions required to identify the priority action lines as well as their management needs.

Through a range of city descriptors and indicators, information about the existing conditions including some of the key aspects for the sustainable development are collected and shown in a standardised manner: social, economic and environmental aspects. This information is essential to promote actions and management plans for implementing the sustainable urban regeneration model aiming in mySMARTLife project. The characterization model will provide the entry point to extensive available data sets, to be regularly updated with numerous sources, which will enable to detail the lighthouse and followers cities analysis. Moreover, it will facilitate the replicability assessment and adaptation of the Innovative Urban Transformation Strategy.

The characterization will follow the approach developed for the evaluation framework developed in WP5. While the overall framework and the full set of indicators will be depicted in WP5 related documents, this report includes a selected list of indicators aiming at covering the city characterisation.

3.2 Predefinition of the evaluation framwork

A specific Evaluation Framework is being defined in task 5.1, and developed in mySMARTLife to assess the project activities from a holistic point of view and to replicate the project in other cities. This framework will be based on indexes, which can be built by integration of an objective set of key indicators, grouped and classified by categories that represent the main aspects of cities processes.

The Evaluation Framework of mySMARTLIfe is currently under definition but in this first stage of city diagnosis, a preliminary set of indicators at City Level can be considered to obtain some information about the starting point of every city.

This pre-selection of indicators at City Level is mainly connected with parameters or information related with the main aspects considered in the city audit, which are the following:

- City characterization.
- Existing urban plans for promoting low energy districts and sustainable mobility.
- Public procurement procedures, regulations and normative.
- Identification of existing actions for Citizen Engagement.
- Local Energy supply and resources diagnosis.

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

- City transportation current status.
- Suitable urban infrastructures for integration.

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

4. City characterisation

4.1 General overview and geographic positioning

Figure 2: What Nantes Métropole is

Nantes Métropole is the name given to the administrative structure that brings together all the 24 municipalities of the Nantes conurbation. The result of a long history of nearly a century of cooperation between municipalities, Nantes Métropole now exercises enlarged responsabilities instead of municipalities (but also of county-departement and region councils) in the fields of mobility, urban development, public spaces, water and sanitation, environment, economic development and employment, climate, energy, waste, housing, higher education, tourism.

This kind of administrative organisation enables investments that are essential for the attractiveness and influence of the territory, and allows the deployment of efficient public services in the 24 municipalities of the agglomeration.

Figure 3: The 24 municipalities of Nantes Métropole

The 24 municipalities of Nantes Métropole are: Basse-Goulaine, Bouaye, Bouguenais, Brains, Carquefou, Couëron, Indre, La Chapelle-sur-Erdre, La Montagne, Le Pellerin, Les Sorinières, Mauves-sur-Loire, Nantes, Orvault, Rezé, Saint-Aignan de Grand Lieu, Saint-Herblain, Saint-Jean-de-Boiseau, Saint-Léger-des-vignes, Saint-Sébastien-sur-Loire, Sainte-Luce-sur-Loire, Sautron, Thouaré-sur-Loire, Vertou.

4.1.1 Nantes Métropole, capital of a dynamic and attractive West

Located near the mouth of the estuary of the Loire river, Nantes Métropole has about 600,000 inhabitants; thus it is the "capital" of the Greater West and the 7th largest city in France by its population.

The metropolis of Nantes now benefits from a strong attractiveness and a strong economic dynamism. This growth is driven by both the dynamism

Figure 4: Geographic positionning of Nantes Métropole (reference: géoportail)

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

of the Nantes agglomeration and its surrounding environment, as well as by the attractiveness of the Atlantic coast.

This growth is also part of a context of great attractiveness in all of the French West, where the effects of the attractiveness of the coastline are particularly marked.

4.1.2 A metropolis connected and integrated into national and European flows

The Nantes metropolitan area enjoys satisfactory accessibility to major national and international metropolis, thanks to major transport infrastructures: Nantes-Atlantique international airport (60 regular destinations, including 33 European and 9 international destinations, 3.9 million passengers in 2013, an increase of + 97% since 2000), railway station served by high speed trains (2h10 to reach Paris with 21 TGV[1] per day, 11 million passengers per year in Nantes station), major roads and motorways.

The Nantes conurbation also has port infrastructures located throughout the estuary of the Loire, to its mouth in Saint-Nazaire. The port of Nantes Saint-Nazaire thus constitutes a major logistics tool, which allows to connect the local economic activities (but also those of all the French Great West) to the main corridors of national and European freight exchanges.

4.1.3 A major economic pole, backed by historical and emerging fields of excellence

With 330,000 jobs and just over 180 head offices of companies with more than 100 employees, the Nantes conurbation is the main economic center in the west of France. Its economic fabric is today diversified: Nantes Métropole is affirming itself both as a metropolis of services (which represent 8 jobs of the 10th) and as a territory of industrial excellence. Indeed, the territory has managed to preserve an important industrial base that is now structured around historical sectors that have been able to adapt and renew themselves (agri-food, shipbuilding), and emerging sectors that have grown more recently (aeronautics, health, marine energies, eco-industries, etc.). Most can rely on dedicated competitiveness clusters to support them in their development and innovation.

Economic activities linked to the creative and cultural industries are also in full development (notably around the creation district located on the Ile de Nantes).

Lastly, Nantes has established itself as a full-fledged tourist destination (urban tourism and business tourism), thanks to the enhancement of its urban and natural heritage (as part of the *Voyage à Nantes* for example), its proximity to the major seaside destinations (La Baule, Pornic, the Vendée coast), and recent and efficient facilities for business meetings (congress center, exhibition center ...).

4.1.4 An important university center

Nantes Métropole is also a leading academic area with nearly 120,000 students. The University of Nantes (33,000 students) and its branch in Saint-Nazaire (2,000 students), Audencia Group (3,000 students), the

[1] Train à Grande Vitesse: French high speed train

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

Ecole Centrale de Nantes (1,900 students), Oniris (1,000 students), École Pivaut (750 students) or Ecole des Mines (745 students) are the main institutions of higher education. About 3,400 foreign students attend the University of Nantes.

4.2 Socio-economic characterisation

Regarding the socio-economic aspects, Nantes Métropole has a diverse characterization, summarised in Figure 5. All these aspects are explained in the following subsections.

Figure 5: Summary of socio-eonomic aspects in Nantes Métropole

4.2.1 A territory with a strong population growth

The territory of Nantes Métropole counts 609,200 inhabitants (in 2013). The agglomeration of Nantes is experiencing an extremely strong population growth, which places it among the most dynamic territories in France. Today, the Nantes urban area is gaining close to 3,000 inhabitants per year (+ 0.5%) and for the past 20 years, 100,000 additional inhabitants have been welcomed on the metropolitan area of Nantes.

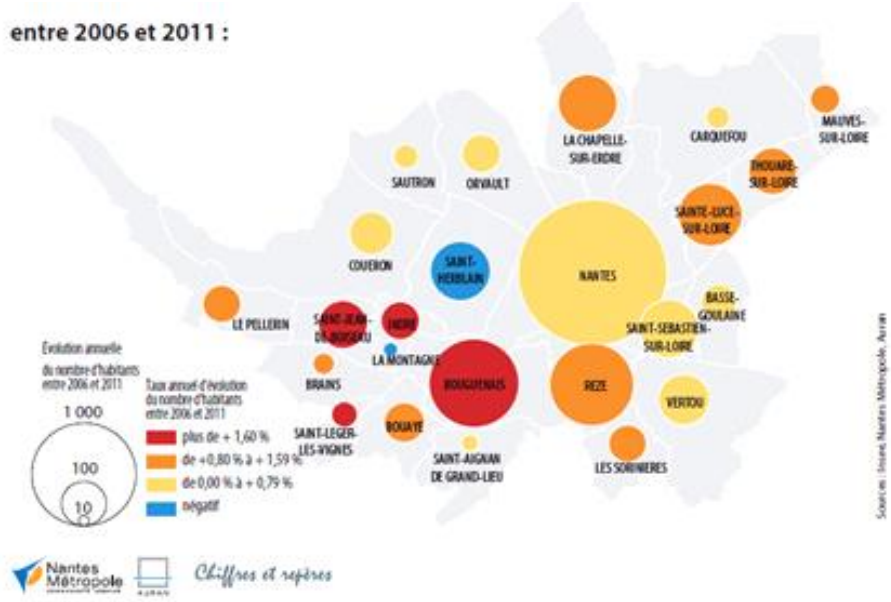


Figure 6: Population growth per areas in the 24 municipalities of Nantes Métropole (reference: AURAN)

While the various municipalities in the agglomeration are experiencing differentiated evolutions, almost all of them see their population increase. The municipality of Nantes, which totals 288,000 inhabitants (almost half of the inhabitants of the agglomeration) gains around 1,450 inhabitants every year.

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

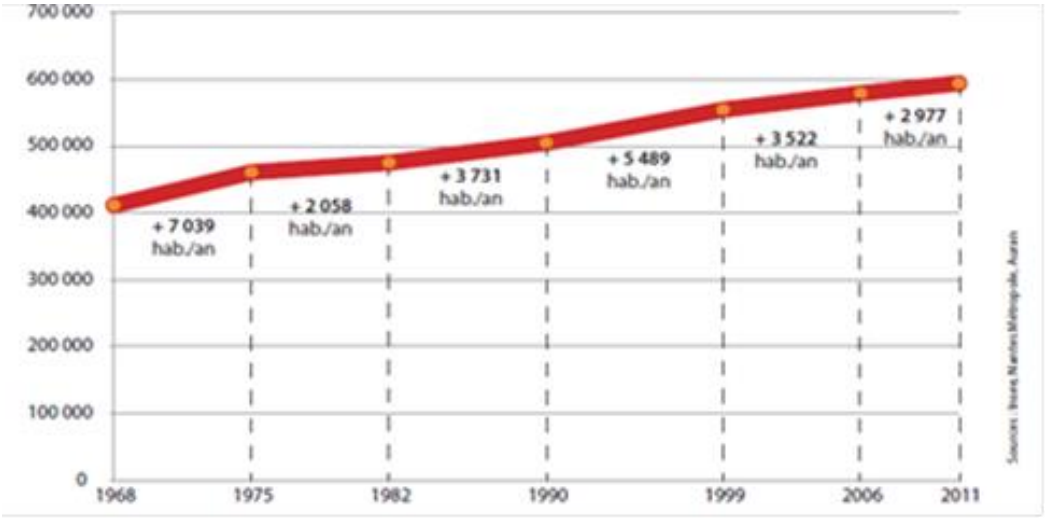


Figure 7: Population growth trend in Nantes Métropole (reference: AURAN)

The population growth of the agglomeration of Nantes is today mainly driven by the very largely positive natural balance. The net migration, which had largely contributed to population growth in the 1980s and 1990s, is now slightly negative. The residential attractiveness of the territory is rather manifested by a movement of urban sprawl towards cities located outside the perimeter of Nantes Métropole. It should be noted that in France, most of the major agglomerations, like Nantes, have a negative net migration.

4.2.2 A context of aging of the population

Despite the strong population growth observed in the Nantes conurbation, the number of younger has not changed or even slighly decreased. Since the end of the 1990s, the most noteworthy increases are only in the age groups above 45 years. For the past 10 years, the most important increases have been concentrated among the over 60s (especially those over 75 years of age), reflecting a real aging of the population in the Nantes area.

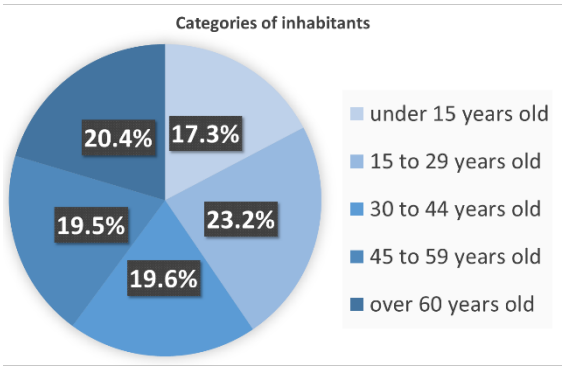


Figure 8: How old are Nantes inhabitants?

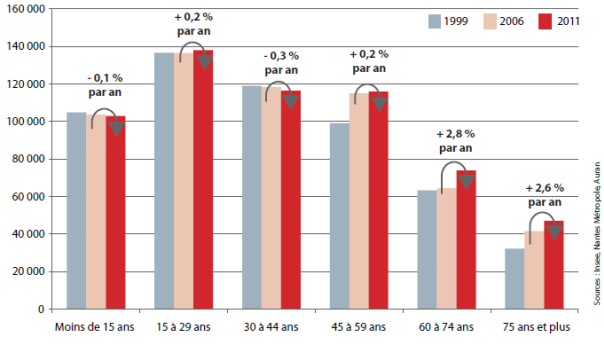


Figure 9: Population and its evolution by age groups in Nantes Métropole (reference: AURAN)

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

Nantes Métropole counts 114,000 pensioners or pre-retirees, and their number is growing more than 3 times faster than the rest of the population (+ 1.8% / year). This context of the aging of the population is a major issue for the future in terms of health needs, but also housing or transport needs.

4.2.3 An active population that is transforming

The Nantes conurbation has nearly 300,000 working-age adults (up by +0.9% / year since 2006). Women account for 49% of this population and their number is growing faster than that of men. The level of qualification of the active population increases significantly: people without any qualification now represent 11% of the workforce, compared with almost 13% in 2006, and the working people graduated from higher education increase strongly (32% today compared to 27% in 2006).

This trend is explained in particular by an increase in the number of middle managers and intermediate professions, who represent the vast majority of the working people profiles that arrived on the territory of the agglomeration in recent years.

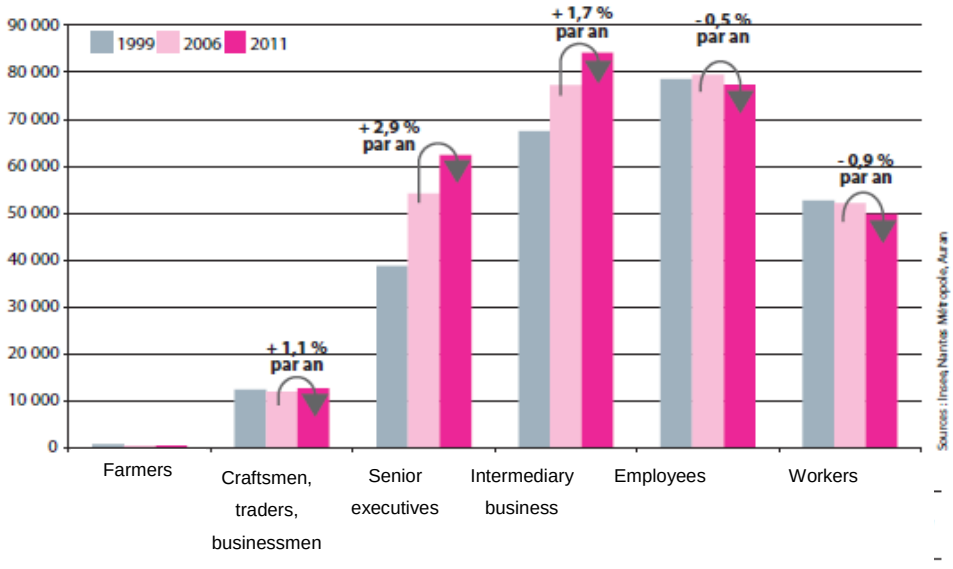


Figure 10: Evolution of the working population by socio-professionnal groups in Nantes Métropole (reference: AURAN)

Consequently, despite the significant increase in the working population, some business activities occupations are experiencing a labour shortage (particularly low-skilled jobss in industry).Besides, the unemployment rate observed in Nantes Métropole has risen sharply since the 2008 crisis (9.7% of working-age adults in 2014[2]) even if it remains below national averages.

[2] According to the population census figures (INSEE); but according to the International Labour Office definition, the unemployment rate was 8,1% (4rd quarter of 2013) – see: http://pays-de-la-loire.direccte.gouv.fr/sites/pays-de-la-loire.direccte.gouv.fr/IMG/pdf/Note_taux_de_chomage_4eme_trimestre_2013DIFF.pdf

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

4.2.4 A diversified job-creating economic fabric

Despite the economic crisis that has affected France and Europe in recent years, the agglomeration of Nantes has experienced a rather exceptional economic dynamic: employment has increased by 1.3% / year since 2006 (+ 5,700 jobs created annually), placing Nantes in third position among the major French agglomerations.

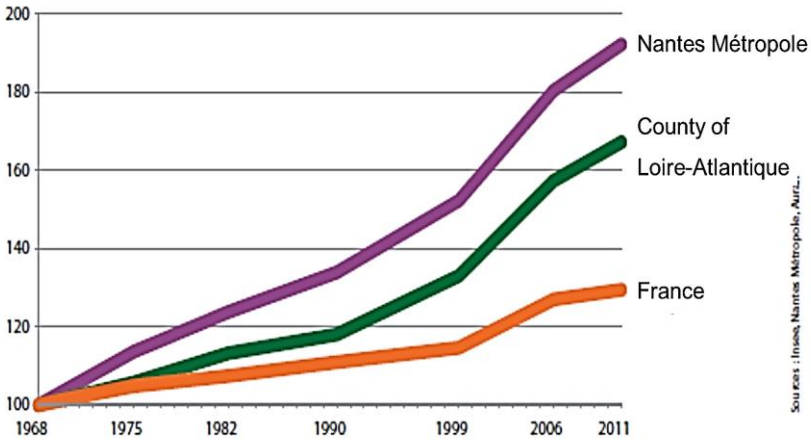


Figure 11: Number of jobs created since 1968 (reference: AURAN)

Since the end of the 1990s, the Nantes economy has been largely expanded towards service industries (4 out of 5 jobs are now in the tertiary sector), due to the growth of personal services, the development of higher metropolitan functions (consultancy, creative activities ...) and the outsourcing of certain activities previously carried out by industrial sectors (accounting, cleaning, human resources, etc.). Some sectors are particularly concerned with the development of employment in the service industries:

- the new information and communication technologies (Nantes is certified "Métropole FrenchTech"),
- logistics and transport,
- health and biotechnology,
- financial services.

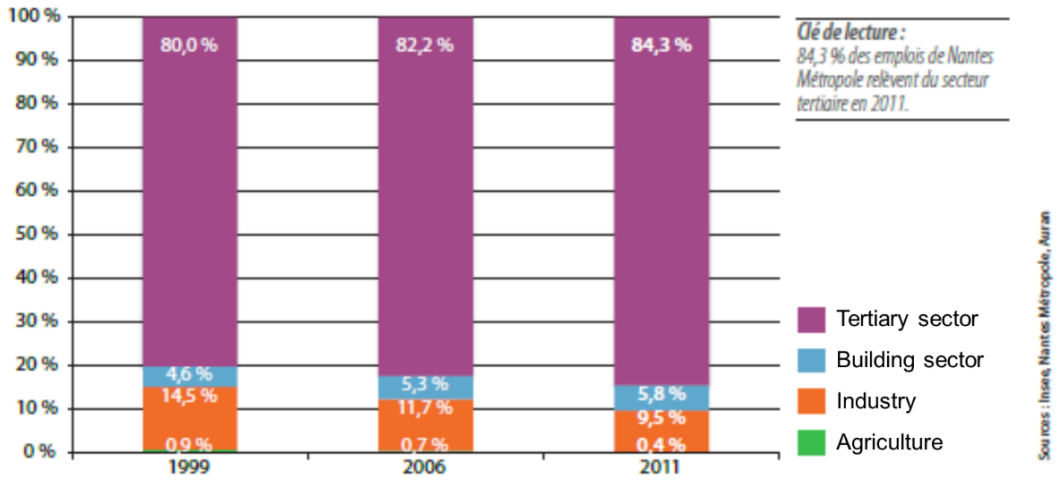


Figure 12: Evolution of jobs by activity sectors in Nantes Métropole (reference: AURAN)

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

The service sector is experiencing very strong growth as a result of the development of large services projects in the heart and on the outskirts of the Nantes metropolitan area. Nantes also intends to be the most important business center of the Atlantic seaboard with an offer of 600,000 m2 dedicated to services industries scheduled for 2020.

The industrial sector, however, still accounts for 10% of jobs in the agglomeration (30,500 jobs) despite reductions in the number of employees in recent years (a 2.9% decrease since 2006 in the industrial sectors). Previously highly specialized (especially in the shipbuilding industry), the industrial sector has managed to transform and diversify, in particular for new sectors. As a vector of added value and innovation, it is now structured around several dynamic sectors:

- Aeronautics, with an Airbus site in Nantes and another one in Saint-Nazaire (4,000 direct jobs), and the Neopolia cluster, which brings together around 145 companies and 13,000 employees
- Boating and shipbuilding. Nantes Saint-Nazaire is the first shipbuilding center in France (with STX France, DCNS, Bénéteau ...)
- Food processing, with the national food market in Nantes (the second biggest in France after Paris-Rungis), United Biscuits (BN), Kraft Food (LU), Tipiak...

4.2.5 Nantes, a tourist destination

Nantes is also a tourist destination that attracts several million visitors each year.

The agglomeration enjoys both its proximity to the coastline which constitutes a traditional tourist destination, but also emblematic sites and facilities such as the Castle of the Dukes of Brittany (1,277,000 visitors in 2012), or the Machines of the Island / the great Elephant (505,000 visitors). These sites are part of an original tourism offering, highlighting the cultural, historical, architectural and natural heritage of Nantes (and especially the Loire, to its mouth at Saint-Nazaire).

Nantes Métropole tourism also benefits from the development of new recreational activities, such as cycling tourism: the itineraries of the "Loire à Vélo" attract nearly 800,000 cyclists, of whom nearly 1/3 of foreigners.

Nantes is finally a major destination for professional tourism (69% of overnight stays are business customers, 9.2% of which are foreign customers). Corporate events and trade shows generated 100,000 visitors in 2014 in the two main facilities of the conurbation (Cité Internationale des Congrès and Parc des Expositions de la Beaujoire).

4.3 Climatic characterisation

The climate of the Nantes agglomeration is of temperate type oceanic, strongly influenced by the proximity of the Atlantic coast. On a relatively flat landscape, the climate of Nantes does not mark great differences from one place to another. The climatic elements to be retained are:

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

- morning mists in the bottom of the valley and the favorable sunshine insolation in the south and south-west;
- Nantes is under the dominant west winds linked to cyclonic depressions of the Atlantic. The presence of north, northwest, and west winds is common;
- the direction of the winds from south-west and north-east to east-north is rather rare.

The winters are mild and rainy (about 5° C on average), and the summers are hot without excess (18.5° C on average).

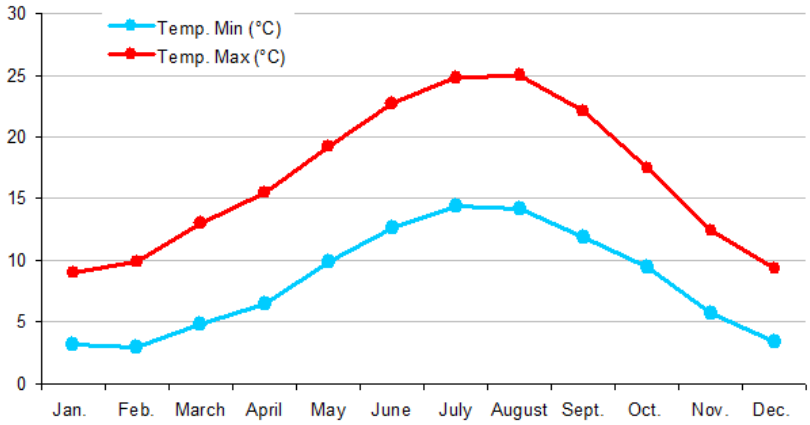


Figure 14: Temperatures in Nantes Métropole (reference: Météo France)

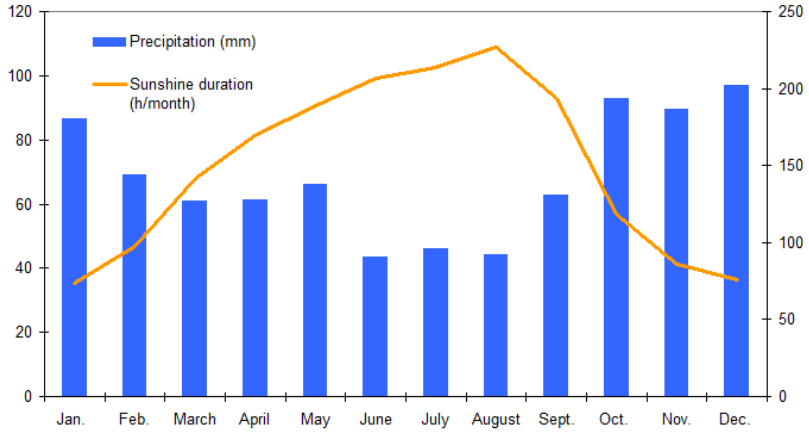


Figure 15: Precipitation and sunshine in Nantes Métropole (reference: Météo France)

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

Table 3: Climate data in Nantes MétropoleUrban morphology and land use characterisation

Indicator	Value	Source
Total annual precipitation	820 mm	Météo France
Number of days with precipitation (days/yr)	119,1 days	Météo France
Average annual temperature	12 ° C	SEAP – Plan d'action en faveur de l'énergie durable de Nantes Métropole – Etat d'avancement 2017
Average annual temperature in winters	Min: -5 ° C max: 10 ° C	SEAP – Plan d'action en faveur de l'énergie durable de Nantes Métropole – Etat d'avancement 2017
Average annual temperature in summers	Mini: 17 ° C max: 35 ° C	SEAP – Plan d'action en faveur de l'énergie durable de Nantes Métropole – Etat d'avancement 2017
Sunshine duration (h/yr)	1791,3 h	Météo France
Number of days of good sunshine (days/yr)	57,6 days	Météo France
Global solar radiation [kWh/m2/yr]	1 257 kWh/m²/year	Ines[4]
Average wind speed [m/s]	3,67 m/s (average over the period 1990-2016)	https://www.tameteo.com/meteo_Nantes-Europe-France-Loire+Atlantique-LFRS-sactual-26143.html
Average annual rel. humidity [%]	81 %	www.meteo-nantes.net
Heating degree day (HDD) [°C]	1945 (base 18°C, méthod Météo-France; reference period: 01/01 to 15/05 and 15/10 to 31/12)	Nantes Métropole
Climatic zone	Temperate oceanic climate	

[3] Reference: Météo France - http://www.meteofrance.com/climat/france/nantes/44020001/normales

[4] Institut national de l'énergie solaire - http://ines.solaire.free.fr/gisesol_1.php

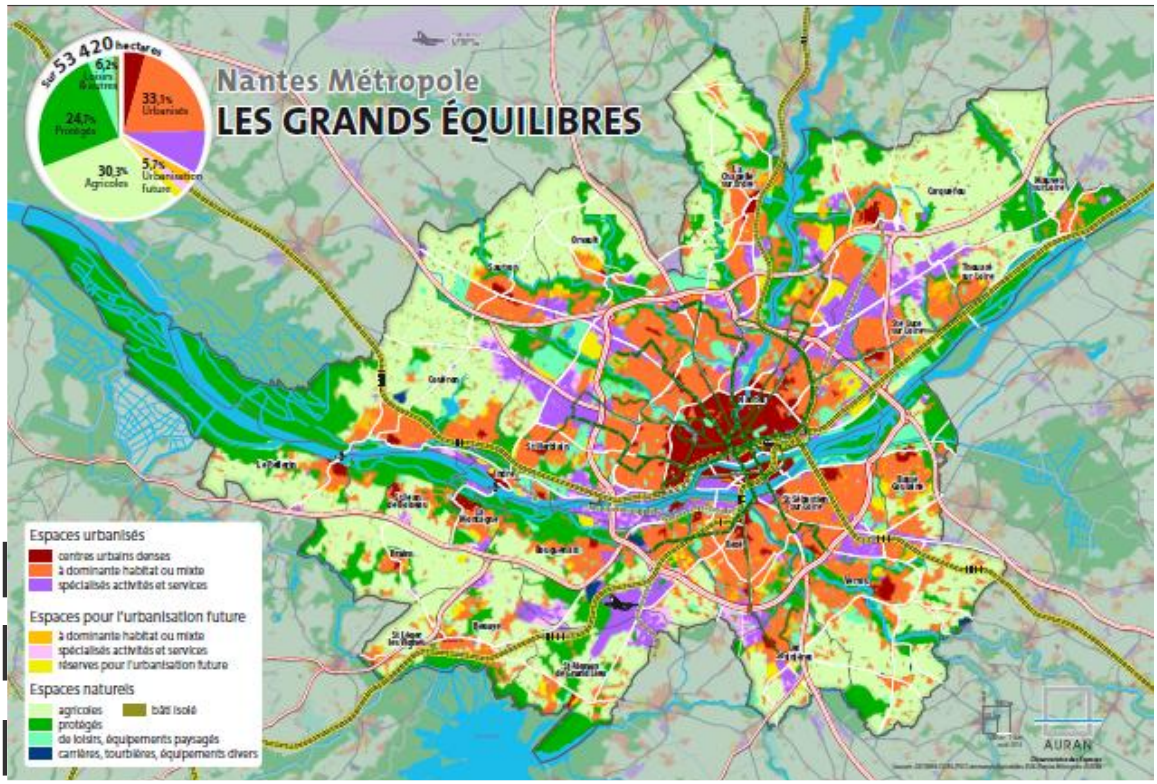
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

4.4 Urban morphology and land use characterisation

4.4.1 Use of space

The territory of Nantes Métropole covers 523 km² (52,300 ha). Approximately 30% of the urban area is urbanized, and almost 6% is destined for future urbanization. Agricultural areas account for 30% and protected areas for 25%; 6% of the territory is occupied by recreational areas. In total, agricultural and natural spaces cover 61% of the territory of the Nantes conurbation.

It should also be noted that the territory of Nantes Métropole is crossed by more than 250 km of main rivers and houses more than 9,250 ha of wetlands.



Urban spaces

Spaces for future urbanisation

Natural spaces

Figure 16: Space occupation in Nantes Métropole (reference: AURAN)

4.4.2 Space consumption

The demographic dynamics that the agglomeration of Nantes has experienced for several decades came along with a significant increase of urban areas; they have grown faster than the population (in 30 years urban areas have been multiplied 3 when the population increased by 50%).

Today, the space consumption amounts to about 160 ha per year at the Nantes Métropole level. Approximately 100 ha (63%) are used for housing and 60 ha (37%) for economic activity. It is important to

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

underline that about 1/3 of the space consumption is filling the existing urban fabric, the remaining 2/3 being in the form of urban extension.

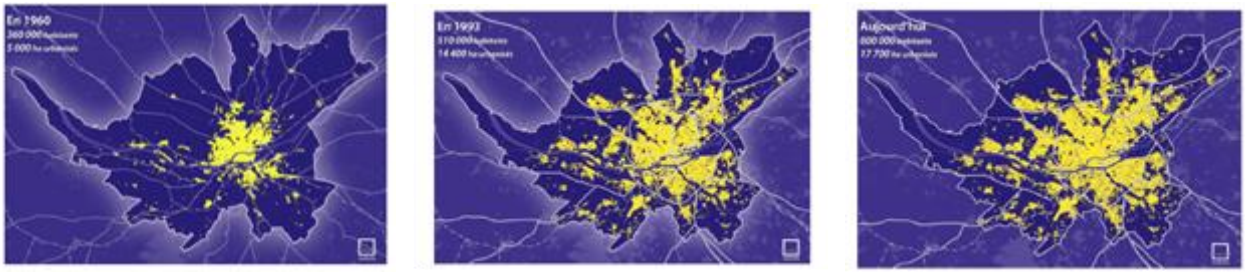


Figure 17: Evolution of urban spread since 1968 (reference: AURAN)

Since the 2000s, the fight against urban sprawl and the urbanization of agricultural areas have been one of the main objectives of urban planning and development policies in the Nantes conurbation. The actions achieved by Nantes Métropole in the field of economical land management are beginning to bear fruitful although the annual consumption of space by urbanization has remained broadly stable since the 2000s, the number of housing per ha has almost doubled compared to a decade ago.

Focus on the Island of Nantes

With its 337 hectares in the heart of the river, the Island of Nantes represents 0.6% of the territory of the agglomeration of Nantes.

The Island of Nantes has 93% urbanized areas for housing or economic activities; 5% of the surface of the island is occupied by natural spaces.

Since the early 2000s, the Island of Nantes has been the subject of a major urban renewal project; the aim is to make the island, which today presents a composite face, a real heart of agglomeration by developing all the urban functions of centrality: quality housing, economic activities, shops, public transport, metropolitan facilities, socio-cultural and leisure facilities...

As an alternative to urban sprawl, the island of Nantes project takes the gamble of a dense city, irrigated by public transport and soft transports. It is the subject of a measured transformation, respectful of the existing, attentive to the management of natural resources and concerned with the environment. Public spaces play an essential role and support a certain form of urban ecology

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

4.4.3 Housing stock and property market

Nantes Métropole has 311,600 dwellings (in 2013); their number now increases by +1.9%/year, a much higher rate than the population (increasing by + 0.5% to + 1% per year). This difference is explained by the decrease in the average size of households, as a result of the aging of the population and decohabitation.

The growth of the housing stock concerns all the municipalities of the Nantes conurbation, even if by its demographic weight, the municipality of Nantes concentrates almost half of the new constructions registered at the metropolitain level.

Production of housing is now about 7,000 per year, making the Nantes property market one of the most dynamic in France. More than 1/3 of the new dwellings are part of public initiative and 22% of these new dwellings are social housing. This latter figure shows a strengthening of the weight of social housing in the production of new housing, even if it remains below the target of 33% set by Nantes Métropole in its Housing Local Plan (PLH).

The total housing stock in Nantes Métropole consists of 41% of houses and 59% of apartments; the proportion of multi-family buildings is on the rise, whereas it accounted for only 56% 10 years ago. Vacant units represent 6% of the building stock, a figure clearly lower than the national average (9%).

The average surface of the housing is about 76 m². 31% of dwellings have 1 or 2 rooms and, while 23% have 5 rooms and more.

Compared to the national level, the housing stock in Nantes Métropole is more recent: 18% of dwellings have been built since 2000 (compared with 14% in France), and dwellings built before 1949 represent 22% (compared to 34% in France).

The building stock is the largest source of CO2 emissions in the Nantes Métropole area (31% of the total emissions) and the largest energy-using item.

A priori, the most energy consuming housing concerns the older homes, especially those built before 1974 that represent about 116,000 units (a little more than 1/3 of the housing units in the conurbation). Among them, 78,000 are occupied by their owner, and 38,000 by private sector tenants. In these dwellings, there may also be situations of energy poverty, situations resulting from the combination of a household with low incomes, bad thermal efficiency of the dwelling and high costs of energy.

4.5 Environmental characterisation

4.5.1 Natural heritage

Located between the Loire River and the ocean, Nantes' area has an exceptional natural heritage. Protection of biodiversity, aquatic environments, agriculture and the development of urban forests are essential for the development of the territory.

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

On this day, 61% of the Nantes Métropole area is classified as a natural and agricultural area; this represents 15,400 ha of agricultural areas and 17,200 ha of natural areas.

In addition, 14% of the Nantes' area is covered by regulatory protection areas ; the perimeter of Nantes Métropole also includes 5 Natura 2000 areas, 2 regional nature reserves, 1 national nature reserve, 4 bird conservation areas, and 31 natural areas of ecological, fauna and flora interest.

Wetlands

Nantes Métropole's area has an important rivers system (1,040 km) and important wetlands (9,250 ha). The main part of wetlands are maintained by agriculture activities, and in particular by livestock farming activites.

Wetlands shelter specific fauna and flora. They also perform many functions, such as reducing flooding risks, maintaining the quality of water and living environments, storing carbon...

Biodiversity

Biodiversity knowledge at the Nantes Métropole level considerably increased over the past 10 years, thanks to many studies and close collaboration with naturalist associations. Since 2015, Nantes Métropole publishes an atlas which presents the local biodiversity and draws up an inventory of actions, spaces and species over time.

To date, 1,298 plant species have been identified in the area, including 154 remarkable species. Regarding wildlife, 408 animal species have been censused.

Agriculture

In addition to its function of maintaining wetlands and landscapes, agriculture represents an important economic activity (330 farms, 1,400 jobs), with a wide variety of productions and emblematic local products.

Nantes Métropole is carrying out various actions to support this suburban agricultural activity, in close collaboration with various partners: the Chamber of Agriculture of Loire Atlantique, the Land Development and Rural Settlement Company (SAFER), the Loire-Atlantique Departmental Council. Protection perimeters for suburban agricultural and natural areas (PEAN[7]) have been set up. This leagal tool makes it possible to limit urban sprawl, to preserve agricultural and natural lands, and to encourage the development of agricultural activites around the Nantes conurbation.

Through its future PLUm (Metropolitan Urbanism Plan), Nantes Métropole is committed to preserving the biological diversity of the territory by defining a "Green and Blue belt network"; it is protected from urbanization, and will constitute the natural framework of the territory. It will include ecological continuities, agricultural spaces, watercourses, wetlands and flood plains, spaces for nature in the city...

[7] PEAN: Périmètre de protection des Espaces Agricoles et Naturels Périurbains

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

In addition, Nantes Métropole is developing urban forests: this concerns 1,400 ha spread over 3 sites and 8 municipalities in the agglomeration.

The objective is both to preserve and enlarge wooded areas, to facilitate public access to them and to set up a sustainable management by producing wood while preserving biodiversity.

4.5.2 Natural risks

Within the Nantes Métropole perimeter, the main natural risk concerns floods especially for sectors crossed by the 3 main rivers: the Loire river, the Erdre river and the Sèvre Nantaise river. Some road infrastructures (like the ring-road) are also exposed to flooding.

4.5.3 Water

Nantes Métropole manages public services for drinking water and sanitation and also operates some infrastructures.

The water consumed in Nantes comes mainly from the Loire river, which is an abundant reserve to cover the water needs of the conurbation.

Consumption decreased from 139 L / day / inhabitant in 2004 to around 120 L / day / inhabitant in 2015. This figure is a bit below the average consumption in France.

4.5.4 Household waste

Nantes Métropole provides the household waste disposal service in its 24 municipalities. This concerns waste prevention, collection, sorting, processing and recycling.

In 2015, 306,536 tons of household waste were collected, or 504 kg / inhabitant. This figure has been declining (it was 512 kg / inhabitant in 2010); however, the overall volume of waste collected increases (in relation to the population increase).

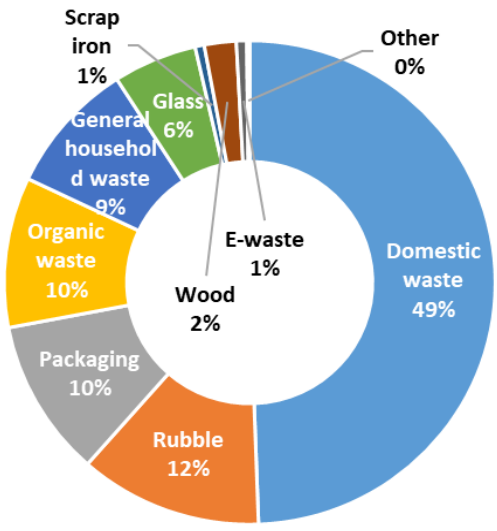


Figure 19: Household waste collected in 2015 (reference: Nantes Métropole)

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

Nantes Métropole has been certified "Zero waste" since 2014 by the French Ministry of the Environment. This comes to reward the city action, but also citizens, associations and companies commitment.

4.5.5 Air quality

The air quality on the territory of the metropolitan area of Nantes - Saint-Nazaire is rather good. The 2012 assessment of the air quality did not mention any exceeding of the limit thresholds in the 5 measurement stations of the metropolitan area (3 in Nantes, 2 in Saint-Nazaire). The risks of exceeding the quality thresholds essentially concern areas near the main roads and near facilies of energy production, which are the main sources of air pollution in the region.

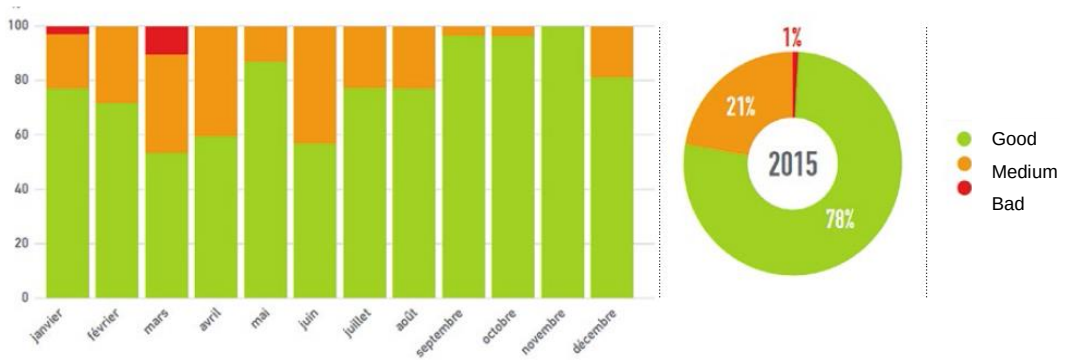


Figure 20: Number of days (per month) broken down by air quality index in 2015 (reference: Nantes Métropole)

Pollution due to fine particules is a rising concern, even though the current situation in the Nantes area remains well below the annual limit values. This pollution is the result of very diverse sources of emissions (road, heating, agriculture, burning, industry, ...) and of phenomena of different scales (regional to european scales). Air quality tends to improve over the years across the region. However, a decrease in the number of days with a very good index of air quality was recorded on the Nantes conurbation, as well as on the Saint-Nazaire conurbation. This deterioration is even more marked during the summer period near the main roads, because of the high traffic due to influx of tourists.

Nantes Métropole is committed to the protection of air quality through its Atmosphere Protection Plan (PPA, Plan de Protection de l'Atmosphère), adopted on August 13th, 2015. This plan concerns the same perimeter as the Territorial Coherence Scheme (see below) and enables consistency in actions against air pollution. Similarly, speed regulation plans have been developed by several local authorities (including Nantes Métropole) and contribute to the preservation of air quality. The prospective evaluation of the air quality (based on simulation models) to the horizons 2015 and 2020 conducted by "Air Pays de la Loire" underlines the positive impacts of the actions implemented by Nantes Métropole in the Urban Mobilty Plan (PDU) and in the Atmosphere Protection Plan. For example, the number of inhabitants exposed to annual limits values for nitrogen dioxide should sharply decrease to zero by 2020.

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

4.5.6 Noise

The strategic noise maps (CBS, Cartes de Bruit Stratégiques) carried out by Nantes Métropole show that 32% of the population is affected by noise pollution from all sources (road noise, railway, others facilities). These maps make it possible to identify the main areas concerned by this matter on the island of Nantes.

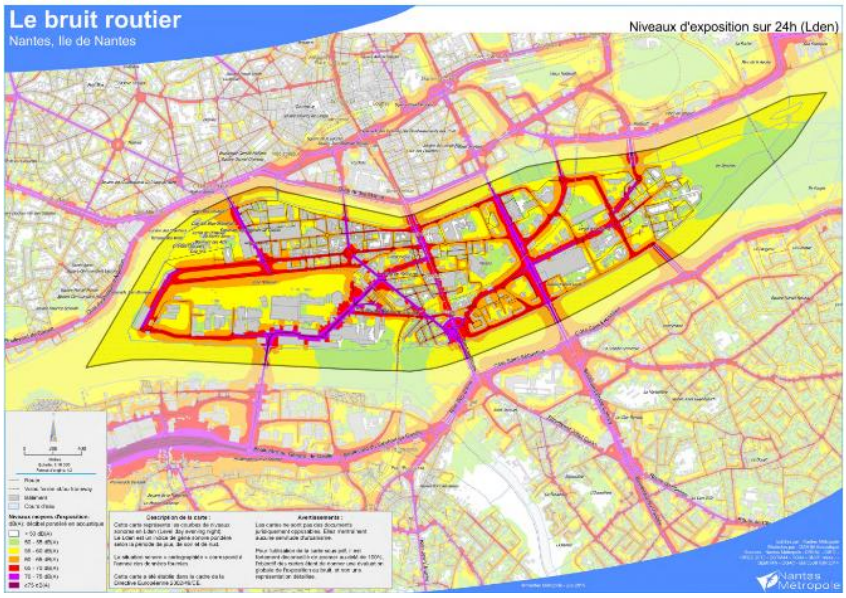


Figure 21: Road noise exposure (24h, Lden) (reference: Nantes Métropole)

On the territory of Nantes Métropole, noise nuisances are therefore mainly related to transport infrastructures. They come mainly from road traffic, tramway and rail traffic and air traffic (the proximity of the airport requires an overflight of Nantes during the landing phases). These nuisances concern the populations located in the city center, but also in the suburbs, near roads serving the agglomeration.

This problem is taken into account by the public policies (mobility and urban planning). For exemple, Nantes Métropole develop the concept of "calm city" (publics spaces are designed to meet the needs of pedestrian and cyclists, access to the public transport system is improving, urban policies support a better cohabitation bettween the different road users...). All these actions have positive impacts by reducing noise pollution in particular due to road traffic.

Finally, the Nantes Atlantique Airport is the subject of a Noise Exposure Plan. The project of a new airport (aéroport du Grand Ouest) and the relocation of air traffic on the north of the urban area would also significantly reduce the number of inhabitants affected by noise pollution due to the Nantes Atlantique Airport (from 42,000 inhabitants today to 2,700 when the new airport will be built).

4.5.7 Greenhouse gas emissions

Greenhouse gas emissions across the Nantes Métropole territory are estimated (for 2012) at 2.2 Mtons eqCO2. Almost half of the emissions come from the transport sector. The remainder is distributed at 33% for the residential sector and 18% for the tertiary sector.

It is estimated that :

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

- local public authorities (Nantes Métropole and the 24 municipalities) are responsible for 6% of the GHG emissions (through publics buildings and facilities and public vehicles fleets);
- 94% of the remainder emissions are due to all the other activities accross the territory.

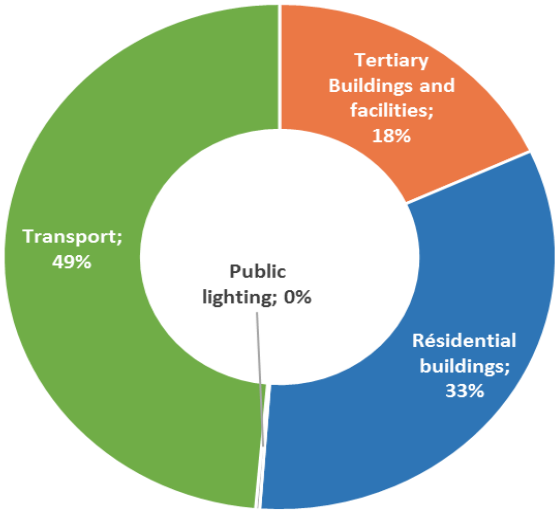


Figure 22: Greenhouse gas emessions split by sectors (reference: SEAP Nantes Métropole)

The public policies carried out by Nantes Métropole (mobility, housing, urbanism and land planning ...) do not allow to act the main part of the GHG emisions. Nantes Métropole must therefore carry out actions of territorial animation towards the inhabitants and the companies, because individual behaviors and strategies of the local actors will be decisive for reducing the emissions linked to the activities of the territory.

Nantes Métropole now has tools to objectively evaluate the evolution of GHG emissions on its territory. The analyzes show that energy-related GHG emissions decreased between 2003 and 2012 for the three following sectors: residential, tertiary and transportsectors. This is also the case for emissions of local atmospheric pollutants.

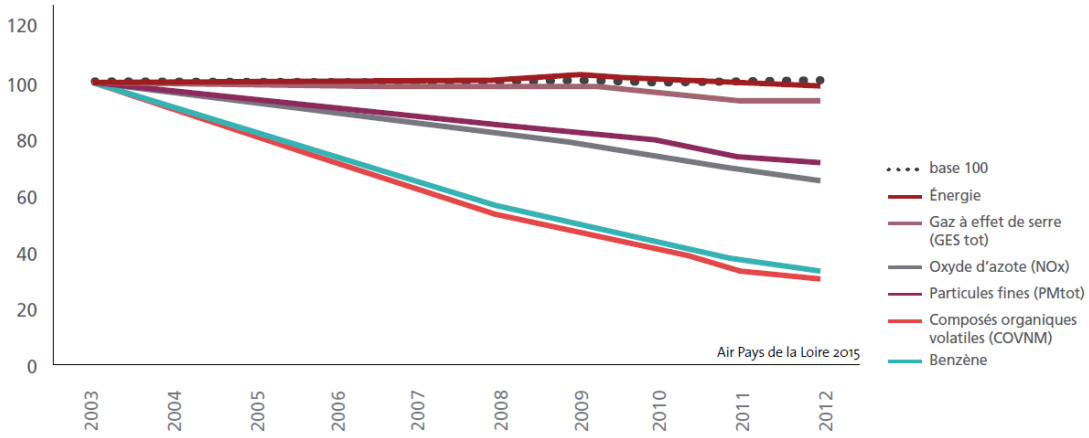


Figure 23: Evolution of consumption and emissions per inhabitants in Nantes Métropole (reference: Nantes Métropole)

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

4.6 Calculation of indicators for city characterization

The indicators selected for City Characterization are being calculated and they are showing in the following table.

Table 4: Indicators for city characterization

Indicator	Units	Value	Reference
Size	km2	523	INSEE[9]
Population	Inh	619,240 (in 2014)	INSEE
Population density	Inh./km2	1,184 (in 2014)	INSEE
People > 75 years	%	8,1%	INSEE
Type of city		metropolitian	
Land consumption	nº build/Km2	556.9	
Land consumption	Total built surface/Total city surface	0.41	INSEE[10] and DGFiP
Balance between residential and no-residential building use	%	non-available	
Overall CO2 emission reduction target	%	-30% by 2020 -50% by 2030 (tons of GHG EqCo2 per capita, compared to 2003)	Nantes Métropole[11]
Tourism intensity	# hotel nights / 100,000 inh.	254,436.6 (1 575 573 hotel nights (2012)	Nantes Métropole[12]
Climate koppen geiger classification		Cfb	http://koeppen-geiger.vu-wien.ac.at/pdf/kottek_et_al_2006_A4.pdf
Smart energy meters	# of smart electricity meters (Linky)	non-available* *130,000 Smart electricity meters (on sept 2017), 0 gas smart meters	Enedis
Number of connections to a district heating network	% of buildings	25,973 housing including 15,580social housing (in 2016) (excluding housing units connected to private district heating),	Nantes Métropole

[9] INSEE (Institut National de la Statistique et des Etudes Economiques): https://www.insee.fr/fr/statistiques/1405599?geo=EPCI-244400404

[10] https://www.insee.fr/fr/statistiques/2501732

[11] https://www.nantesmetropole.fr/medias/fichier/rapport-annuel-dev-durable15-nm_1447342484850.pdf?INLINE=FALSE

[12] https://www.nantesmetropole.fr/institution-metropolitaine/competences/tourisme-28884.kjsp

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

Indicator	Units	Value	Reference
		or about 7,8% of the Nantes Métropole's housing stock	
Greenhouse gas emissions per capita	tonnes CO2/capita	3,67 (in 2012)	Air Pays de la Loire - Basemis V3
Greenhouse gas emissions (tertiary)	Mtonnes CO2/year (tertiary buildings, equipment / faclities)	0,4 (in 2012)	Air Pays de la Loire - Basemis V3
Greenhouse gas emissions (transport)	Mtonnes CO2/year (municipal fleet, public transport, private and commercial transport)	1,7 (in 2012)	Air Pays de la Loire - Basemis V3
Greenhouse gas emissions (Residential)	Mtonnes CO2/year	0,7 (in 2012)	Air Pays de la Loire - Basemis V3
Greenhouse gas emissions in buildings, equipment/facilities and Industries	Mtonnes CO2/year	1,12 Mt/year (=municipal buildings , equipment and facilities+ tertiary + residential) (in 2012)	Air Pays de la Loire - Basemis V3
Greenhouse gas emissions (Public lighting)	Mtonnes CO2/year	0,004 Mt/year (in 2012)	Air Pays de la Loire - Basemis V3
Greenhouse gas emissions (Municipal building, equipments / facilities)	Mtonnes CO2/year	0,019 Mt/year (in 2012)	Air Pays de la Loire - Basemis V3
Transport greenhouse gas emissions per capita	t /(pers.·a)	1,79 t / inh (in 2012)	Air Pays de la Loire - Basemis V3
Water consumption	m3/cap/day	0,138 (in 2015)	Nantes Métropole (Rapport annuel sur l'eau, 2015)
NOx emissions	g/cap	Tot / inh = 9 384 g/inh (in 2012)	Air Pays de la Loire - Basemis V3
PM emissions (total: from 10 to 2,5)	g/cap	Tot / inh = 1 739 g/inh (in 2012)	Air Pays de la Loire - Basemis V3
Air quality index	index	0.53 (roadside index) 0.28 (background index)	Air Pays de la Loire[13]
Recycling rate	% tonnes	80.4%* 51% in energy recovery 19% in material recovery 10% in organic recovery (in 2015)	Nantes Métropole (Rapport annuel sur le prix et la qualité du service d'élimination des déchets ménagers et assimilés, 2015)
Exposure to noise pollution	%of people	13%	
Amount of solid waste collected	tonnes/capita/year	0,503 (in 2015) (including household waste,rubble, wrapping, green Waste, general waste, glass, wood, electric and electronic waste, furnitures, and other waste)	Nantes Métropole (Rapport annuel sur le prix et la qualité du service d'élimination des déchets ménagers et assimilés, 2015)
Voter participation	%	44% (2017 legislative election, 2nd round)	Ministère de l'Intérieur[14]

[13] http://www.airpl.org/Publications/rapports/13-06-2016-rapport-annuel-2015

[14] https://www.data.gouv.fr/fr/datasets/elections-legislatives-des-11-et-18-juin-2017-resultats-du-2nd-tour-par-communes/

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

Indicator	Units	Value	Reference
Unemployment rate	%	7,9% (at the "employment area" level, 3rd quarter of 2016)	DIRECCTE Pays de la Loire[15]
Youth unemployment rate	%	non-available	
Fuel poverty	%-points in €	non-available	
Costs of housing	% in €	non-available	
Green public procurement	Qualitative Likert scale	non-available	
GDP	€/cap	" 32,595* * at the Loie-atlantique department level "	
Population Dependency Ratio	#/100 = (number of 0-14 years old + 65 years old and over) / number of 15-64 years old)	49,8% (in 2014)	INSEE

[15] http://pays-de-la-loire.direccte.gouv.fr/sites/pays-de-la-loire.direccte.gouv.fr/IMG/pdf/note_tx_de_chomage_2016_t3-2.pdf

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

5. Existing urban plans for promoting low energy districts and sustainable mobility

In the following sections, the current status of the most important urban plans promoting sustainability in the urbansim, building and mobility sectors are listed. Section 5.7 lists some of the national/international awards that Nantes has received in terms of sustainability.

Figure 24: Summary of current building stock and mobility plans

5.1 Current status

The development of the territory of the Nantes metropolitan area is the result of a voluntary project carried for decades by local public actors to build together a metropolitan area being both balanced and inclusive, attractive and carrying strong environmental ambitions.

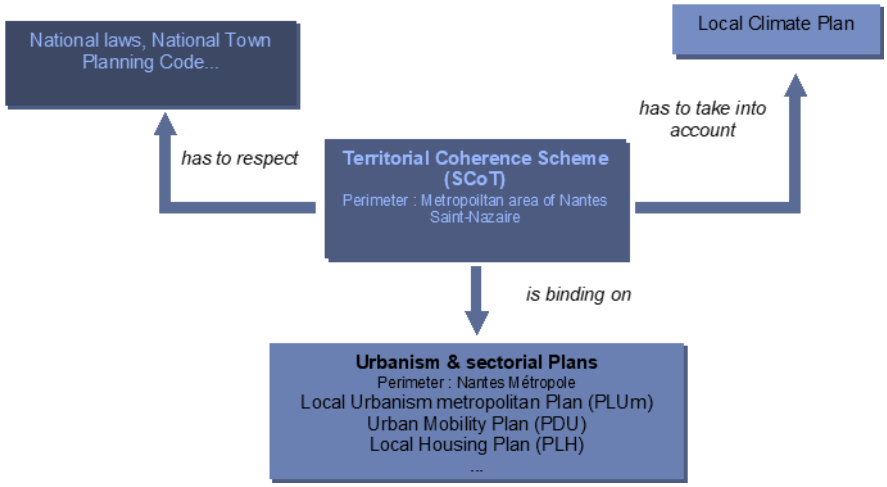


Figure 25: Legal & reglementary relationships between Strategic Plans of Nantes Métropole

There has been a sharp acceleration in the integration of metropolitan issues with the creation in 2001 of 2 public organisations for inter-municipal cooperation (Nantes Métropole and Saint-Nazaire Agglomération[17]) and the subsequent decision to establish a common Territorial Coherence Scheme (SCoT). This common land planning plan represents a key element in a shared strategy for the development of the territory from Nantes to Saint-Nazaire, at the mouth of the Loire estuary.

[17] Saint-Nazaire Agglomération is called CARENE: Communauté d'Agglomération de la Région Nazairienne et de l'Estuaire

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

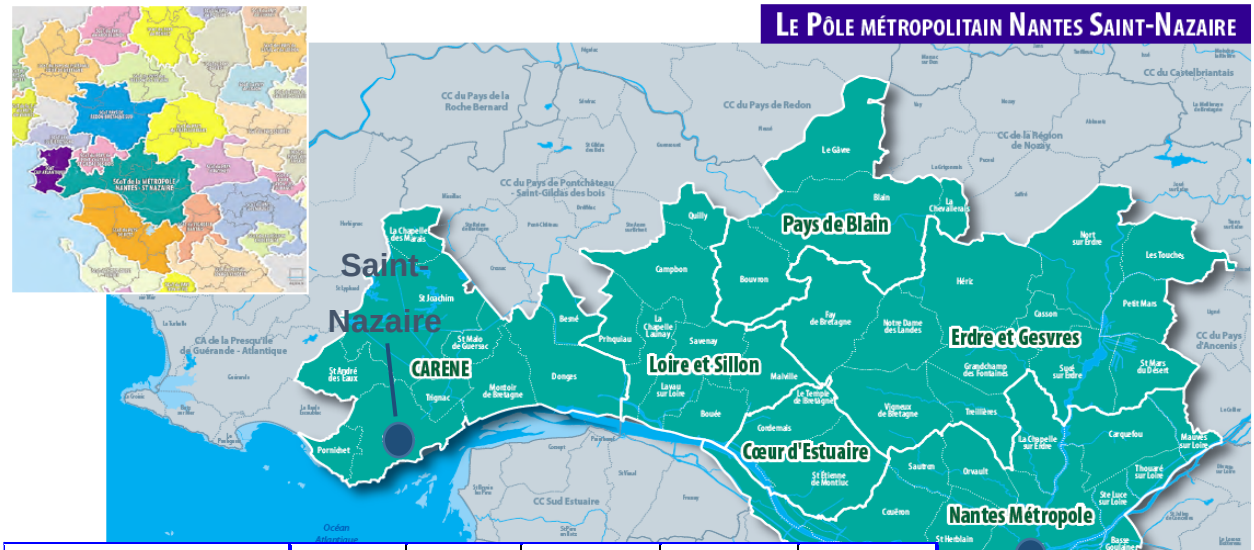
Beyond the SCoT (a new version has just been approved in 2016), the Metropolitan project has been steadily strengthened through the drafting of different strategic plans (Urban Mobility Plan, Local Housing Plan, Local Urbanism Plan...) as well as the commitment of the territory in resolutely proactive approaches, especially in terms of citizen involvement or environmental protection (Convention of Mayors, Eco-city, European green capital ...).

To date, Nantes Métropole has drafetd many plans and schemes, which together constitute a vision and a coherent strategic framework for the future of the city at the 2030 horizon. They define clear and ambitious goals in the fields of urban sprawl control, energy efficiency and reducing emissions of greenhouse gases, biodiversity conservation or sustainable mobility.

5.2 Territorial Coherence Scheme (SCoT) of Nantes Saint-Nazaire

5.2.1 General presentation

Adopted on December 2016, the SCoT (Territorial Coherence Scheme) of Nantes - Saint-Nazaire is a strategic planning document, which sets major development trends for the next 15 years in a sustainable development perspective across the territory from Nantes to Saint-Nazaire.



Public organisations for inter-municipal cooperation & urban agglomerations	Number of municipailities	Surface area (ha)	Population (2013)	Housing (2012)	Jobs (2012)
Communauté de Communes Cœur d'Estuaire	3	9 680	11 931	4 694	3 957
Communauté de Communes d'Erdre et Gesvres	12	50 980	57 776	22 483	13 653
Communauté de Communes Loire et Sillon	8	21 670	24 553	9 843	6 796
Communauté de Communes de la région de Blain	4	21 420	15 787	6 722	5 041
Communauté d'Agglomération de la Région de Saint-Nazaire et de l'Estuaire (CARENE)	10	32 290	120 518	67 345	57 062
Nantes Métropole	24	53 410	609 198	302 524	328 372
Pôle Métropolitain Nantes Saint-Nazaire	**61**	**189 450**	**839 763**	**413 611**	**414 881**

Figure 26: The Metropolitan area of Nantes Saint-Nazaire (perimeter of the SCoT) (refence: AURAN)

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

The SCoT serves as a reference for different public policies especially in terms of housing, mobility, business development, environment and organization of space.

5.2.2 Guidelines of the SCoT

From a regulatory perspective, the SCoT is essential to city planning documents (Local Urbanism Plans) as well as sectorial policies documents (Local Housing Plan, Urban Mobility Plan), which must be consistent with its guidelines. However, the SCoT is not binding directly on third parties and on citizens.

Defined across a vast territory beyond the limits of the only city of Nantes, the SCoT of Nantes Saint-Nazaire defines 5 major ambitions that will structure the public policies for the territory development by 2030:

- **the ambition of solidarity, cohesion and social diversity** to build a territorial project for the benefit of inhabitants. The demographic growth of the Nantes – Saint-Nazaire area implies strong societal responsibilities. Elderly people, commuters, precarious people, families, and workers in 2030: it will be a question of meeting the housing needs of all the inhabitants of the territory .
- **the ambition of employment and attractiveness.** The metropolitan area must remain attractive to companies, it should organize its economic development with concern for the solidarity between territories. Throuh the development of marine renewable energy, the port and industrial dynamics, the new cultural and creative industries, the digital development perspectives, the territory of the Nantes Saint-Nazaire will be identified by other major European cities for its innovative initiatives and its capacity to host companies that provide jobs for its inhabitants.
- **the ambition of a sustainable territory** that allows, at the Nantes Saint-Nazaire scale, to contribute to meet the environmental challenges of the preservation of biodiversity, global warming, the preservation of agricultural land, an efficient urban development (in terms of space use, energy consumption, production of renewable energy). The planning strategy is based on mixing urban and economic development and preserving agricultural and natural areas. In 2030, efforts to limit the environmental impact induced by the city building will allow to preserve and enhance the environmental quality and the living environment of the territory.
- **the ambition to preserve an original urban form** characterized by:
    - a multi-center structure that allows the coexistence of the two major urban centers (Nantes and Saint-Nazaire) and local centers;
    - the Loire estuary and the river network (Erdre, Gesvres, Sevre, Nantes-Brest canal)
    - rich and fragile natural and agricultural areas.

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

- **the ambition of easy mobility** to ensure good accessibility to all territories, economic sites, public facilities and transport services for all categories of the population. Commuting, access to leisure activities, shopping…: mobility is a key point in the daily life of everyone. In 2030 transport development policies linked to urbanization will reduce the car's use, and travel times.

5.3 Metropolitan Urbanism Plan (Plan Local d'Urbanisme métropolitain - PLUm)

5.3.1 General presentation

PLUm (Plan Local d'Urbanisme métropolitain - Metropolitan Urbanism Plan) is the single planning document that will define in 2018, the land use rules for the 24 municipalities of Nantes Métropole. As the former 24 PLU (local urban plans, drafted at the municipalities level) that it will replace, this legal document will determine which land is buildable and under what conditions and will be binding on all property owners (individuals, public and private legal persons). PLUm, currently under development, is now at the stage of public inquiry and will enter into force in 2018.

However, more than just a legal tool, the PLUm also reflects the Nantes conurbation development project for the next 15 years. As such, it decides on the objectives and guidelines for reducing greenhouse gas emissions, preservation and restoration of ecological continuities, improvement of the energy performance of buildings, development of urban public transports, limiting the use of space...

5.3.2 Guidelines of PLUm

Through its future PLUm, Nantes Métropole will promote a new model of urban development to enhance quality of life and economic dynamism. Indeed, by 2030, Nantes Métropole will accommodate 75,000 additional residents; nearly 6,000 housing units will have to be built each year and 60,000 jobs will have to be created. While maintaining this dynamism, Nantes Métropole has the ambition to be a reference area for ecological and energy transitions, promoting urban, architectural and environmental quality. In this way, the PLUm contains 4 major strategic guidelines, 2 refering directly to the fight against climate change and the development of a more sustainable mobility.

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

5.4 Urban mobility Plan (Plan de déplacements urbains - PDU)

5.4.1 General presentation

PDU is a mandatory document for French conurbations with more than 100,000 inhabitants. It determines the principles governing the organization of transport of persons and goods, traffic and parking at the Nantes Métropole level. It includes an actions plan with an implementation schedule and precises the financing arrangements. It is the operational application of the PLUm for the mobility aspects.

The actions plan of the current PDU (2010-2015) came to an end; the PDU should be revised to propose a new actions program for the period 2017-2028, and to draw up new perspectives by 2030-2035. Based on the strategy established in the PLUm, the new PDU must take into account on one hand, the developments of a growing metropolis that welcomes new residents (every day, more than 2.3 million trips are made by Nantes Métropole inhabitants and 270,000 additional trips could be recorded by 2030), and evolving transport and mobility needs. On the other hand, it will have to meet the ambitions of Nantes Métropole in terms of preservation of life, the environment and resources, particularly energy. It is important to note that transportation represents close to 50% of the total emissions of greenhouse gas[18] at the Nantes Métropole level.

The revised PDU will enter into force by 2018, after a public inquiry and approval by the elected representatives during a Metropolitan Council. However, it is important to stress that the subject of mobility has already been the subject of many civic contributions under the Great Debates organized by Nantes Métropole ("Loire river and us", "the energy transition debate"); this will be taken to continue and deepen the specific dialogue to the PDU.

5.4.2 Guidelines of the future PDU

Mobility management is closely linked to land use in urban planning. Therefore, in continuation with the PDU in force and in compliance with the guidelines defined in the PLUm, the future PDU will promote better coordination between mobility and urban development. It will in particular:

- continue the development of an attractive metropolis by improving accessibility;
- contribute to energy transition, climate plan and preservation of the environment and of the quality of the living environment;
- ensure mobility for all inhabitants to access to employment, shopping, services, training, culture and recreation facilities;
- manage mobility in a "calm" metropolis;
- promote and support behavior changes for more sustainable mobility, in particular by facilitating a better work-life balance in the city, through innovation in services and a new parking policy.

[18] Total greenhouse gas emissions, in Tons of Oil Equivalent (reference: SEAP Nantes Métropole 2017)

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

Furthermore, as a continuity of the transportation policy led by Nantes Métropole for over 20 years, the future PDU will continue to promote a more rational use of private cars. It will also promote modes of transport polluting less, using less space and energy.

5.5 Local Climate Plan (Plan Climat Territorial)

5.5.1 General presentation

For over 10 years, Nantes Métropole is committed in the fight against climate change. Thus, in 2007, Nantes Métropole adopted its first Climate Plan, that represents a real strategic framework for action in this field.

The Local Climate Plan (now called Plan Climat Air Energie Territorial - PCAET[19]) is a territorial sustainable development project whose primary purpose is the fight against climate change. Resulting from the National Climate Plan and from the "law for energy transition and green growth"[20], it is a framework of commitment for Nantes Métropole. The PCAET pursues two objectives:

- mitigation to limit the impacts of the Nantes Métropole territory on climate by reducing emissions of greenhouse gas (GHG) from the perspective of factor 4 (division GHG emissions by 4 by 2050) and to limit air pollution. More precisely, the objective of the Climate Plan of Nantes Métropole is gradual:
    - reducing by 30% (compared to 2003) the greenhouse gas emissions per capita by 2020 (in residential, tertiary and road transport sectors);
    - reducing by 50% (compared to 2003) the greenhouse gas emissions per capita by 2030.
- adaptation to reduce the vulnerability of the territory, as it is now established that the impacts of climate change can not be entirely avoided.

5.5.2 Guidelines of the Climate Plan of Nantes Métropole

The Climate Plan of Nantes Métropole focuses on five directions to act in collaboration with the local actors.

Reduce greenhouse gas emissions

Nantes Métropole and its 24 municipalities have more or less direct levers to reduce emissions of greenhouse gases in the territory. They can act directly on their assets (buildings, vehicle fleets ...); and thanks to its public policies, Nantes Métropole can act consistently to limit emissions of the territory (urban layout, development of public transport and of new sources of energy...).

Acting in co-responsibility with the local stakeholders and city networks

[19] PCAET is the new official name of the former Plan Climat Territorial (Local Climate Plan) and Plan Climat Energie Territorial (Local Climate and Energy Plan).

[20] French law n° 2015-992, adopted on 17/08/2015.

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

This strategic direction can be illustrated by three concrete actions already implemented:

- *CoachCopro®:* it is a free web platform that guides co-owners at all stages of the energy retrofitting of their building[21].
- *Corporate Social Responsability (CSR) Platform*: Nantes Métropole has developed a website dedicated to the Corporate Social Responsibility. It mainly allows SME to be guided in CSR initiatives. The platform's main role is to federate initiatives on CSR.
- *Mon projet rénov (My energy retrofitting project)*: it is a digital platform set up by Nantes Métropole to provide homeowners complete and simple information about energy retrofitting. Its main goals are: (i) enable homeowners to self-assess their housing and identify the work to be undertaken, (ii) inform them of all existing financial aid (from Nantes Métropole, but also from State and other public authorities), (ii) provide them free advices (in energy, law, financing) and (iv) connect with local building professionals[22].

Adapting to climate change

In order to preserve its quality of life and maintain its attractiveness, Nantes Métropole as many local authorities, will have to adapt to climate change. With the expected increase in temperatures, sea-level rise and the accentuation of extreme weather events, territories will have to limit potential negative impacts and take advantage of new weather and climate conditions.

Understand and innovate

What can be done to combat climate change? What means to implement? What to act first and how? To answer this question, Nantes Métropole has set up a Scientific and Technical Council that brings together multidisciplinary skills. In addition, Nantes Métropole supports innovative projects to find new energy, housing and mobility solutions in order to accelerate the reduction of greenhouse gas emissions on a global scale.

Measure and evaluate

Nantes Métropole has developed a number of tools in order to know the status of the territory in terms of reducing greenhouse gas emissions. In particular, Nantes Métropole contributed to the Basemis MRV research program. This programm led to the development (in partnership with Air Pays de la Loire) an inventory tool for energy consumption, local air pollutants and greenhouse gas emissions. This tool is now used to monitor the evolution of emissions at the Nantes Métropole level over time[23].

[21] https://nantesmetropole.coachcopro.com/

[22] https://monprojetrenov.nantesmetropole.fr/

[23] http://www.airpl.org/Emissions-Climat/Resultats/methode-BASEMIS

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

Likewise, an evaluation framework of the climate plan is used to examine regularly the performance of the Climate Plan actions.

Example: Nantes Métropole certified "Cit'ergie"

Nantes Métropole examines its Climate Plan using the Cit'ergie tool; it is an evaluation grid, divided into different topics: Strategies mitigation / adaptation & urbanism; Built heritage; Urban services (energy, water, waste); Territorial animation and co-responsibility between inhabitants and businesses; Community organization linked to the Climate Plan.

For this evaluation, nearly 400 proofs of the action were collected by an expert accredited by the French Environment Agency (ADEME). The National Label Commission has awarded the Cit'ergie label to Nantes Métropole in November 2015. On the territory of the metropolitan area, the municipalities of Nantes (2010 and 2015) and Orvault (2013) are already certified.

The Climate Plan initiated in 2007 as part of a voluntary approach reflects the commitment of Nantes Métropole on issues of sustainable development. From Agenda 21 in 2006 to the Strategic Framework for Climate in 2007, the Climate Plan has been strengthened as a result of operational progress and legislative and technical developments, in particular in terms of quantifying greenhouse gas (GHG) emissions.

The years 2015, 2016 and 2017 are pivotal years for the Climate Plan of Nantes Métropole: from a technical evaluation phase (via the Cit'ergie tools), the Climate Plan has now entered a stage of citizen participation.

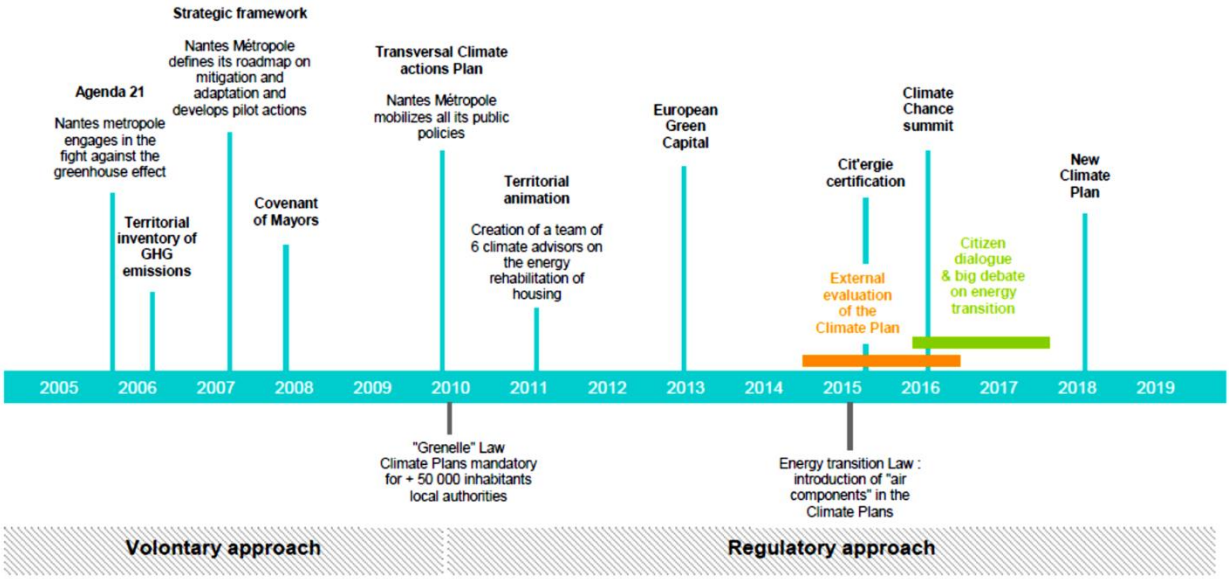


Figure 27: Timeline of the Climate policy of Nantes Métropole (references: Nantes Métropole and Cerema)

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

Indeed, Nantes Métropole evaluated its Climate Plan in 2015-2016. This evaluation based on both an expert and a citizen analysis aimed to reconsider the public policies of Nantes Métropole, and to clarify the role of the local public authority in relation to citizens or companies initiatives. On this last point, Nantes Métropole plays a key role in territorial animation, coordinating initiatives on its territory in the field of energy transition.

By setting an objective of reducing greenhouse gas emissions (50% reduction in eqCO_2 emissions per capita by 2030 compared to 2003 for the three sectors considered: residential, commercial and road transport), Nantes Métropole is also responsible for the effectiveness of local actions by measuring their impact in terms of avoided CO_2.

5.5.3 A new Climate Plan by 2018

In 2018, a new Climate Plan will be adopted by Nantes Métropole. It will reflect the ambitions shared between Nantes Métropole and local actors.

Nantes Métropole, a pioneering community in France in the fight against climate change, acts at local, European and international levels: thus, while acting locally, Nantes Métropole also signed the Covenant of Mayors in 2008. By becoming the Green Capital of Europe in 2013, Nantes Métropole has also promoted the ability of European regional cities to take concrete actions to reduce greenhouse gas emissions. As a follow-up to these actions, Nantes Métropole organized the first global summit of non-state actors, Climate Chance, in 2016.

In this context, the period 2015 - 2017 represents a turning point in the implementation of the Climate Plan of Nantes Métropole. After importante stages of evaluation and mobilization of residents and local stakeholders, Nantes Métropole will renew its climate plan by 2018.

The 2018 Climate Plan will meet several objectives:

- strengthen the adaptation component of climate change; this will require a new European commitment with the signing of the initiative Mayors Adapt;
- act for the protection of air quality in relation with the reduction of emissions of greenhouse gases;
- continue to develop actions with residents and local stakeholders (including companies).

On this last point, Nantes Métropole launched in 2016 - 2017 a "Grand Debate" on the energy transition, to create a local dynamic with citizens and local stakeholders and to find concrete solutions to limit greenhouse gas emissions across the territory.

5.6 Local Housing Plan (Programme Local de l'Habitat - PLH)

The Local Housing Plan (Programme Local de l'Habitat - PLH) defines the objectives of the housing policy for a five years period. The last Local Housing Programm of Nantes Métropole was etablished over the

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

period 2010-2016 and met three objectives: to offer housing for all inhabitants, more varied and more affordable.

It stipulated the construction of 5,000 housing units per year, including 1,400 social housing units. In connection with the 24 municipalities of Nantes Métropole, it also planned a minimum of 25% of social housing in each building operation. In addition, the PLH of Nantes Métropole provided financing for the rehabilitation of social housing, as well as the rehabilitation of 500 private housing to reduce unhealthy housing. Now, it will have to be evaluated and revised to reflect the objectives defined in the future PLUm in terms of housing.

But because housing is one of the main source of energy consumption and GHG emissions in the Nantes Métropole area, the PLH is also a key document within the climate policy of Nantes Métropole.

Among the PLH sections, the part 3 aims to "*promote inclusive and sustainable development of the Nantes area*". Since 2010, several events about climate have been organized in response to the challenges of energy improvement of existing buildings and reduction of greenhouse gas emissions. Individual counselling has been set up through different schemes: "Espaces Info Energie", "Allo Climat" switchboard, awareness campaigns in schools, conferences and workshops ... and "energy housing forums" have been set up to inform residents on energy savings and to encourage the energy retrofitting of existing housing stock.

Moreover, in 2011 Nantes Métropole has implemented a support system for the energy retroffitting of multi-owners buildings. This first experimental scheme was conducted with the support of an housing operator on a few buildings; it has allowed to train six employees of Nantes Métropole ("climate advisers"), who can now amplify coaching. The first action consisted in supporting co-op boards who needed to be informed by a reliable third party to engage energy retrofitting works. The Climate Advisers are complementary to the co-op boards, consulting firms and contractors. They mainly focus on buildings with more than 20 housing units, built between 1945 and 1985, with at least one important item of energy savings projects, and at least one motivated member in the co-op board.

To maximise support for multiowners buildings, a new scheme was launched in 2014, in relation with the Climate Plan ("CoachCopro®", mentioned above). In April 2016, 86 multiowners buildings had received detailed information and 45 had received technical support.

The PLH also promotes the incentive schemes "eco-premium boiler" (support for installation of new boilers with at least 40% gain) and the solar-thermal and thermal bonus "Live Better" (action led by Nantes Métropole since October 2011 for works improving energy performance of housing by at least 25%).

Finally, the PLH promotes the connection of new housing units to the district heating network.

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

5.7 The recognition of the commitment of Nantes Métropole to build a sustainable city

In this section, some of the most important awards received by Nantes Métropole in terms of sustainability are introduced. These are explained in the following subsections, while a summary of them can be found in Figure 28:

Figure 28: Most important sustainability awards received by Nantes Métopole

5.7.1 Ecocity project

"*How large French cities are they organized to accommodate a large number of new residents in 2020?*". This is the question asked in 2009 by the French Ministry of Sustainable Development as part of the call for projects "Ecocity". The metropolitan area of Nantes Saint-Nazaire has responded and its project has been awarded, so that Nantes Saint-Nazaire is certified "Ecocity" since 2009.

This certification label allows the Nantes Métropole area to benefit from the aid fund "City of Tomorrow" of the French government[24]. Thus, 5.3 million euros in grants were awarded to co-finance integrated urban innovative projects and demonstrators on the theme of sustainable cities, particularly on the Ile de Nantes.

5.7.2 Nantes, European green capital

Nantes was voted Europe's green capital in 2013. This award recognized the quality of life offered by the city. It rewards the commitment led for many years to sustainable development. The European Commission has elected Nantes Green Capital because of twelve criteria that demonstrate its commitment to offer a particularly healthy and pleasant environment to its inhabitants[25].

The appointment of Nantes as a Green Capital of Europe in 2013 was accompanied by events that strengthen its involvement in favor of sustainable development and has confirmed its city-pilot position on the matter. Nantes has hosted dozens of international conferences in 2013, including the 10th Ecocity World Summit on sustainable cities, the World Forum on Human Rights, or the European Biogas exhibition.

[24] http://www.caissedesdepots.fr/ville-de-demain

[25] Reduction of greenhouse gases emissions, balance between urbanized areas and natural areas, area of green space per inhabitant, organization of public transport and of "soft" transport modes, preservation of biodiversity, air quality, fight against noise pollution, water management, waste management, environmental management and communication to residents, businesses, visitors and partners.

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

5.7.3 ÉcoQuartier (EcoDistrict) certification Label

The EcoQuartier certification label, driven by the French Ministery of Housing, aims to promote a new way to design, build and manage the cities in a sustainability perspective. An eco-district is a multifaceted development project that integrates all the issues and principles of sustainable cities and territories. The EcoQuartier label is based on 20 commitments gathered in a Charter, which can be applied to any urban development operation.

Nantes Métropole has 7 projects certified EcoQuartier; 1 on the municipality of Carquefou, 1 in La Chapelle-sur-Erdre, 1 in the municipality of Rezé and 4 in the municipality of Nantes.

One of these 4 eco-districts is the Prairie-au-Duc neighbourhood, part of the urban renewal operation of the Ile de Nantes. This urban development operation received the EcoQuartier label in 2009, in the category "Biodiversity and Nature in the city". The site of 18 ha at the west part of the Ile de Nantes, is mainly intended to receive a park (13 ha), 380 housing units, 18,000 m² of public facilities, 7,000 m² of shops on ground floor and 14,000 m² of offices buildings.

5.8 Improvement potential identification

Improvement areas for a more sustainable territory will of course be integrated in the main guidelines of the new strategic documents in preparation and whose approval is expected soon (PLUm, PDU, PCAET).

However, it also possible to mention:

- the development of an actions plan in favor of "active modes" of transportation (development of a pedestrian plan and updating of the "bicycle plan") in order to further strengthen the modal share of soft modes;
- the development of new regulations for deliveries in the city center to promote the energy transition in delivery practices and encourage clean vehicles (eg clean, quiet vehicles and non-motorized vehicles could be authorized 24h/24 whereas access to internal-combustion vehicles would be more severely restricted);
- a reflection on a Supply and Services center for construction sites in the Nantes Métropole area;
- the forthcoming approval of an Energy Master Plan. It will include a multi-energy territorialized programming, consistent with the urban development scenario of the PLUm.

5.9 Calculation of diagnosis indicators for Existing Urban Plans for promoting low energy districts and sustainable mobility

The indicators selected related to urban plans for promoting low energy districts and sustainability mobility are being calculated and they are showing in the following table.

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

Table 5: Indicators for existing plans for promotting low energy districts and sustainable mobility

Indicator	Units	Value
Existence of plans/programs to promote energy efficient buildings	Number of plans	SCoT (Territorial Coherence Scheme) PCAET (Local Plan for Climate, Air and Energy) PLUm (Metrpolitan Urbanism Plan) PDU (Urban Mobilty Plan) PLH (Local Housing Plan)
Existence of plans/programs to promote sustainable mobility	Number of plans	The Urban Mobility Plan is the main plan to promote sustainable mobility. But mostly of other plans (Local Urbanism Plan, Territorial Coherence Scheme, Climate Plan...) also contribute, for their relevant aspects, to sustainable mobility.
Existence of local sustainability action plans	YES/NO	YES
Existence of local sustainability plans	YES/NO	YES
Existence of an Agenda 21	YES/NO	YES
Signature and compliance of the Covenant of Mayors	YES/NO	YES

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

6. Public procurement procedures, regulations and normative

6.1 Current status

6.1.1 Public procurement, a tool for the sustainable development of the territory

Nantes Métropole acts in favor of sustainable development, and its "Purchasing" policy contributes directly to the respect of these principles.

For the last 15 years, Nantes Métropole and the Municipality of Nantes have developed a responsible purchasing policy based on the three pillars of the sustainable development (social, environmental and economic). Indeed, by its economic weight - 310 M€ per year for Nantes Métropole and 120 M€ for the Municipality of Nantes - public procurement is an important lever to incite local companies to develop more sustainable practices.

The responsible purchasing policy of Nantes Métropole obviously respects French and European public procurement regulation. On that point, public procurement regulation has evolved in recent years, making it possible to take into account sustainable development objectives through public purchasing.

The last European directive on public procurement (Directive No. 2014-24 of 26 February 2014)[26], underlines that public procurement must "*increase the efficiency of public expenditure by facilitating the participation of small and medium-sized enterprises in public procurement*" and encourages "*a better use of the public procurement to achieve social objectives*".

This evolution is reinforced by two French laws (Law 2014-856, July 2014, on the Social and Solidarity Economy, and the Law for Energy Transition and Green Growth No. 2015-992 of 17 August 2015). Both aim to encourage public purchasers to integrate and formalize their sustainable purchasing practices. Thus, from € 100 million of public purchasing per year, public authorities must develop and approve a plan for responsible purchasing (Schéma de Promotion des Achats Responsables, SPAR).

6.1.2 Guidelines of the plan for public responsible purchasing of Nantes Métropole

For Nantes Métropole, the drafting of such a scheme (approved in March 2017) was an opportunity to reinforce responsible public procurement practices and to set innovation targets. It was also an opportunity to communicate towards economics actors.

[26] Transposed into French law by Ordinance No. 2015-899 in July 2015 and Decree No. 2016-390 in March 2016 relative to public procurement.

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

The plan for responsible public puchasing defines precise objectives on different sections. These objectives are formalized in 11 thematic action-sheets.

Each action-sheet specifies the orientations and objectives to be achieved, the legal tools used, the relevant purchasing families and the potential impacts on the application files of companies.

By way of illustration, four sections can be presented in more details:

- "**employment**" **section**: Clauses of professional insertion makes it possible to reserve hours of work for unemployed people for the performance of the contract and companies must describe in their offer how to meet this obligation. By this way, public procurement generates activity to economic reinsertion organisations, and helps to support the development of an effective integration path towards sustainable employment. This system, which historically concerns building sector and public works, cleaning industry, environmental activities and maintenance of green spaces, is now aimed at concerning new activity sectors. It also aimed at better targetting women and peopole living in social housing neighbourhoods.
- "**territorial development**" section: This mainly concerns the concept of Corporate Social Responsibility (CSR). Public procurement uses the concept of corporate social responsibility through a selection of indicators, that can be used as criteria for awarding contracts. This is done in coherence with Nantes Métropole's actions in the field of CSR (actions carried out with the Pays de la Loire region and the chambers of Commerce and Industry).
- "**equality**" **section**: Public procurement can contribute to objectives of combating discrimination and promoting equality[27]. The Nantes system is based on a two-track approach. It consists in asking contender companies to carry out concrete actions to fight against discriminations, and to promote companies whose actions are the most relevant. This experimental system, is now ued for service contracts (collection of waste, distribution of the community magazine, graffiti removal) and must be extended to other activity sectors.
- "**energy transition**" **section**: This section refers to a large number of purchasing families in which Nantes Métropole integrates objectives of climate impact reduction through technical prescriptions and technological choices, or even in its award criteria for the contracts. This is the case for vehicles fleet, and allows Nantes Métropole to have more than 20% of "clean cars" (legal threshold). Reflexions on energy consumptions leads each year to a large volume of works dedicated to an improvement of buildings and of public lighting.

[27] On that issue, Nantes Métropole participated in the drafting of a guide in 2014, within the BUYDIS project: "Fight against Discrimination and promotion of equality in employment through public procurement clauses - A first guide for local authorities "- October 2014.

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

The following examples illustrate some of the other practices of Nantes Métropole in terms of responsible or innovative procurement:

- **use of the eco-comparator software SEVE** to analyze offers of companies in terms of road renovation: this eco-tool allows Nantes Métropole to compare objectively and easily different environmental variants proposed by companies for public tenders. Four environmental indicators are taken into account: energy consumption, greenhouse gas emissions, use of natural resources and quantity of asphalt material recovered.
- **integration of carbon clauses in public procurement:** since 2006, carbon clauses have been integrated into 47 operations and 73 batches. To date, the inclusion of such clauses makes it possible to raise companies' awareness about energy and climate issues. That is also a way to promote the Climate Plan of Nantes Métropole and to support companies to commit in actions against climate change. Lastly, that allows to recover data about GHG emissions linked to the perfromance of contracts taken out by Nantes Métropole (and thus to better measure the emissions of the territory). Specific calculators are designed and developed by activity sectors to facilitate appropriation by companies, especially SMEs.
- **use of research and development contracts to support innovation:** for public purchasing, Nantes Métropole has used several times public research and development contracts to support innovative projects. When they are successful, these projects can lead to standard public procurement procedures. This was the case, for example, with the development of the "Navibus Jules Vernes 2", the first river-shuttle in Europe using hydrogen.
- **inclusion of specific clauses to promote innovative practices:** Nantes Métropole used this possibility on the call for tender related to street furniture. Through these clauses, Nantes Métropole aims to promote and accompany new digital uses. The aim here is to guide applicant companies towards the supply of urban furniture anticipating the digital innovations. For example, that means to make it possible to install Wi-Fi antennas, sensors or transmitters on furnitures (shelters, billboards ...). The clauses also specify that candidates companies should precise their innovative proposals on sustainable employment, social progress, new services to users, sustainable development, new business models (other than revenues generated by advertising)...
- **signature by Nantes Métropole of an "energy performance contract**" for the refurbishment and maintenance of public buildings and facilities.

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

6.2 Calculation of diagnosis indicators for public procurement procedures, regulations and normative

The indicators selected for public procurement procedures, regulations and normative are being calculated and they are showing in the following table.

Table 6: Indicators for procurement procedures, regulations and normative

Indicator	Units	Value
Existence of regulations for development of energy efficient districts	Number of regulations	At least 1. New constructions respects the new (2012) national thermal regulation
Existence of regulations for development of sustainable mobility	Number of regulations	At least 1. No specific local regulation, but many actions defined in the Urban Mobilty Plan
Existence of local/national Energy Performance Certificate (EPC)	YES/NO	Yes (national)
Share of Green Public Procurement	%	non-available
Level of correspondence between local energy codes	YES/NO	non-available
Level of correspondence with national regulation	YES/NO	non-available
Level of correspondence with European legislation	YES/NO	non-available
Level of correspondence with international construction standards	YES/NO	non-available

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

7. Identification of existing actions for citizen engagement

Regarding Citizens' engagement strategies in Nantes, as it will be thoroughly explained, many initiatives are already in place. As a summary, Figure 29 summarises the most important :

Figure 29: Most important Citizens' engagement strategies in Nantes Métropole

7.1 Citizen participation in Nantes: a long standing political commitment

For some twenty years, the Municipality of Nantes has developed a practice of citizen consultation, well before the 2002 French law about grassroots democracy[28]. First mainly focused on issues about the living environment and community life, the participation of inhabitants in public action reached a milestone in 2008 now considering public policies and projects at the city level. The Charter of the citizen dialogue adopted by the Municipal Council on 29 January 2010 reflects this political will to go "from citizen consultation" to "doing together" through the co-construction of local public policies: "*Today the municipality of Nantes opens a new stage in the recognition of citizens as actors of public policies*" (Preamble of the Charter). So that citizens' perspectives are integrated into the decision-making process of elected officials over all municipal decisions.

This scheme of citizen participation allows inhabitants to contribute at all stages of a public policies, from diagnosis to conception, to implementation and evaluation. For example, in 2012, 15 of the 18 local public policies have set up participatory approaches, involving 34 citizen workshops during 2 years. Likewise, large-scale participatory approaches such as "Ma Ville demain, Nantes 2030[29]" (2011-2012) or the "Assises socio-culturelles"[30] (2012) can be mentionned.

In 2014, this political ambition about citizen dialogue was confirmed and amplified as a principle of local action (political and technical) at the beginning of the mandate of Johanna Rolland, new Mayor of Nantes and President of Nantes Métropole. Thus, a renewed governance was set up, based on a constant dialogue between the elected representatives, the municipal administration and the inhabitants. From the neighborhood to the conurbation levels, different participative formats (citizen workshops, participatory evaluations, major debates) aim to support citizen involvement in the design and implementation of public policies.

[28] French Law n° 2002-276, adopted on 27/02/2002.

[29] "My city tomorrow, Nantes 2030"

[30] Sociocultural Conference

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

This commitment is formalized in the report "Citizen dialogue and co-construction: towards a new governance" presented to the City Council on 30 January 2015. This report establishes the political and technical roadmap for participatory governance for the period 2015-2020.

The new roadmap for citizen participation & dialogue is structured around five purposes,14 principles and 3 major pillars:

The 5 purposes of the Nantes citizen dialogue:

1. *make fairer public policies more appropriate and better understood*
2. *foster social links, inclusion and the collective approach*
3. *share a common vision of the general interest on the territory*
4. *support social innovation and empowerement of Nantes' inhabitants*
5. *develop a culture of sobriety and shared responsibility*

The 14 principles for citizen dialogue specify the rules of the citizen dialogue, the subjects of dialogue, and the role of the public authotiry; they also describe the method of citizen dialogue.

The 3 major pillars:

1. *citizen dialogue based on public policy-making (mobility, public space, economy, energy transition, sports activities, night life, academic success, the fight against discrimination…) and using different participatory tools (great debates, participative assessments, workshops, 10 thematic councils…)*
2. *close dialogue with inhabitants to better meet their expectations and based on local issues: local information, consultation and better visibility of the municipal action at local levels, participation of users in the management and evaluation of local public services, co-construction of public policies, support for community projects*
3. *e-collaborative city, that refers to the digital city and to the opening of public data.*

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

7.2 A dedicated unit in the local administration

To support the evolution towards this new open and participative governance, a specific administrative unit "citizen dialogue, evaluation and prospective"[31] was created and directly attached to the Managing Director of the Nantes and Nantes Métropole shared administrations[32] (certain units are common to Nantes and Nantes Métropole administrations). This cross positioning allows this unit to "*support the strategic management of public policies, to support the implementation of transitions towards more sustainability, to strengthen innovation in democratic practices, to assist the decision-making and to facilitate the change management*".

7.3 Diversified and evolving citizen dialogue tools

The Nantes Métropole participatory scheme has been enriched over the years. It now covers indeed all the fields of local public action, different projects and different levels of territory (from the neighborhoods to the metropolitan area).

This scheme is based on various participation processes more or less innovative, suitable to different audiences and adapted to new paces of life to allow everyone to take part in the life of the city. This is a real "process to citizenship" which aims to "discuss, do together and develop a common vision of the public interest".

7.3.1 The major metropolitan forward-looking debates

The major debates are organized to discuss strategic decisions to be taken on the future of the territory, at the metropolitan level.

Debate "My city tomorrow, invent the Nantes metropolis 2030" (2012-2013)[33]

Through this debate, coordinated by the Nantes City Planning Agency (Auran), it was to develop a widely shared collective project that could inspire and guide the actions of all citizens, elected officials, public and private decision makers... This ambitious initiative, whose principles were adopted by the entire community council of Nantes Métropole on June 2010, aimed to collectively examine the present and the future, everyday life, shared values, practices and habits... Based on participatory work, transparency on all contributions and provision of expertise, the approach was based on an open framework. It has been formalized in a "Nantes 2030 Project" (adopted on 14 December 2012), which defines guidlines for a metropolis both attractive and pleasant, stronger and more protective.

[31] The same unit is in charge both of "citizen dialogue" and "evaluation and forecasting", as they both are considered as an integral part of municipal governance and as a support for the management of public action.

[32] To be complete it is important to note that another administrative department exists, but restricted at the local administration of the municipality of nantes: the municipal department for "citizenhip, social life and territorial coordination".

[33] http://www.mavilledemain.fr/

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

Debate "Nantes, the Loire river and us" (2014-2015)

This is the first major debate of the new elected metropolitan Council; it led to 30 commitments for a regeneration of the urban spaces along the Loire river and the creation of a Loire permanent steering comitee, responsible for ensuring the implementation of actions (see: www.nanteslaloireetnous.fr).

Debate "The energy transition is us" (2016-2017)

The process is still ongoing, although the participative component of the debate is now completed since the end of March 2017. The purpose of this debate was to "*build a metropolitan library of knowledge, resources and experiences to establish the main guidelines of the local energy transition and to invent its future governance, based on a multi-stakeholders and citizen approach*". This debate was led by an independent commission that also drafted the final report summarizing all of the thinking.

The debate focused on 4 questions: Which lifestyles transition? Which landscapes and new uses? What access to energy? Which innovations ?

A summary document[34] accessible to all has been drafted by the departments of Nantes Métropole, in order to give a basic knowledge to all (the document is neutral, contextualized and educational). Different kinds of communication tools have also been used to reinforce the interactive dimension of the debate (as for example: exhibition "containers" installed on the public spaces of the city, digital tools such as social media and websites...). Then, several types of citizen contributions were proposed, based on the principles of participative governance adopted by Nantes Métropole. (see the Charter of the debate and the 14 principles of citizen dialogue already mentioned; see also: https://www.nantestransitionenergetique.fr/).

It is important to note that this debate was not conceived as only a debate of ideas, but rather as a process to mobilize, engage and take action for the citizens and local actors (more than 500 citizens have been involved in actions)

34

https://www.nantestransitionenergetique.fr/medium/W1siZiIsIjIwMTYvMDkvMDkvMmNpdGJxNGV4N19kb2Nzb2NsZWdyYW5kZGViYXR0ZS5wZGYiXV0/docsoclegranddebatte.pdf?sha=2979c1c7db7e6adf

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

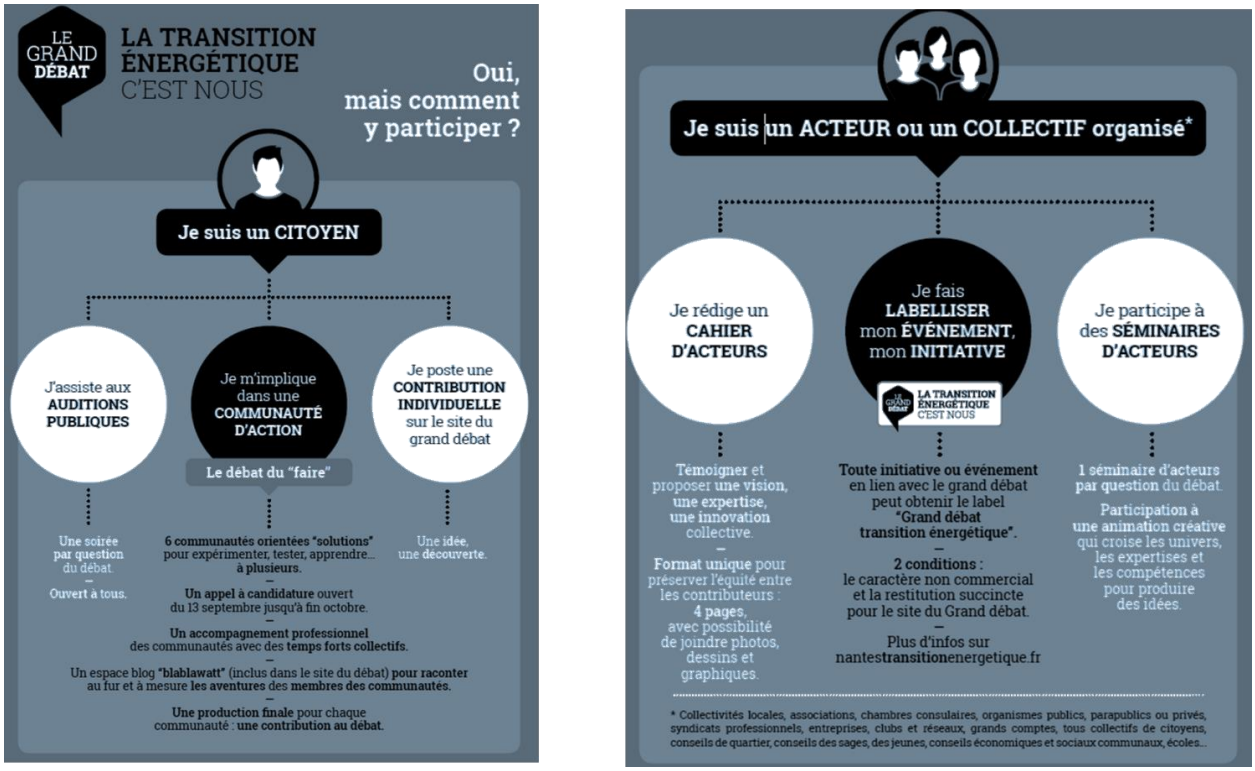


Figure 30: Example of communication documents published during the Bid Debate on energy transition (source: Nantes Métropole)

7.3.2 The 10 local citizen councils

These are thematic consultation bodies or citizen networks with an open governance. Among these consultation bodies and / or networks, some have been renovated, and new were created as for example the council for women Equality (created in March 2015) or the council "Night in Nantes".

7.3.3 Citizens' workshops

Citizens' workshops refer to a formalised method of citizen dialogue. Around fifty citizens workshops were conducted over the last mandate and a new annual program was adopted (8 to 10 are planned per year).

7.3.4 Participatory assessments of public policies

Since 2004, the municipality of Nantes (followed in 2008 by Nantes Métropole) launched a voluntarist approach to evaluating public policies, with a focus on participatory and democratic aspects; this approach has been recognized at the national level (Innovation Award - AFIGESE 2012).

Each evaluation is based on an open debate with stakeholders (users, public administration, partners, associations, professionals, elected officials, etc.) and aim to support public actors to define fairer, more appropriate, more efficient and more sober public policies. For this purpose, evaluations take into account different points of view, and involve citizens in reporting of the results: thus, in accordance with the principles of the French Evaluation Society and with the principles of the Nantes Citizen Dialogue policy, a public document is drafted and published (called "Les Cahiers de l'évaluation"; more than fifteen are

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

available on www.nantes.fr). The evaluation procedures cover a wide range of subjects covering all public policies of Nantes and Nantes Métropole. The most recent (2016) have dealt with the cultural offer for seniors, night mobilities ("City at night: how to move easily at night"[35]) or metropolitan projects linked to the energy transition.

7.3.5 The neighborhood councils / neighborhood workshops

In 1996, 11 neighborhoods have been created by the municipality of Nantes and "neighbourhood advisory committees" were set up; they became in 2009 the "neighborhood councils". Since 2010, citizens have also developed "neighborhood workshops" (often to support urban projects). In May 2015, the "neighborhood meetings" have replaced "neighbourhood councils" and are now open to all residents, stakeholders and users of the districts.

7.3.6 Support for citizen initiatives

The municipality of Nantes supports citizens' initiatives, from the district level to the city level. This goes through:

- calls for citizens' projects (the first was linked to "Nantes Green Capital", about the use and recovery of green wastelands; the latest is "my street is a garden")
- a "projects office" in each neighbourhood, set up in 2015 (based on a group of elected officials and inhabitants)
- a participatory budget dedicated to districts to finance proximity facilities designed and selected with the inhabitants (one million euros per year)
- a citizen digital platform launched in December 2015 to promote the citizen dialogue and promote "community action" between citizens, groups and associations.

[35] https://www.nantes.fr/files/live/sites/nantesfr/files/PDF/Publications/05-AVN/Dialogue-Citoyen/CahiersEval_mai2017_WEB_avec_feuillet_central.pdf

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

Finally, the policy of Nantes Métropole and the city of Nantes in terms of citizen dialogue can be summarized by the diagram below.

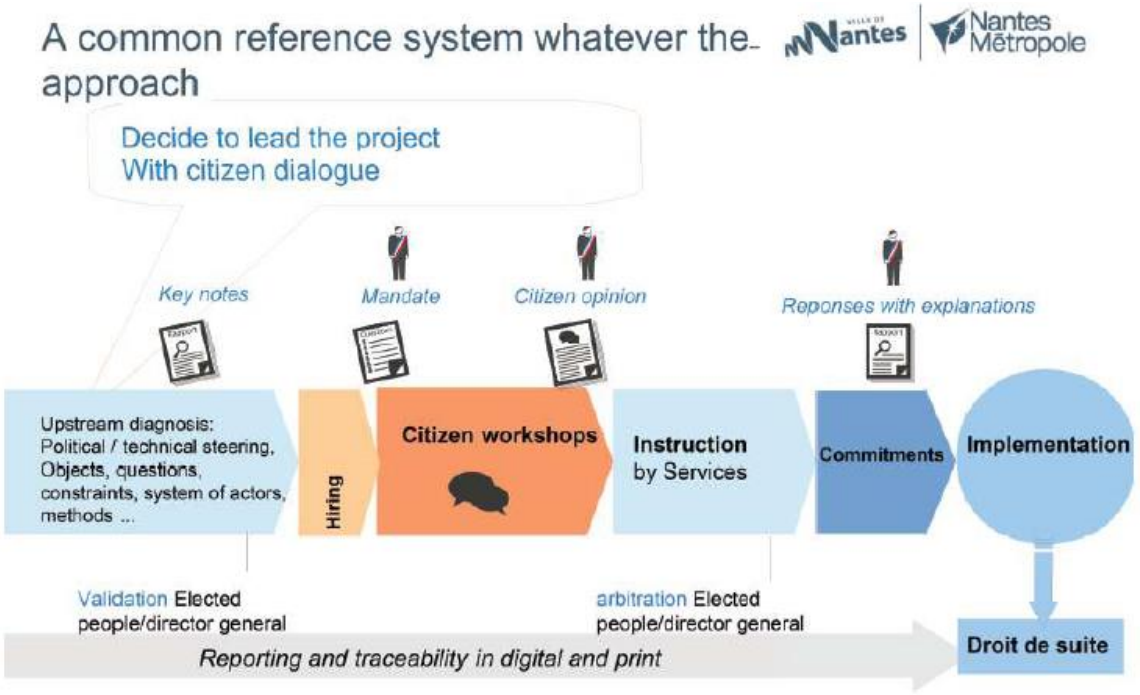


Figure 31: Citizen dialogue steps (reference: D1.3 Methodology for citizen engagement based on system thinking, My Smart Life Project, WP1, Task 1.1.2, 2017)

7.4 Improvment potential identification

Following the arrival of a new municipal team, the citizen dialogue has thus significantly strengthened in the Nantes area: a new scheme is progressively implemented, characterized by the creation of new thematic discussion forums accompanying the development, implementation and evaluation of public policies at different levels of the territory. Participatory tools are now broadly diversified; they use in particular new digital tools that facilitate the contributions of citizens and local actors.

A progress report relative to the citizen dialogue policy was carried out by the municipality of Nantes in March 2016: it provides a first assessment of the achieved actions, compared to the road map adopted at the beginning of 2015, and highlights the progress made, such as:

- an increasing participation (for example, the debate about the Loire rivergathered 40,000 participants);
- a greater diversity of audiences, rejuvenation of participants;

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

- a wider field of public action concerned by citizen dialogue (eg the issues of gender equality, public space, nightlife, economy etc ...);
- an effort to provide information and knowledge transfer in a pedagogical approach;
- the formalization of a democratic process;
- innovations in selection procedures (call for volunteers, random draws on electoral lists, polls ...) and intervention methods (citizens' workshops are recognized as a reference method);
- the acquisition of knowledge and new professional practices in the local administration;
- renewal and quality of exchanges between residents and elected officials.

All this generates a new collective and territorial dynamic that enriches public action and facilitates conducting the necessary transitions.

To meet the new objectives of renewal of governance and co-responsibility, ways of improvement have also been identified:

- better take into account certain inhabitants (young people, working people and peopole living in social housing areas)
- the appropriation of new methods of citizen dialogue by the local administration departments (need support and training)
- the clarification of the objectives of the citizens' debate
- a best way to summarize the results of the debates to citizens.

Moreover, to improve practices of citizen dialogue and governance arrangements, a few of key issues are emerging, including:

- how to describe more precisely participation, and the contribution of the diversity of points of view to the citizen dialogue?
- how to analyse the citizen dialogue at the metropolitan level?
- how to increase the gender-equity in the participation to citizen dialogue in Nantes?
- how to continue to increase citizen dialogue practices in the city and metropolitain administrations?

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

7.5 Calculation of diagnosis indicators for citizen engagement

Table 7: Indicators related to existing actions for citizen engagement

Indicator	Units	Value	Source
Number of local associations per capita	Number of consultations / inhab.	non-available	
Number of information contact points for citizens	Number of information points	non-available	
Number of municipal websites for citizens	Number of municipal websites	non-available	
Number of interactive social media initiatives	Number of social media links	non-available	
Number of discussion forums	Number of forums	non-available	
People reached	%	non-available	
Access to public amenities	%	non-available	
Access to commercial amenities	%	non-available	
Diversity of housing	%	16.4%	INSEE[36]
Preservation of cultural heritage	Qualitative Likert scale	non-available	
Number of high edu degrees per 100,000 population	n/100,000h	27.109 (in 2014)	INSEE

[36] https://www.insee.fr/fr/statistiques/2011101?geo=EPCI-244400404#chiffre-cle-6

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

8. Local energy supply and resources diagnosis

Nantes Métropole is deeply engaged into the energy transition, as testified by including into its staff some energetic skills (in addition to other linked skills such as urban development, energy planning, public lightning…):

- Production and distribution of heat.
- Production and distribution of electricity.
- Distribution of gas.
- Support in energy demand management.

Since 2006, Nantes Métropole has been developing a voluntarist and ambitious public energy policy, led by the Energy department. The main policy strengths are:

- The acquisition of jurisdiction by the granting authority of electricity and gas distribution through the exit of Sydela, in order to better control the distribution on its territory;
- The implementation of an ambitious Climate Plan and the signing of the Covenant of Mayors
- The strong development of an authority organizing district heating networks powered mainly by renewable energies, major tool of the Climate Plan
- Adoption by deliberation in April 2006 of an energy action plan

For 2014-2020, two main strategic orientations for the energy policy have been defined:

- Development and optimization of energy public services near the users
    - Reinforce the ambition of the energy transition strategy
    - Optimize the management of electricity and gas distribution public services
    - Continue the ongoing development of renewable heat at controlled prices
    - Guarantee public services close to users
- Reduction of the territory energetic footprint: consume less and produce more
    - Energy efficiency exemplary of Nantes Métropole assets
    - Improve the energy quality of existing homes
    - Doubling the renewable energy in the overall territory consumption, from 5% coverage in 2012 to 10% in 2020.

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

8.1 Energy supply diagnosis

8.1.1 At national scale

At a national scale, the primary consumption can be analysed per energy source (Figure 32) or per sector (Figure 33). The total primary consumption has increased in general pattern since 1970 and since the 2000's the total primary consumption has stopped to increase and even start slightly to decrease. The energy mix changes around the 1980's with the introduction of a nuclear electric production, a French specificity.

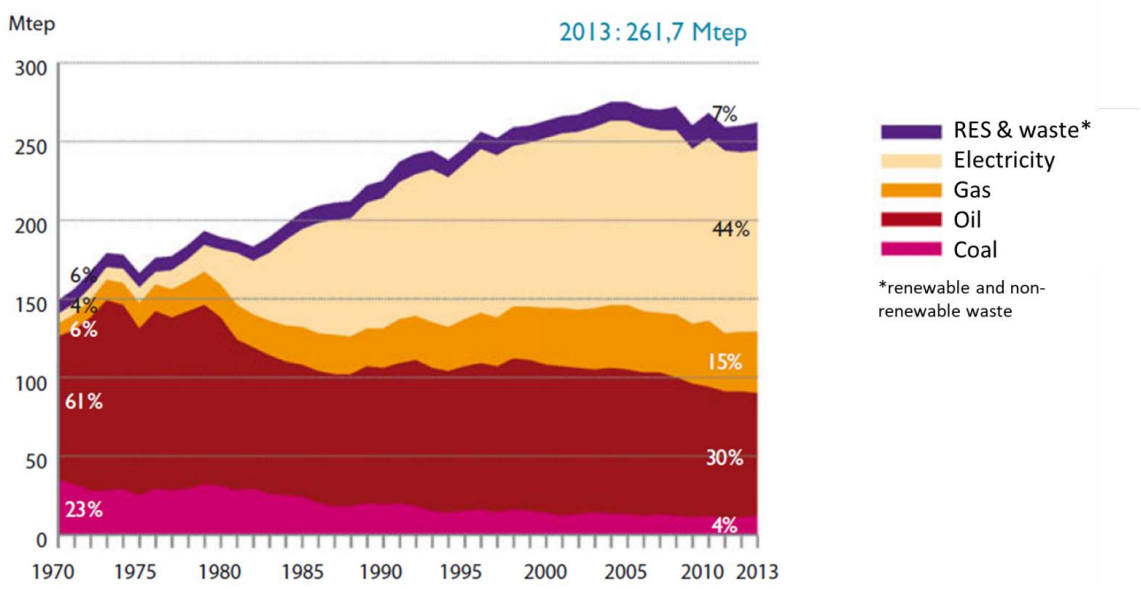


Figure 32: Primary energy consumption in France per energy sources (reference: ADEME KPI air-climate-energy 2015)

As the analysis is in primary energy and not in final energy, in Figure 33, the losses in the production and distribution of energy are represented. They reach the first share (around 30%) of the total primary energy consumption. Then, the next two main parts (around 20%) are the consumption of the household and of the industry.

A more casual analysis is done in final energy consumption, as in Figure 34, in which the transportation is more easily identified as one of the three main sectors. Agriculture is not a significant energy consumer sector.

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

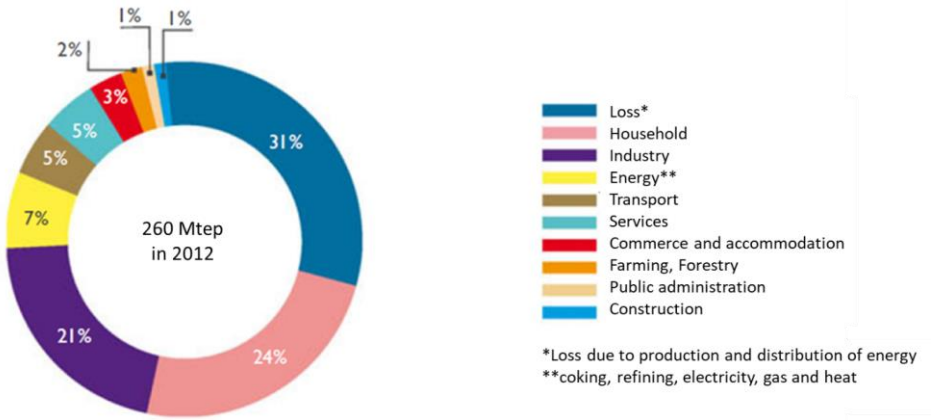


Figure 33: Primary energy consumption in France per sector [source: ADEME KPI air-climate-energy 2015]

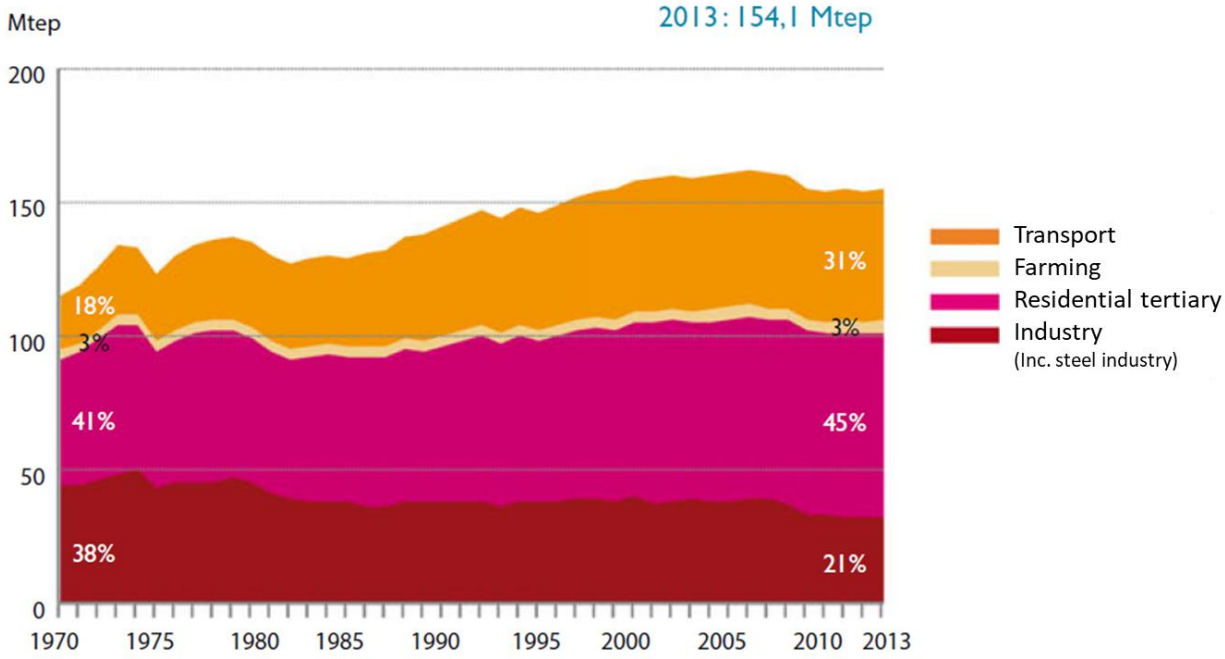


Figure 34: Final energy consumption in France per sector [source: ADEME KPI air-climate-energy 2015]

The breakdown per sector and per energy source shown in Figure 35 enables to identify quickly that the transportation and agriculture sectors are mainly depending on fossil fuels, whereas the energy mix is better mixed for residential, tertiary and industry sector.

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

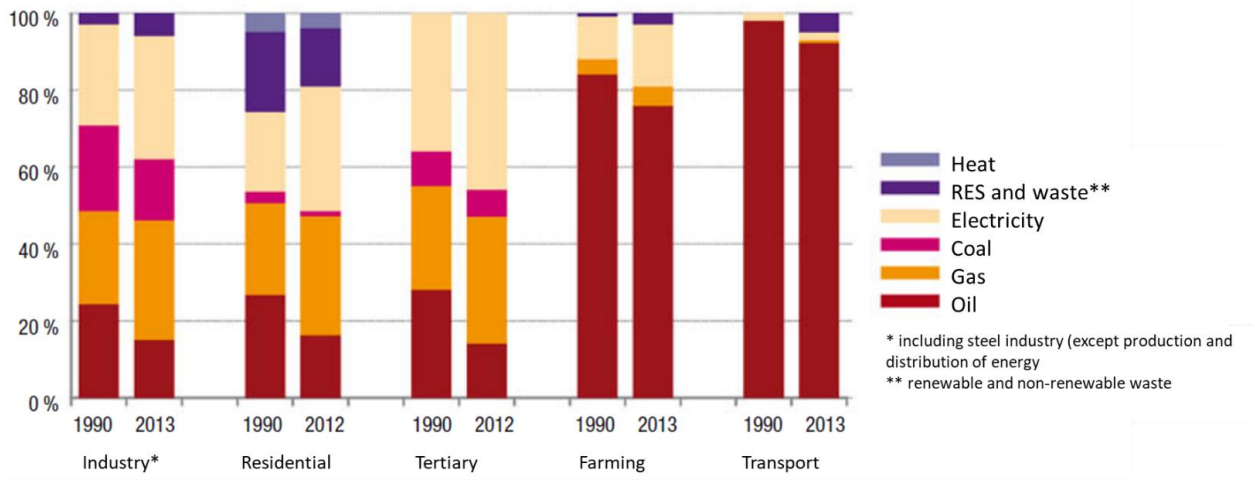


Figure 35: Final energy consumption in France breakdown per sector and per energy sources [source: ADEME KPI air-climate-energy 2015]

8.1.2 At Nantes Métropole scale

The main reference concerning energy statistics at Nantes Métropole scale comes from a local methodology for the GHG emission called BASEMIS. The BASEMIS version 4 analyses statistics from 2008 to 2014 and is very detailled. Two other source types are used, Nantes Métropole annual reports (water, waste and energy) and SEAP 2017 (monitoring emission inventory statistics communicated to the Covenant of Mayors). This later updated in 2017 concerning the year 2012 is officially used to communicate with the European Commission, that's why the energy indicators detailed at the end of this section are based on this source. Moreover, the year difference, the sectors are slightly different (for instance street lighting or municipal buildings) and more information for local energy production are available.

8.1.2.1 Energy consumption overview

The consumption of Nantes Métropole accounts for about 44% of the consumption of department of Loire-Atlantique and around 15% of the Pays de la Loire Région (Figure 36). After decreasing for the first time between 2008 and 2009 (- 5%), the regional consumption increases again in 2010 (+ 4.6%), then decreases again and stabilizes (around 13 TWh) in the years 2011 and 2012.

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

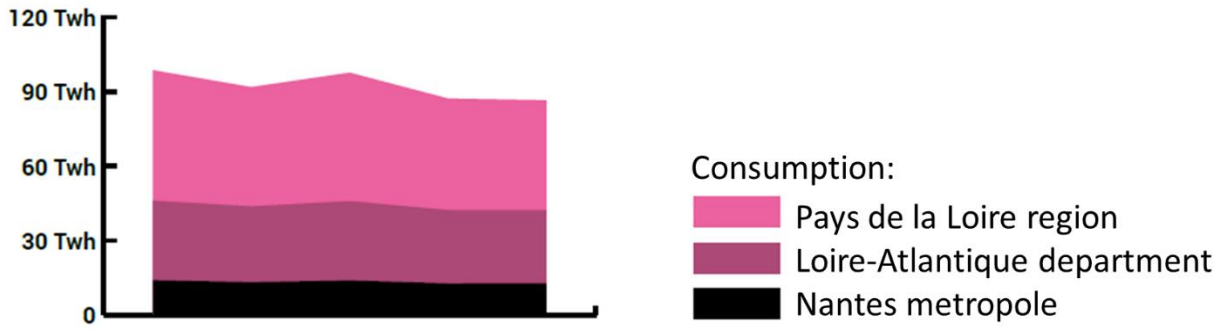


Figure 36: Energy consumption evolution between 2008 – 2012 [source: illustration document socle, based on Nantes Métropole 2014 energy annual report]

In comparison at Nantes Métropole scale (Figure 37), the consumption remains nearly stable between 2008-2009, then increases significantly (as at the regional scale) in 2010, increase from 12.9 to 13.8 TWh from 2011 to 2013 and finally drops to 12.6 TWh in 2014 (easily explained by a soft climate, which has a very strong impact on heating consumption). The energy mix from Nantes Métropole is mainly spread in 3 main sources (Figure 38): 28.3% of electricity, 28.4% of natural gas and 40% of oil product. The biomass, heat and cold represents less than 4%. Between 2008 and 2014, each source has been more used except solid mineral fuels which is no more consumed.

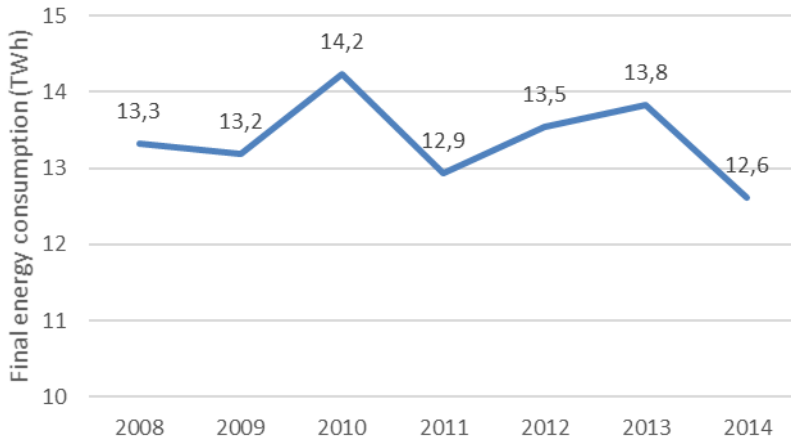


Figure 37: Nantes Métropole final energy consumption evolution (2008-2014) source: BASEMIS v4

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

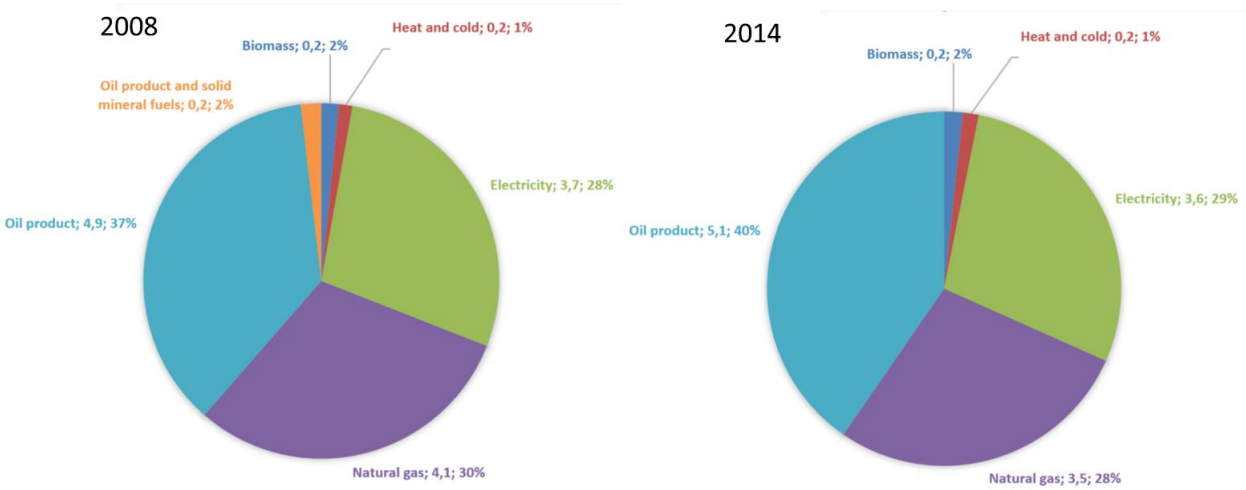


Figure 38: Nantes Métropole consumption per energy sources, comparison between 2008 and 2014, [source: BASEMIS v4]

Spited by sectors and sources (Figure 39), 4 main sectors are identified (residential & tertiary together 48%, transport 33%, industry 19,). The farming sector is apart with a very low consumption (0.05 TWh, 0,4 % of Nantes Métropole consumption, mainly based on oil product). The transportation is the most consuming sector (nearly 4 TWh, 33%), highly based on oil product. In road transport sector very few natural gas is introduced (0.3%) and in non-road transport sector a high share of electricity is introduced (28%). Electricity and natural gas are used in significant shares in Residential, tertiary and industry sectors. In residential and tertiary sectors, a few heat and cold is consumed (3% each). Biomass is only used in residential, as a significant share (6.6%). Very few oil products are used in residential (1,4%).

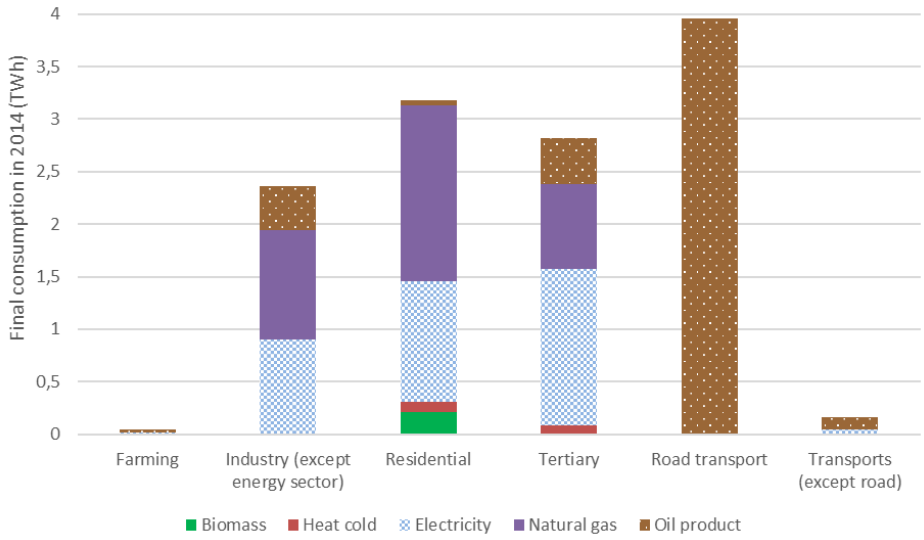


Figure 39: Nantes Métropole energy breakdown per activity sector and energy sources (2014) [source: BASEMIS v4]

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

8.1.2.2 Renewable energy production

In 2012, the “official”[37] share of local energy production to overall final energy consumption was only 2.6%.

In 2015, according to the annual energy report from Nantes Métropole, the production from RES at Nantes Métropole accounts for 715 GWh (9,3% of residential and tertiary final consumption), an increase of 23% compared to 2008. The 10% target due 2020 could therefore be achieved in advance. However, there are significant differences between the various renewable energy sectors.

The territory uses 2 mains local resources in 2015: biomass (57%) with mainly heat produced individual housing and waste incinerator (23%). The geothermal energy is also well promoted locally (17%). The solar energy is very low but on progress (photovoltaic 2%) and thermal panel (1%).

8.1.2.3 Nantes Métropole, as a licensing authority for district heating network

In Nantes Métropole territory in 2017, 6 district heating networks (DHN) are in operation, of which 2 are privately managed by a Free Urban Land Association. The DHN and the potential development area are drawn over a map Figure 40.

In 2017, excluding the 2 networks privately managed, statistics are show in Table 8. At Nantes Métropole, 7.2 % of the housing are now connected to a DHN (compared to 3% 8 years ago). Mainly DHN connection (60%) concerns social housing (the social housing connected represents 23% of the buildings stock). 274 500 MWh of heat are delivered. The average tariff is around 70 €/MWh tax included.

Table 8: DHN statistics

Indicators	Nantes Métropole 2016 (except 2 private operated DHN)	National French statistic (2014-2015)
Energy delivered	274 479 MWh	20 500 000 MWh
Service building connected (hospital, school)	44%	43%
Territory delivery	7,2% (23 262 Buildings, 23% social housing connected)	5% (1 215 000 Buildings)
Total pipe length	102 km	4 660
RES share	73% (45 000 tCO2 avoided)	50%
Indicators	Nantes Métropole 2016 (except 2 private operated DHN)	National French statistic (2014-2015)

[37] Official statistics communicated in the SEAP 2017 with a monitoring emission inventory year 2012

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

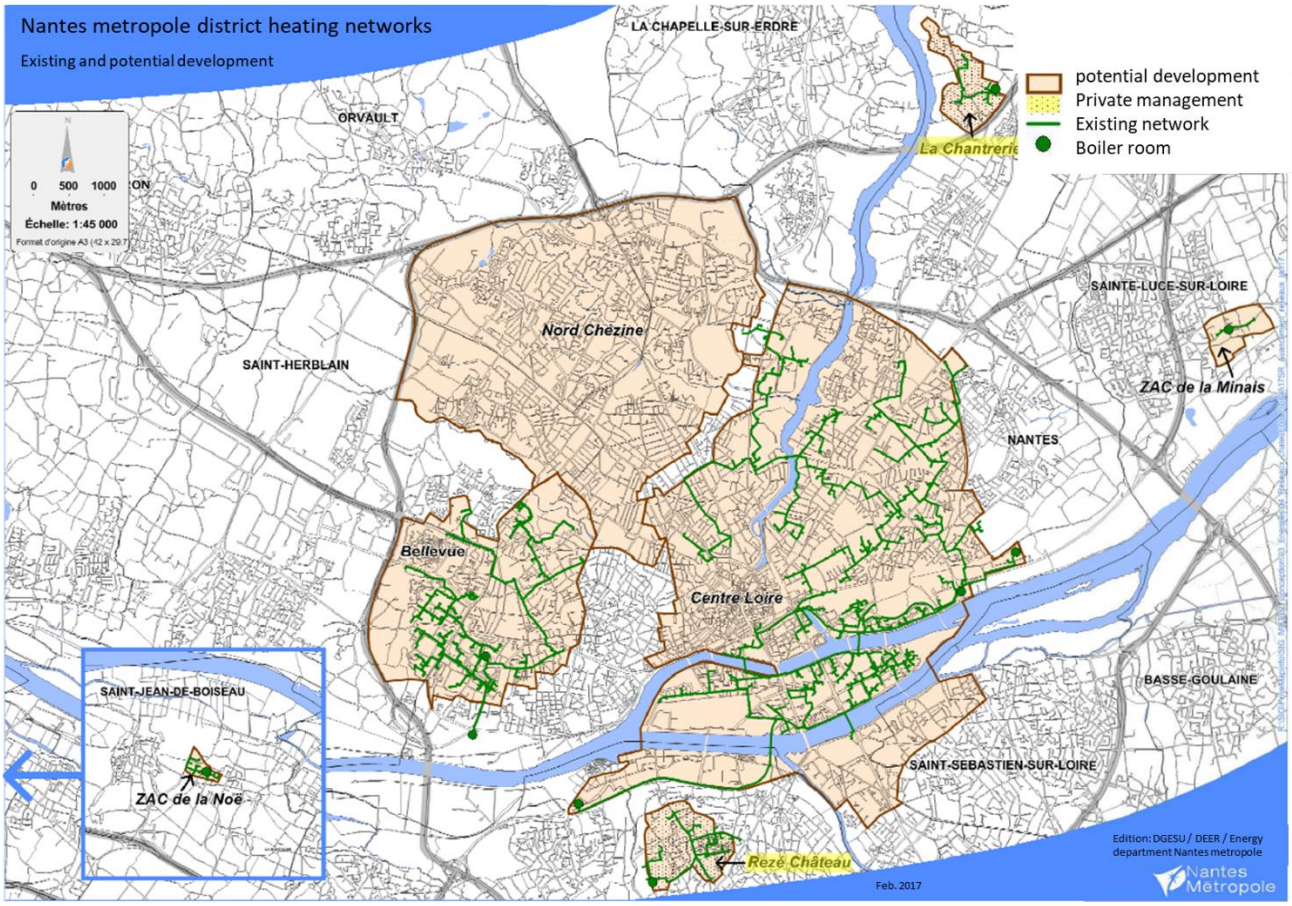


Figure 40: Nantes Métropole district heating networks: existing network and potential extension (source Nantes Métropole annual report Energy 2015)

The development strategy of district heating at Nantes Métropole enables to increase the number of connection and the share of RES into the energy mix:

- In Figure 41, the number of connection to DHN has doubled from less than 10 000 buildings in 2008 up to 20 000 buildings in 2015. Mainly thanks to the extension of Bellevue and Centre Loire network. In addition, a new network in Nord Chézine is currently under construction (delivery in 2019). The goal

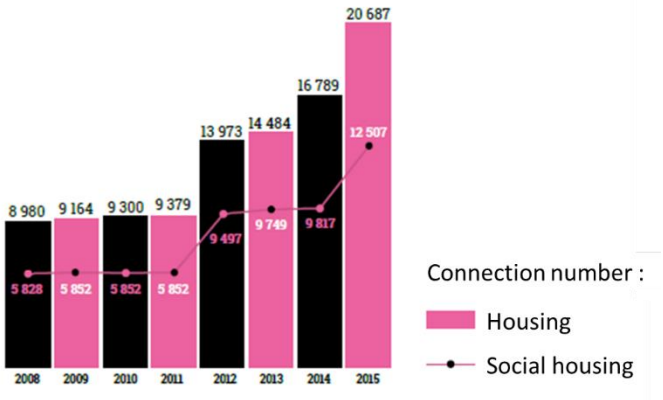


Figure 41: Evolution of district heating network connection (housing and social housing) between 2008-2015, source document socle

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

is to deliver 60 000 housing.

- Nantes Métropole renewable energy share (75%) is well above the national average (50%). It is thus approaching the target of 75% of renewable energies in district heating networks at the horizon 2020 (Grenelle of the environment).

The renewable energy promotion enables to both reduce the GHG emission (36 500 ton avoided in 2015) and to manage the energy tariff (in 2015, the new users connect to DHN have the energy bill reduce in average by 18%).

8.1.2.4 Nantes Métropole, as a granting authority for electricity and gas network

Since June 2008, Nantes Métropole exercise the full competence for the **public electricity distribution** in all the municipalities. The distribution activity is granted to Enedis, which include the electricity distribution from medium to low voltage, from source poste (interface with the transport network) to the consumer meters. 3 072 GWh of electricity are distributed through 5 708 km of network, connected to 354 400 users. Nantes Métropole has 4 contracts with Enedis.

Since March 2015, 24 communes agreed to purchase in a common group electricity for a 5 500 livraison points representing 160 GWh, with 4 different electricity suppliers[38] (EDF, ENGIE, ENERCOOP and Direct Energie). The average tariff is 147 €/MWh tax included. One part is 100% renewable electricity guarantee, by Enercoop, which represents 3.9 GWh. This common purchase enables to save a lot of money, thanks to a better prices negotiation (public regulated tariff and market price).

Concerning the **gas distribution**, this public service is granted to GRDF. 3 410 GWh of gas are distributed through 2 198 km of network, connected to 173 218 users. The gas supply is based on the market. The average tariff is 86 €/MWh tax included. The city of Nantes has launched two times a common purchase of gas (in 2011 for 3 members 60 GWh and in 2014 125 GWh).

Those public granting authorities are specific, because the delegate is in a monopole situation (French specificity) and the public fixed tariff are not fixed by Nantes Métropole (but by a national energy regulation commission[39]).

8.1.2.5 Sewage water production plant

Concerning the drinking water supply plant (Nantes Métropole 2016 Annual water report), the La Roche company is responsible to pump, treat, store and distribute water. The nominal capacity is 200 000 m^3 per day. Refurbishment work and a new smaller sizing is under consideration in order to reduce consumption and cost: energy audit of the plant, connection to the district heating network, lowering the daily nominal

[38] Since 2007, the electricity market has been fully liberalized: any consumer can freely choose his electricity supplier. However, only 8% of non-residential sites had opted for an alternative electricity supplier in June 2013

[39] More information about the French energy regulation comission: http://www.cre.fr/en

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

capacity from 200 000 m³ à 115 000 m³. The water supply network is more detailed in the infrastructure chapter, section 10.1.8.

8.1.2.6 Waste incinerator

Needless to say, energetic waste recovery is an interesting measure but the core issue is to reduce the waste production. Nantes Métropole is well implicated in such topic since a long time. The following statistics highlight the efficiency of promoted actions to reduce and recycle (between 2010 and 2016, -33 kg per inhabitants per year and -15 kg collected on recycling site). In 2014, Nantes Métropole won the call of proposal “zero waste territory”.

According to the annual waste report from Nantes Métropole, the different recycling point and the two waste retreatment plants are located on the map (Figure 42). Some energetic characteristics:

- The arc-en-ciel plant recycles 185 000 ton of waste (glass, paper, cloth, plastic, …) to produce in energy terms (other organic or material production see the rapport) 121 GWh supplying Centre - Loire district heating networks, 30 GWh for the steel industry (Arcelor) and electricity 9 GWh (6,6 GWh in self consumption).
- The ALCEA plant collects 140 000 ton of waste for incineration. It produces 160 thermal GWh, in which 121 GWh are delivered to Centre Loire district heating networks, and 4 GWh electricity thanks to an Organic Rankine Cycle (ORC). Some energetic works are plan to improve the overall energy efficiency of the ORC (more than 60%) especially in summer when the heat is not reused.

The Centre-Loire DHN is supplied by more than 77% from waste heat recovery.

Figure 42: Nantes Métropole recycling point and waste retreatment plant (Source: Nantes Métropole annual report Waste 2015)

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

8.2 Potential local energy resources

The Nantes Métropole RES potential is summed up Figure 43, either for electricity or for heat production. The potential is estimated to be equivalent around 20% of the current consumption. The heat and electricity potential production from RES are high and easily included into the mix (especially for the heat production, thanks to biomass in district heating networks), there is barely no potential for renewable gas production.

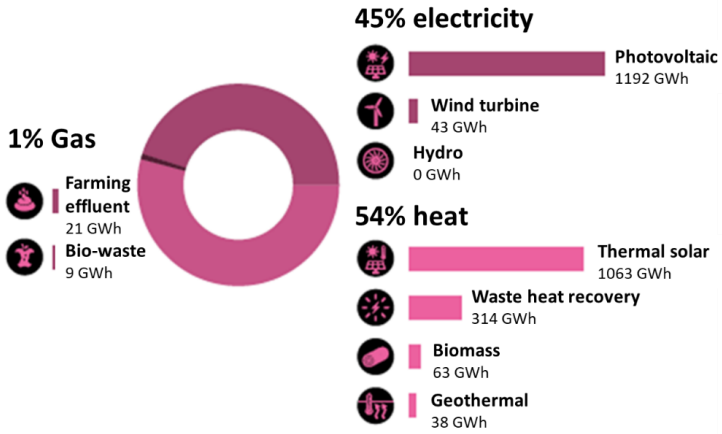


Figure 43: RES potential in Nantes Métropole (source: Nantes Métropole 2015, Document socle du grand débat sur la transition énergétique)

The pros and cons are summed up in Table 9. Briefly the first step of potential identification is done but the feasibility study or more accurate potential study has to be carried out.

A new climate plan is due to end 2018, including a territorial energy strategy deployment. This study aims at planning the development of the potential RES already identified. It will be an operational tool to plan the production, the distribution and the consumption of Energy at Nantes Métropole scale.

Table 9: Pros and cons of each RES

RES	Advantage	Disadvantage
Biomass	Interesting potential for small boiler room and bocage maintenance	Potential difficult to evaluate exactly (*)
Wind turbine	Location and production precisely identified (small to large-scale)	Low availability area in the territory
Wasted heat recovery	Potential sites identified	(*)
Hydraulic	La Loire: a natural resource yet enough	Potential study not enough deeply

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

RES	Advantage	Disadvantage
	exploited	detailed
Geothermal	Located resources well known	(*)
Solar	High solar potential (photovoltaic and thermal) thanks to high roof surface	Precis study only at some part of the territory
Difficult to use the roof surface		
Organic waste	Company producing organic waste well identified.	

8.2.1 Renewable electricity production

The renewable electricity production is estimated to be 45% of total potential of RES, mainly photovoltaic, a little of wind energy and very few mini-hydraulic.

8.2.1.1 Photovoltaic potential

The global horizontal irradiation is represented in the France map (Figure 44). There is higher solar potential in France than in Nantes, nevertheless in Nantes the global horizontal irradiation represents an interesting potential of 1 222 kWh/m² in average (source meteofrance year 1971 – 2000). The yearly average insulation is 1 690.3 hours.

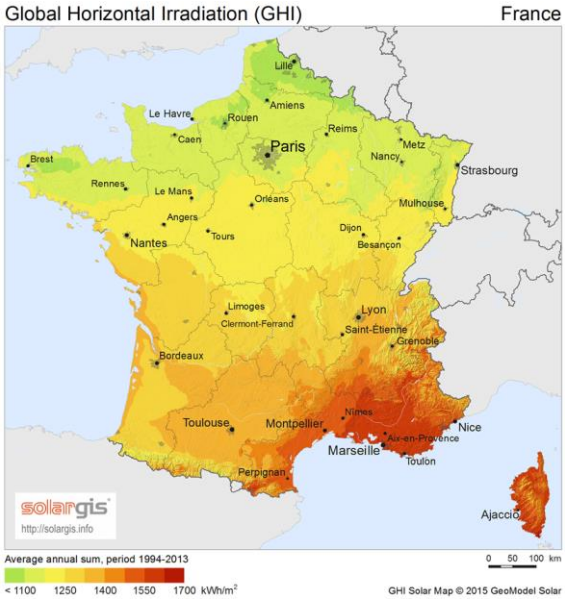


Figure 44: French solar potential map

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

The photovoltaic potential is the highest RES potential share for electricity production, it could represent an annual production of around 1200 GWh. The methodology is detailed in annex 9 of the RES inventory of Nantes Métropole. The roof top surface is estimated and only the area without usage conflict are kept. As a global assumption, 2/3 of those potential area are used for photovoltaic panel and the last third for thermal solar panels.

Nantes Métropole has worked with the company In sun we trust to offer an online solar potential estimation tool[40].

8.2.1.2 Wind turbine potential

The wind potential depends a lot on the local area. Some statistics are detailed from the Nantes-Bouguenais station, the maximal wind speed reached 133 km/h in 1990 and the average 10min wind speed is 14.04 km/h. Moreover, there is 49.8 days with wind speed higher than 58 km/h and only 1.5 days higher than 100 km/h.

According to previous studies carried out on the territory of Nantes Métropole and the wind turbine regional scheme, the area is able to install 27 wind turbines (Figure 45). The production potential of the entire wind farm is estimated at 43 GWh / year, the vast majority is from large-scale wind turbine (96%). It is estimated to install 12 large size wing turbines (power >350 kW, high 80m and rotor diameter >40m) and 15 of average size ((>36kW, between 20-40m high and 15-25m diameter).

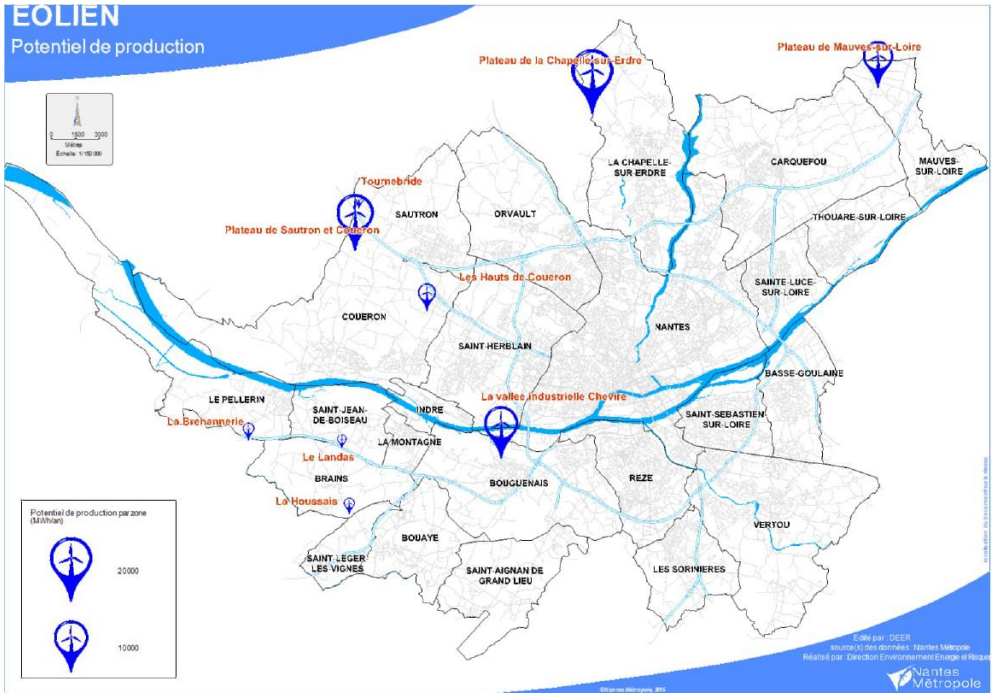


Figure 45: Wind turbine potential map (reference: Nantes Métropole, RES inventory 2015)

[40] https://nantes-metropole.insunwetrust.solar/simulateur

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

8.2.1.3 Mini-Hydraulic potential

Only the hydraulic potential for electricity production was studied by Nantes Métropole, which has identified 3 main sites

- Nearby the chaussée des Moines located in the municipality of Vertou, estimated production of 161 MWh/an.
- Nearby Anne de Bretagne bridge in Nantes, 27 MWh/year of potential production.
- Haute Indre area, 36 MWh/year of potential production.

8.2.2 Renewable thermal production (estimated 54% of RES, mainly solar panel, wasted heat recovery, biomass, geothermal)

8.2.2.1 Thermal solar panel potential

The thermal solar panel potential is the highest RES potential share for heat production, it could represent an annual production of around 1100 GWh. As detailed for the photovoltaic potential, the methodology is detailed in annex 9 of the RES inventory of Nantes Métropole. One of the main difference is the integration issue of those panels because of domestic hat water demand and its high peak fluctuation.

As presented in the photovoltaic potential, Nantes Métropole has worked with the company In sun we trust to offer an online solar potential estimation tool.

8.2.2.2 Wasted heat recovery potential

As a first approach, Nantes Métropole make an inventory of the companies subjected to authorization under Installations Classified for the Protection of the Environment (ICPE). The latter are a risk to the environment and potentially use heavy industrial processes with high energy consumption. They can therefore be considered to be sources of fatal energies. National ratio from the CEREN (French center for economic research and research on energy) are used to estimate the potential depending on the source of the wasted heat (process, sewage treatment plant…). Thanks to this first study, 18 areas are identified in 4 main industrial districts (in orange Figure 46):

- Industrial area from Nantes Carquefou (11 ICPE)
- La Vertonne (10 ICPE)
- Industrial area from Loire-Atlantique (10 ICPE)
- Le bas Chantenay (9 ICPE)

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

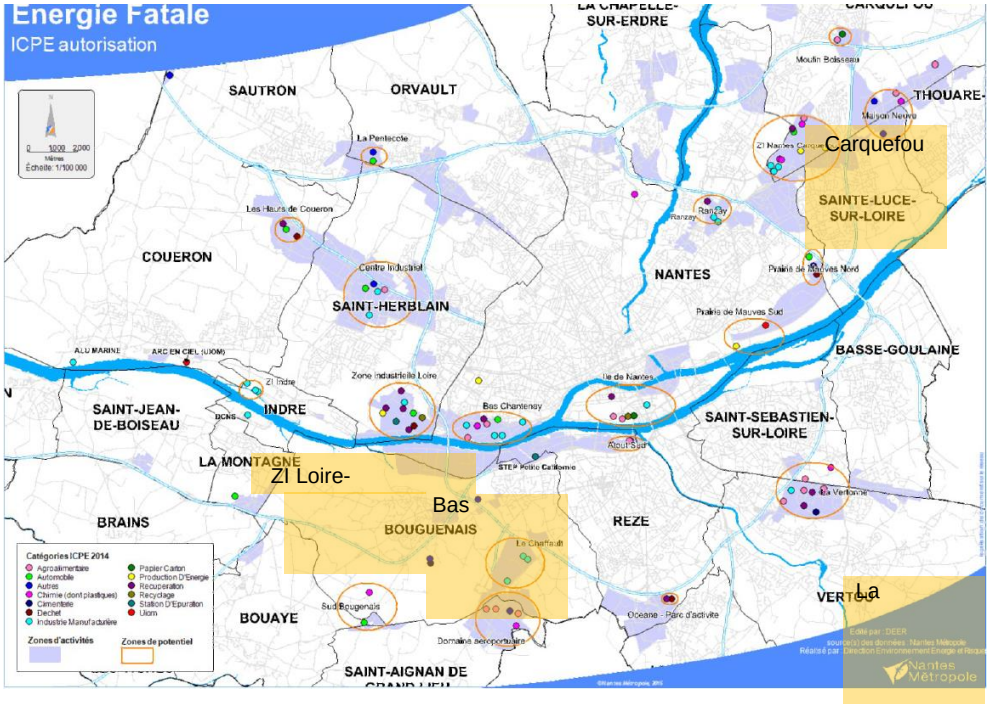


Figure 46: Wasted heat recovery potential map (reference: Nantes Métropole, RES inventory 2015)

8.2.2.3 Biomass potential

In the framework of the 21 agenda, Nantes Métropole launched a biomass potential study with SYNERVIA, ATLANBOIS, CIVAM DEFIS and the national superior school of wood in march 2005. Those first estimation were consolidated by Nantes Métropole to better know the wood resource. Around Nantes Métropole, the average wood quantity available reach 26 000 tonnes per year, which represents a potential heating production of 63 GWh/an. In Figure 47 is represented the wood resource potential per communes. The main potential areas are located in the following communes: Vertou (12%), Chapelle sur Erdre (10%) and Carquefou (8%).

This high potential can be easily introduced into the energy mix thanks to district heating networks.

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

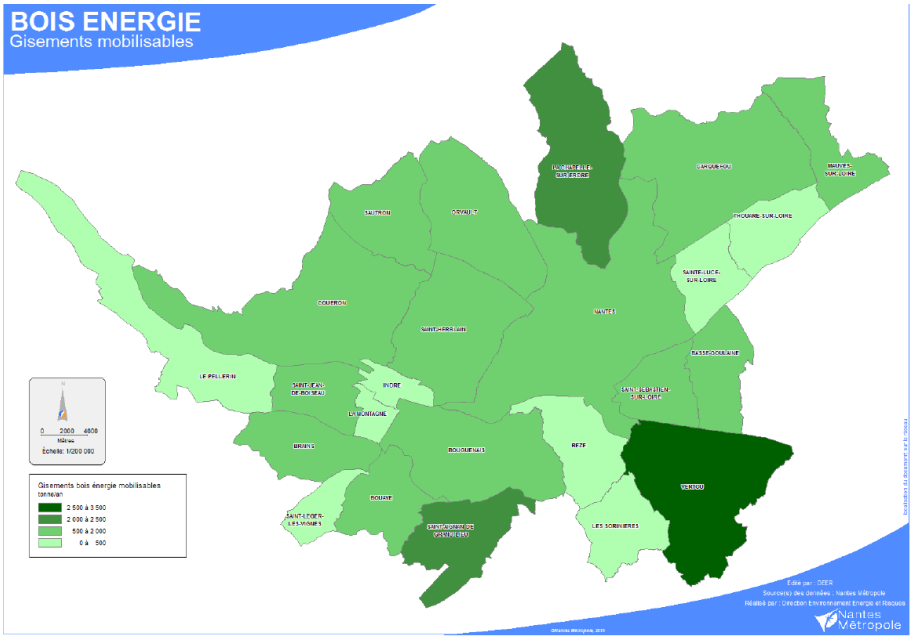


Figure 47: Biomass potential map (reference: Nantes Métropole, RES inventory 2015)

8.2.2.4 Geothermal potential

In the study from BRGM (French office for geological research and mining) in 2009, the potential geothermal areas are identified, see Figure 48 for the potential area identified for a 100m death geothermal vertical probe. But in this study, the geothermal potential production is not estimated. The actual geothermal production is estimated around 38 GWh/an.

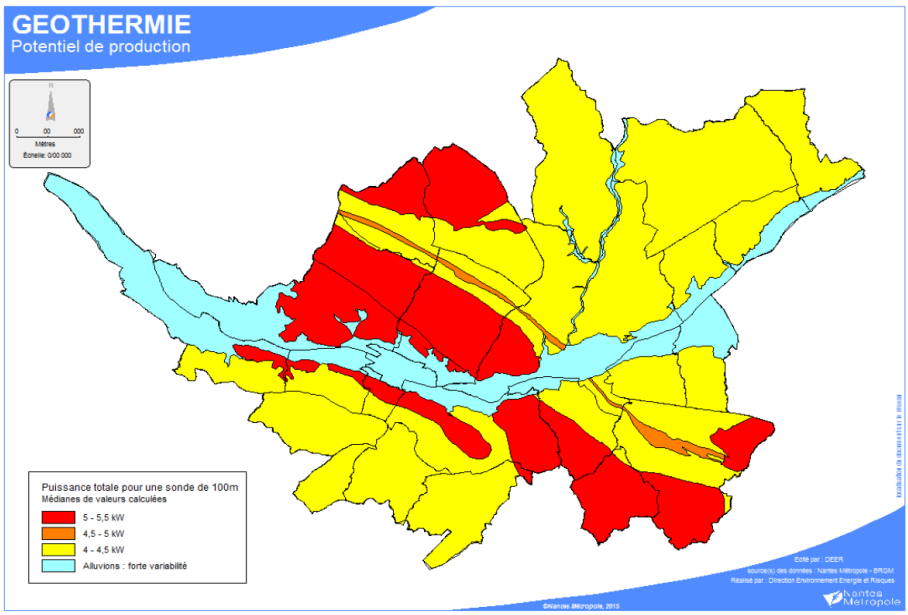


Figure 48: Geothermal potential map (reference: Nantes Métropole, RES inventory 2015)

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

8.2.2.5 Organic waste potential

In total, organic waste potential from effluents and bio-waste from companies in Nantes Métropole are estimated around 68 000 ton/ year (Table 10), which represents around **30 GWh / year of potential gas production**.

Quantitatively, the energy recovery of organic waste appears more interesting in the form of gas for an injection into the network. However, this exploitation is subjected to strong technical constraints related to the presence or not of injection points near the biogas production site. The production of heat is then more relevant by the possibility of consuming the energy produced locally for the heating of buildings for example, **27 GWh/year heat potential production**. The overall efficiency is higher in case of combined heat and power unit.

Table 10: Organic waste potential synthesis

Resource	Available amount of organic waste (ton/year)	Potential production (GWh/an)		
		Gas	Heat	Electricity
Bio waste	11,323	9.2	8.2	3.6
Effluents	56,510	20.6	18.6	7.8
Total	67,833	29.8	26.8	11.4

8.3 Calculation of diagnosis indicators for energy supply network

The indicators selected for energy supply network are being calculated and they are showing in the following table.

Table 11: Indicators for energy supply network

Indicator	Units	Value	Source
Final energy consumption [41]per capita	MWh/capita	18.59	SEAP 2017 , Monitoring emission inventory for year 2012 (*)
Final energy consumption (Transport)	TWh/year	4.12 (37%)	(*)
Final energy consumption (Buildings, equipment/facilities and Industries)	TWh/year	6.98 (63%)	(*)
Final energy consumption (Municipal)	TWh/year	0.14 (1%)	(*)

[41] In 2012, the final energy consumption accounts for 11.09 TWh for 596752 inhabitants according to (*).

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

Indicator	Units	Value	Source
Final energy consumption (Tertiary)	TWh/year	2.83 (25%)	(*)
Final energy consumption (Residential)	TWh/year	3.96 (36%)	(*)
Final energy consumption (Public lighting)	TWh/year	0.052 (0.5%)	(*)
Final energy consumption (Industry)	TWh/year	2.36	In 2014, from Figure 36 from BASEMIS V4
Final energy consumption (electricity)	TWh/year	2.81 (25%)	(*)
Final energy consumption (Heat/Cold)	TWh/year	0.27 (2%)	(*)
Final energy consumption (Fossil fuels)	TWh/year	7.53 (68%)	(*)
Final energy consumption (Renewables)	TWh/year	0.50 (4%)	(*)
Share of local energy production[42] to overall final energy consumption	%	2.6 %	(*),
Renewable electricity generated within the city	%	0.10%	(*)
Non-RES Heat/ ~~Cold~~ production	TWh/year	0.075	(*)
RES Heat/~~Cold~~ production	TWh/year	0.087	(*)
Total buildings energy consumption per year	GWh/inhab. year	non-available	
Renewable energy per carrier	GWh/RES_ supplier	PV : 11.30 Wind : 0.009 other biomass : 19.94	
Percentage of renewable energy	%	non-available	
Primary energy consumption in the city per year	GWh of PE/year	non-available	
Primary energy consumption per capita	MWh/capita	non-available	
Primary energy consumption (Transport)	TWh/year	non-available	
Primary energy consumption (Buildings, equipments/facilities and Industries)	TWh/year	non-available	
Primary energy consumption (Municipal)	TWh/year	non-available	

[42] local energy production = renewable electricity production within the city + electricity generated from CHP +local heat production (from RES and non-RES).

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

Indicator	Units	Value	Source
Primary energy consumption (Tertiary)	TWh/year	non-available	
Primary energy consumption (Residential)	TWh/year	non-available	
Primary energy consumption (Public lighting)	TWh/year	non-available	
Primary energy consumption (Industry)	TWh/year	non-available	
Primary energy consumption (electricity)	TWh/year	non-available	
Maximum Hourly Deficit (MHDx)	min	25-40min between 2008-2014 90min in 2015	Nantes Métropole Energy report 2015
Green electricity purchased	%	2.4 %	Nantes Métropole Energy report 2015

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

9. City transportation current status

9.1 Mobility city profile

9.1.1 Number of daily trips at the Nantes Métropole Level

Nantes Métropole inhabitants carry out 3,8 trips per day on average. At the Metropolitan level, this represents about 2.3 million daily trips. By 2030, according to the growth rate of the population, there will be nearly 270,000 additional trips per day.

Individual mobilty (number of trips per person and per day) tends to increase since 2002 so that the total number of trips increases faster than the population.

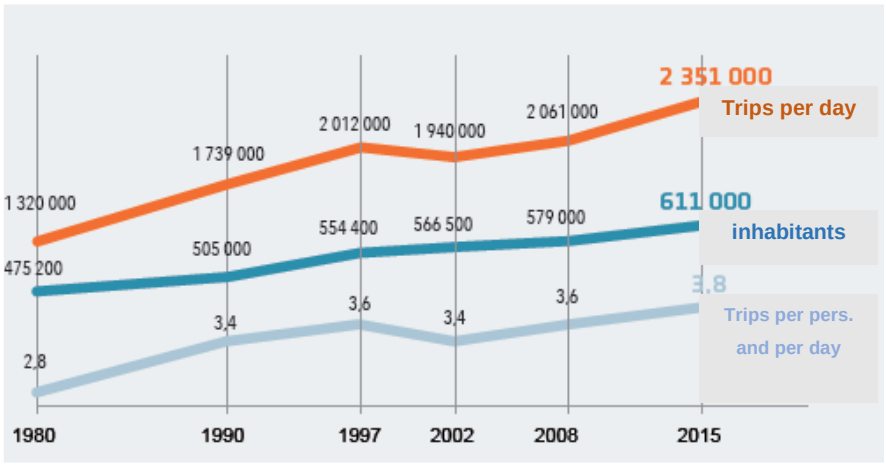


Figure 49: Evolution of population, trips and number of trips per person and per day in Nantes Métropole (reference: AURAN)

9.1.2 Modal share

In the Nantes Métropole area, car (as driver) remains the most important mode of transportation: with a modal share of 43%, this represents 1,008,000 daily trips. Car modal share delined significantly since 2002. However, this decline is not important enough to drive down the total number of trips achieved by car: indeed, the population growth leads to an increase of the overall car trips.

Walking is the second most important mode of transportation; its modal share is 26% (614,000 daily trips). It increased by 5 percentage points over the last decade.

Public transport now accounts for 15% of trips (353 000 trips), with a slight increase (14% in 2002). The modal share of bicycling also increased and now represents 3% of trips.

The modal shares of cars as passengers and of motorcyles remains stable: 12% (291,00 trips) and 1% (less than 9,000 trips) of the total trips at the urban area level.

The modal split strategy defined by Nantes Métropole in its Urban Travel Plan by 2030 aims for a reduction in car use, in favour of other modes of transportation, in particular cycling and walking.

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

However, the modal share targets for 2030 are differentiated according to the different sectors of Nantes Métropole, especialliy depending on whether they are located inside or outside the perimeter of the ring-road.

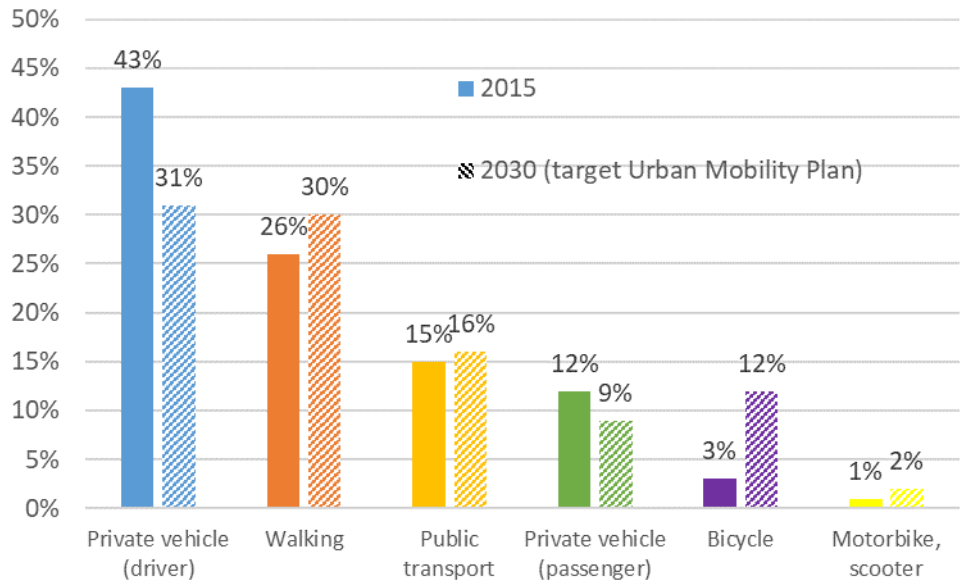


Figure 50: Modal split of transportation in Nantes Métropole (in 2015 and target 2030) (reference: PDU Nantes Métropole)

9.1.3 Trips characterisation

The following figure illustrates the characteristcs of trips according to the travel mode used.

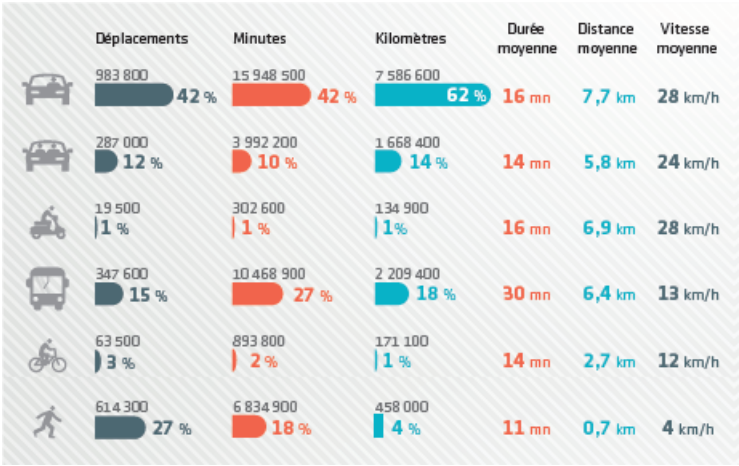


Figure 51: Trips characterisation according to the travel mode used (reference: AURAN)

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

Wa can note the following points:

- the highest average speed is reached by car (as drivers) and motorcycle (28 km/h) ; these two modes of transports also have the longest average distance;
- the average speeds of trips made by public transport and bicycles are quite similar (12-13 km/h) but the average distance covered by bicycles is significantly lower (2,7 km);
- the average travel time does not vary much depending on the mode of transportation used (between 11 and 16 minutes), except for public transport (30 minutes).

9.1.4 Trip purposes

In 2015, the main trip purposes of the Nantes Métropole inhabitants are "leisure and visit to family and freinds" (24%), followed by "purchases" (21,5%). Commuting is the 3rd most important trip purpose (20,5%). Training accounted for 13,5% of the total trips.

Trip purposes are quite similar on all areas of Nantes Métropole. However, trip puporses have a major impact on transportation modes used:

- car is the main mode of transportation for all kinds of purposes, except for training;
- for commuting, the modal share of private cars as passenger is 4%, whereas it is 10% for all othertrip purposes;
- modal share of bicycling is more important for commuting thant for other trip purposes;
- for training, purchases, and leisure, about 30% of trips are achieced by walking;
- public transports are the main mode of transportation for training.

9.1.5 Emissions due to transport

In 2015, Nantes Métropole inhabitants trips emitted 466,200 teqCO2. Nearly 88% of these emissions were generated by cars (as drivers), and 11% by public transport.

Almost 46% of the emissions due to transport were generated by commuting trips.

Trips over 25 km are responsible for 40% of the emissions, whereas they only represent 4% of the total trips. On the opposite, trips under 3 km, which represent more thant 50% of the total trips, emitted 7% of the total emissions.

9.1.6 Traffic accidents

In 2016, 382 physical accidents were registred in Nantes Métropole. These accidents involved 480 victims and caused 17 fatalities.

In recent years, the general trend is to observe a decrease in the number of accidents, but an increase of their severity.

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

Cyclists and motorcyclists are over-represented among casualties compared to their modal share. Furthermore, victims are mainly men (62%), and young people in the 15-29 age group (37% of victims, but 23% of the population)

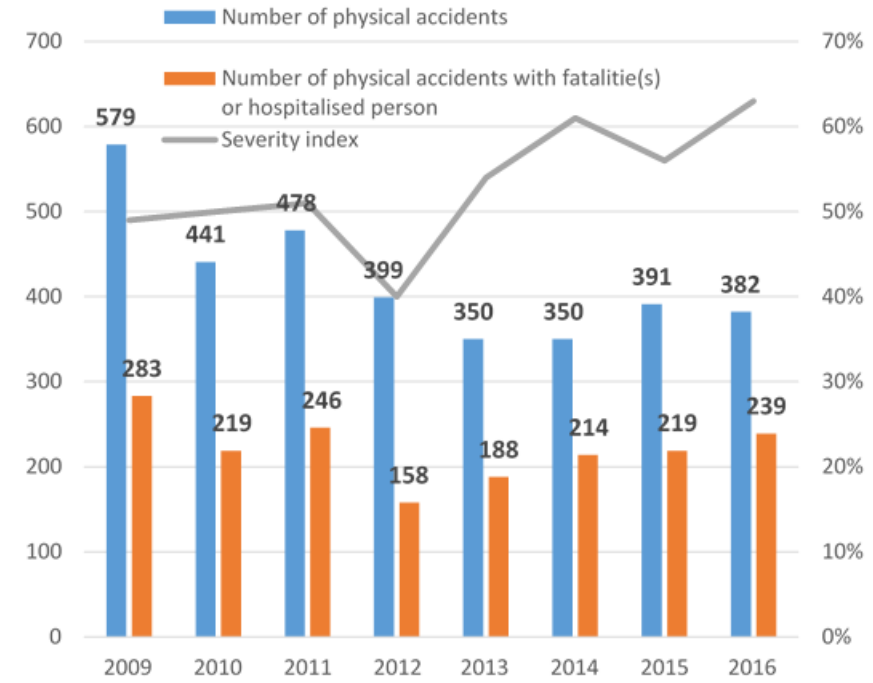


Figure 53: Number of physical accidents in Nantes Métropole (reference: Nantes Métropole)

Drivers are responsible for 87% of accidents where they are involved, but a significant increase in the liability of cyclists is observed (cyclists were presumed to be responsible for accidents in 17% of cases where they were involved in 2014, in 50% of cases in 2016).

9.2 Car mobility

9.2.1 Description of the main road network

Although one of the main goals of Nantes Métropole mobility policy is to limit the use of private cars, cars are still an extremely important mode of transportation. Thus, out of the 2.3 million daily trips, almost 1.3 million (ie 55%) are made by car (1 million as a driver, about 300,000 as a passenger). Consequently, the road network plays a major role for mobility in the Nantes conurbation.

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

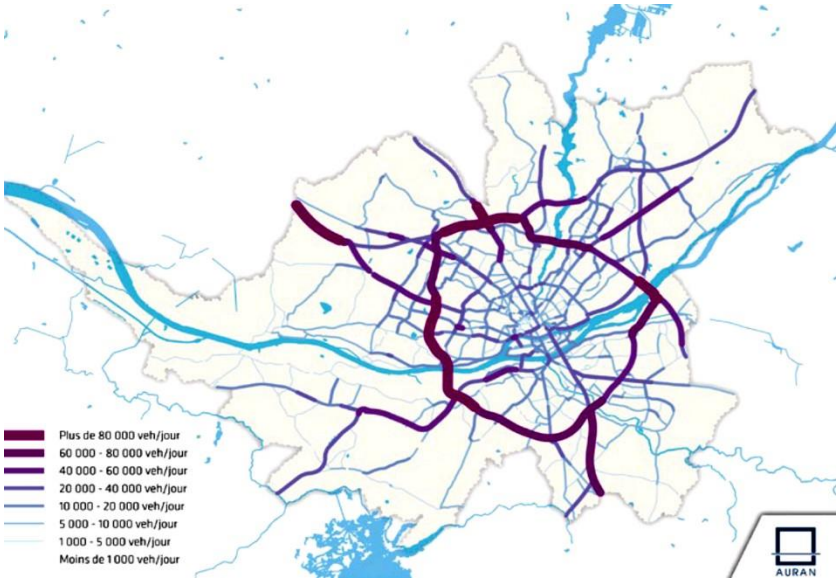


Figure 54: Automobile traffic on the main roads of Nantes Métropole (number of vehicles per day) (reference: Nantes Métropole & AURAN)

This road network includes:

- a complete ring-road around Nantes (between 64,000 vehicles and 95,000 vehicles per day), connected to 2 motorways (A11 to Paris and A83 to Niort) and 3 fast lanes (to Rennes, Cholet and Vannes)
- a total of 14 bridges crossing the Loire: 2 bridges on the ring-road and 10 bridges on the Ile de Nantes (6 to the north, 4 to the south); all of them are densely traffic-intensive areas. Two other bridges are located upstream, east of the metropolis, at the level of Thouaré-sur-Loire and Mauves-sur-Loire. Finally, two ferries operate on the western part (at the level of Basse-Indre / Indret and Couëron / Le Pellerin).

Every day, around 342,000 vehicles run on the road network of the Nantes Métropole conurbation. More than half goes through the ring-road.

Between 2010 and 2015, car traffic going through the "Ile de Nantes", decreased by around 9,000 vehicles per day.

Traffic comming from the Ile de Nantes increased by about 20,000 vehicles / day; likewise, traffic increased on the ring-road bridges by approximately 15,000 vehicles / day.

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

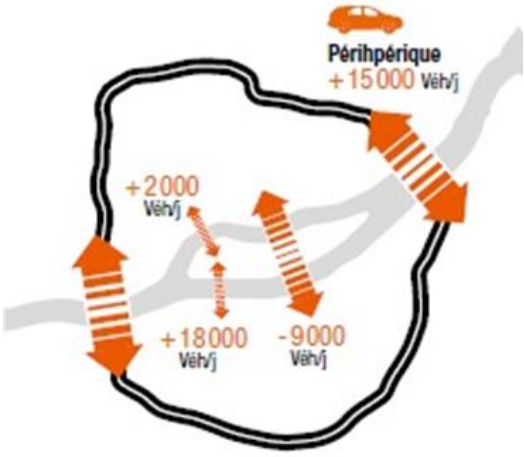


Figure 56: Evolution 2010-2015 of road traffic crossing the Loire river (reference: Nantes Métropole)

9.2.2 Private cars fleet characterisation

Data are not available to know precisely the car fleet at Nantes Métropole level. However, it is possible to estimate (thanks to the last major survey carried out on mobility in the metropolitan area) that the motorization rate is about 1.21 cars per household, or about 352,000 cars.

Precise data on the car fleet are only available at the department (county) level of Loire-Atlantique, for 2013. That year, there were 683,194 private and commercial cars in circulation in the department. Given the figure above, vehicles in circulation in Nantes Métropole would therefore represent about half of the departemental fleet.

The number of vehicles increased by + 0.7% over one year. This increase in the number of private cars is faster than that observed at the national level; it can be explained in particular by the strong population growth in the region.

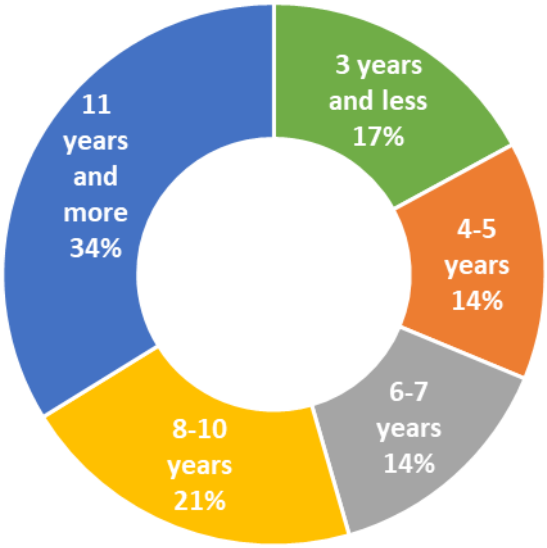


Figure 57: Private vehicules by age groups in the Loire-Atlantique Department (reference: French Ministry for Ecological Transition)

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

The car fleet is aging: more than 33% of cars is more than 11 years old. Therefore, these vehicles do not comply with the EURO 4 standards. On the other hand, only 17% of cars are less than 3 years old and comply with the EURO 5 standards (applicable to vehicles on 1 January 2011).

Source of energy	Number	%
Petrol	214 774	31,4%
Diesel	460 776	67,4%
Petrol / LPG	4 816	0,7%
Electric and hybrid vehicles	2 581	0,4%
Hybrid	*2 380*	*0,3%*
Full electric	*201*	*0,0%*
Other	247	0,0%
Total	**683 194**	**100,0%**

Table 13: Vehicles per energy cources (on 31/12/2013) reference: French Ministry for Ecological Transition)

In terms of motorization and energy sources, the car fleet is for a large part made up of diesel vehicles (67%); less than one out of three cars is a gasoline car. In 2013, electric cars were still very marginal; hybrid vehicles (gasoline + electric or diesel + electric) accounted for about 2,300 vehicles (barely 0.3% of the departmental fleet); the full-electric cars represented only 201 vehicles.

Since the last 3-4 years, however, there has been a sharp increase in the number of new registrations of electric vehicles. They now represent about 1% of new registrations in the department, and between January 2012 and January 2017, the number of monthly registrations of electric vehicles was multiplied by almost 15 in the Loire-Atlantique department (whereas the number of registrations remained stable for other sources of energy). Lastly, while electric vehicles have until recently been bought mainly by legal entities (companies, administrations), they are now also bought by private individuals.

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

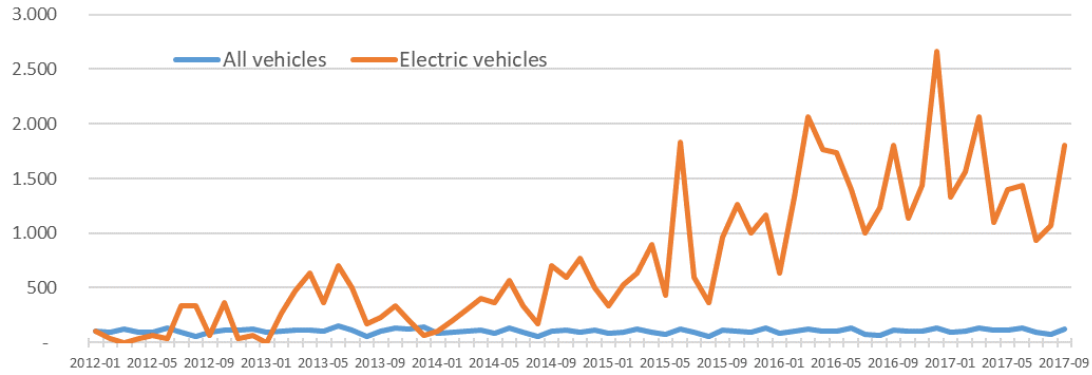


Figure 58: Number of monthly vehicles registrations in the Loire-Atlantique Department - index base 100 in 2012 (reference: French Ministry for Ecological Transition

9.2.3 Parking policy and EV charging stations

Parking management in the Nantes Métropole area, especially in the city center, is one of the key elements of Nantes Métropole's mobility policy. In order to limit the car's place in the city center, one of the objectives is to give priority to parking for residents, and limit commuters car access by providing peripheral parking solutions (in P+R car parks). In 2015, Nantes Métropole had:

- 15,540 on street paid parking spaces (+ 8,740 places since 2008)
- 8,850 parking spaces on public car parks (+ 2,150 places since 2008)
- 3,000 parking spaces in « Blue zone » (free parking, limited to 1h30)
- 58 P+R car parks, offering a total of 7,420 parking spaces and 1,140 bicycle parking spaces. The number of parking spaces in the P+R car parks has thus doubled in 10 years.

Some car parks in Nantes Métropole offer charging stations for electric vehicles. 30 charging stations are now available, mainly in public car parks in the city center and close to the railway station.

9.2.4 Car sharing and car pooling services

At the Nantes Métropole level, the average occupancy rate is 1.26 persons per vehicle; it is also estimated that almost 74% of the 1 000 000 trips made each day by car as drivers are carried out alone. In order to optimize the car use, Nantes Métropole promotes car-sharing and car-pooling solutions.

A car-sharing service, called Marguerite, was set up in 2008. It is a self-service vehicle rental service (operating 24 hours a day) for private individuals and companies, mainly for proximity journeys. The service now includes 45 stations and more than fifty vehicles. By the end of 2014, the service had nearly 600 rentals per month.

It is estimated that a Margarite shared-car, used in combination with other modes of transportation (walking, public transport, bicycle) replaces between 8 and 10 private cars.

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

Nantes Métropole also supports car-pooling, through a web-platform managed in partnership with the Loire-Atlantique Departmental Council (www.covoiturage-nantesmetropole.fr). This platform offers about 16,000 ads to and from Nantes Métropole, 20,000 from or to the department, and 160,000 all over France. 21 car-pool areas were also built in the agglomeration, for a total of almost 2,000 parking spaces.

9.3 Public transport

9.3.1 Public transport network use

The public transport network serves all major centers of Nantes Métropole (commercial areas, employment, services, training institutions, cultural and leisure facilities). In 2015, more than 130 million trips have been achieved on the Nantes public transport network (57% of them on the tram network), for a total of 27,7 millions of km. The number of trips is estimated at 350,000 per day. The modal share of public transport thus reaches about 15% at Nantes Métropole level and incresed by 1 percentage point since 2002. This increase may seem low, but this represents an additional 83,000 daily trips, an increase of 2.1% per year over the last 15 years. Over the period 2002-2015, almost 20% of new trips were absorbed by public transport.

The number of trips made by public transport increases most in the center of the agglomeration and within the perimeter of the ring-road, where the transport offer is the most important and the most suitable with the needs.

Figure 59: Evolution of the annual traffic (millions of passengers) and of the transport offer (millions ok km) on the public transport network of Nantes Métropole (reference: Nantes Métropole)

Public transport is mainly used by people under 25 years old, unemployed people, and women. It is less used by working people and the retired.

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

9.3.2 Public transport network characterisation

The metropolitan public transport network includes: 3 Tram lines, 1 « Busway » line, 7 « Chronobus » lines, 45 bus lines (except chronobus), 2 lines of « Navibus » (boats on Loire and Erdre rivers) and 5 Express Train lines, with 16 railway stations inside the perimeter of Nantes Métropole.

In 2015, 70% of the population of Nantes Métropole is located within 700m of the main public transport network (tramway, busway, chronobus)43. In the city center (i.e. inside the ring-road perimeter), this proportion is 99%.

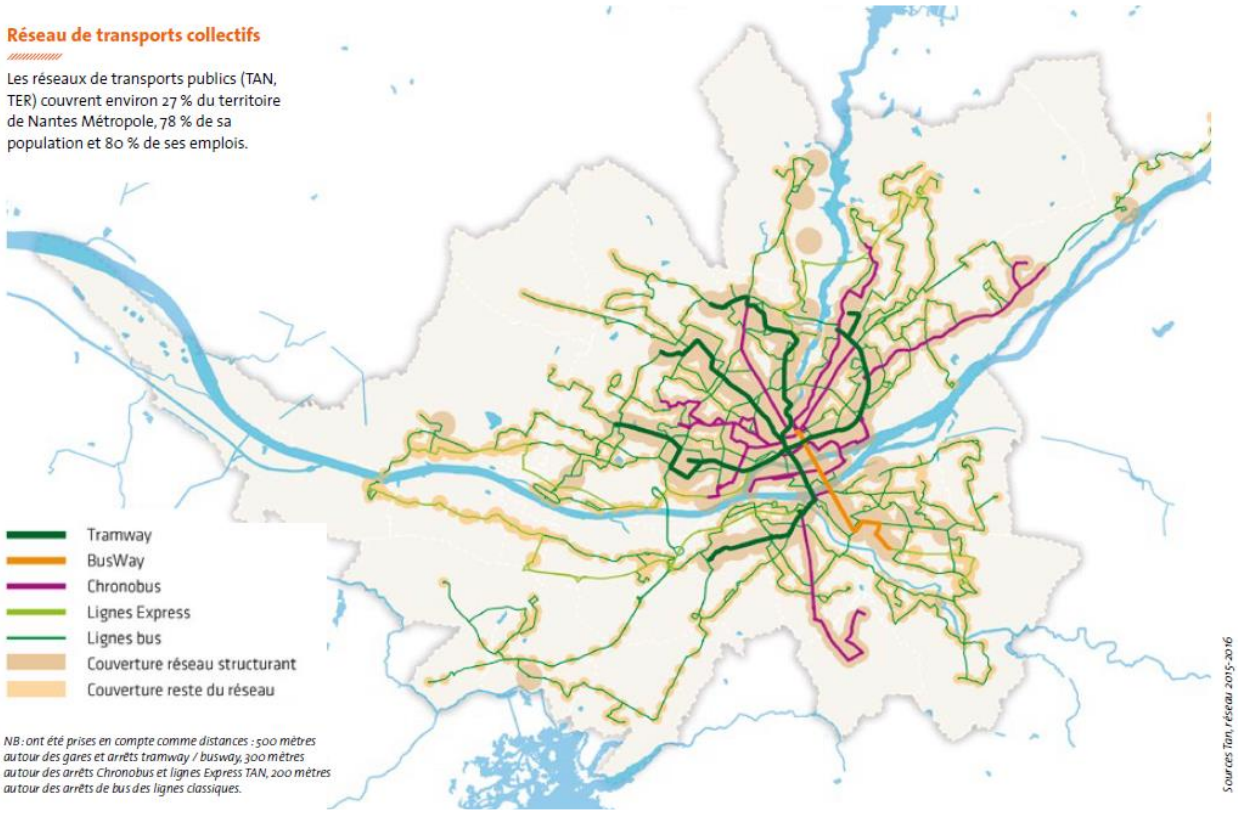


Figure 61: The public transport network of Nantes Métropole in 2016 (reference: Nantes Métropole an SEMITAN)

[43] Also considering bus stops (within a 200 m perimeter), 78% of the population and 80% of jobs of Nantes Métropole are served by public transport.

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

Table 14: Public transport network characterisation (reference: Nantes Métropole)

Public transport network	Length	Number of stops	Commercial speed	Vehicles fleet
3 tram lines	45 km	83	20 km / h	91 electric streetcars
1 Busway line High level of service bus (own-site, prioritary to the crossroads)	7 km	15	21 km / h	23 natural gas vehicles (articulated)
7 Chronobus lines high frequency, partial own-site	70 km	200	16,3 – 24,4 km / h (depending on the lines)	310 natural gas vehicles (154 articulated and 156 conventional) 6 hybrid diesel-electric vehicles (articulated) 42 diesel vehicles (39 conventional and 3 articulated) 120 diesel chartered vehicles (+ 32 diesel minibus for transport services for person with reduced mobility)
45 bus lines with 40 km of reserved lanes to improve the quality of the bus services	-	-	-	

The Nantes public transport network carries nearly 550,000 passengers every day44.

The 3 tram lines provide 55% of the network offer (about 300 000 passengers); the tram service runs from 4:30 to 00:30 on weekdays, with a frequency of 3 minutes during peak periods. Three types of streetcars are currently in service, all fully accessible to persons with reduced mobility.

The Busway (line 4) carries about 36,000 passengers a day. It is entirely in own site, allowing a high commercial speed, slightly higher than that of the tramway. It runs with a frequency of 2min30 in peak hours.

The vehicles currently used are articulated buses fuelled by NGV (natural gas for vehicles).

The Chronobus carries about 90,000 trips per day, on 7 lines (soon 10). The Chonobus is an innovative concept of quality of service applied to bus lines with high potential.

It has priority at crossroad, and runs on reserved lanes on certain sections; stops have been rearranged for more accessibility. These facilities ensure a travel time in peak hours close to that in off-peak hours. It runs at a frequency of 5 to 8 minutes, on a time range similar to that of the tramway and busway.

[44] The number of passengers transported (550,000) is higher than the number of trips made by public transport (350,000), as one trip can generate the use of several transport lines.

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

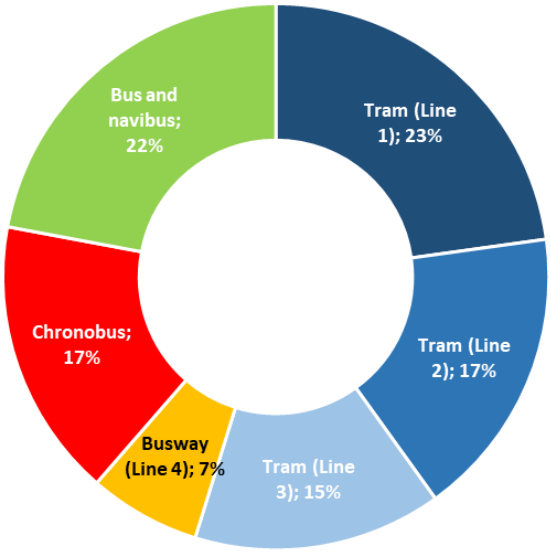


Figure 62: Number of passengers per day and per public transport modes (reference: Nantes Métropole)

9.4 Active mobility

9.4.1 An urban development policy to promote walking and cycling

Nantes Métropole is developing a spatial planning policy favoring the use of alternative modes (bike and walking) in relation to individual motorized modes. That means:

- a spatial planning policy aimed at controlling urban sprawl on a metropolitan scale,
- layout choices of the public space in favor of calm and peaceful urban environments, favoring the diversity on transport modes (and especially walking and cycling).

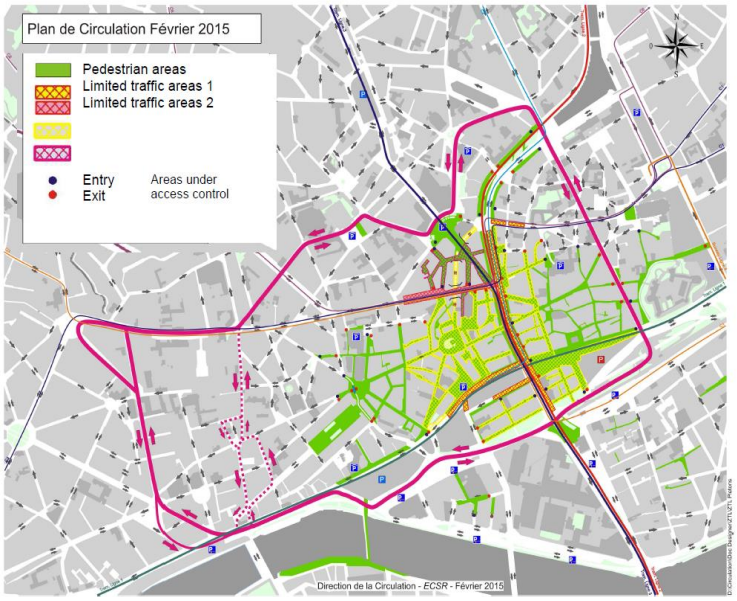


Figure 63: Circulation plan of the city center of Nantes (reference: Nantes Métropole)

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

Nantes Métropole is thus mobilized to build more quality public spaces, taking into account the specific needs of pedestrians and cyclists (by developping calm urban environment, controlling traffic speeds, by modifying access to certain roads).

This policy initiated in recent years has made it possible to reorganize (in 2013) the "boulevard des 50 otages" (main street of the city center) to reduce the space dedicated to cars on the public roads; the traffic on this axis has thus decreased from 50,000 vehicles per day to 5,000 vehicles per day, including 800 buses. This urban operation has also made it possible to design a bicycle lane, used by 3,000 bicycles / day (in 2015).

Figure 64: The new configuration of the Boulevard des 50 otages, Nantes (reference: Nantes Métropole)

In 2015, Nantes Métropole also set up a traffic plan for the city center of Nantes in order to reduce the space dedicated to cars and allocate more space to active modes. "Calm roads" have been built and represent now about 600 kilometers on the metropolitain area (ie 16% of the total road network). As a result, between 2010 and 2015, the number of "zones 30" (areas where the speed limit is 30 km/h) increased from 160km to 430km (half of which located in the municipality of Nantes).

On a wider point of view, Nantes Métropole has begun work on the hierarchy of roads and streets and adopted a speed moderation plan to adapt the speed limits to the intensity of local life. This plan is generalized to all 24 municipalities of the agglomeration, and contribute to promote walking and cycling.

Figure 65: Example of urban configuration in favor of a "calm" city (reference: Nantes Métropole)

9.4.2 Cycling

The modal share of the bicycle is about 6% on the city of Nantes, but only 3% at the Nantes Métropole level. The objective of the Urban Mobility Plan is to achieve a 12% modal share by 2030. In this context, a

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

new action plan for cycling has been adopted by Nantes Métropole for the next 5 years. With a budget of € 50 million, it includes:

- an increase of the network of bicycle paths from 480 km today to 700 km in 2020; will be created in particular: 10 km of bike structuring axes, 20 km of intermunicipalities express network, 3 crossings of the ring-road;
- the development of parking offer for bicycles: an additional 3,000 new parking spaces will be installed near the railway station, as well as 500 new secure bicycle spaces will complement the existing offer (6,500 bike-racks and 2,000 secured bike parkings in railway stations, park-and-ride and public transport stations).
- 2500 new bicycles for long-term rental
- To amplify financial aid for the purchase of electric bicycles or cargo bicycles.

Otherwise, a 24h bike share services system ("Bicloo") has been set up in 2008 (management delegated by Nantes Métropole to operator JCDecaux). It now has 880 bicycles spread over 103 stations (in 2015, more than 3,600 rentals per day). In total, 1,315,000 trips were made in bicloo in 2015, for more than 15 million kilometers traveled.

These actions have been partially successful, as walking and cycling significantly increased since 2002: + 3.4% per year for walking and + 2.6% per year for cycling. Walking thus exceeded the modal share set as a target for 2015, while cycling remains slightly below the targets set by Metropole (4% of the total trips) despite its favorable evolution.

As a result, Nantes Métropole's cycling policy have been recognized and distinguished at national and internaional levels: in 2012, Nantes received the European Civitas award for the citizen dialogue implemented to promote soft modes of transport, and the "Talents du vélo" ("bike talents") prize awarded by the Cycling Towns and Territories Club, for the implementation of the CycloTan service (rental of folding bicycles).

9.5 Sustainable urban logistics

In terms of freight transport and urban logistics, the action of Nantes Métropole concerns different aspects:

- development of urban logistics tools: these aim to optimize the logistics services of deliveries and the use of clean vehicles and bicycles. For example, Nantes Métropole supports the initiative "Les boxes à vélo" (artisans, deliverymen, ... using bikes to move in the city), making available premises and supporting them on communication.
- regulations: Nantes Métropole plans to define a new regulations governing access to deliveries in the city center of Nantes, to promote clean vehicles and optimize delivery conditions.

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

- urban planning and logistic planning to optimize the organization and implementation of logistics activities. Nantes Métropole is thus engaged, alongside other local authorities, in the realization of a logistical scheme at the level of the Nantes-Saint-Nazaire territory.
- territorial coordination, dialogue with city actors to support the experiments carried out by the stakeholders in the territory.

9.6 Calculation of diagnosis indicators for city transportation current status

The indicators selected for city transportation current status are being calculated and they are showing in the following table.

Table 15: Indicators for city transportation current status

Indicator	Units	Value
Total number of public transport vehicles	Number of vehicles	624
Number of Electric Vehicles (EV) in the city	n/100.000	Below than 200
Number of fossil fuelled four wheels vehicles per capita	n/ cao	0,507 (personnal and private cars) per capita (Loire-Atlantique department level)
Traffic accidents	#/100 000 people	38,6 accidents (with fatalities or hispitalised person) / 100 000 people
Public transport use	#/cap/year	210 journeys / capita / year
Access to public transport	%of people	70% of the located within 700m of the main public transport network (tramway, busway, chronobus) ; 99% in the city center
Access to vehicle sharing solutions	#/100 000 people	8,07 shared vehicles (“Marguerite“) / 100 000 people
Lenght of bike route network	km	77,5
Congestion	% in hours	Not available
Vehicle fuel efficiency	kWh/100km	Not available
Fuel mix	%	Petrol: 31,4% Diesel: 67,4% Petrol / LPG: 0,7% Electric and hybrid vehicles: 0,4%
Average occupancy	number of passengers per vehicle	1.26
Average vehicle speed		Not available

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

Indicator	Units	Value
Total energy of charging points	kWh	Not available
Charging points per eVehicle	%	About 0,15
Total charging points	#	30 (public charging points)
Recharges per year	#/year	Not available
infrastructure growth e-car	[number of e-car charging]	30
infrastructure growth e-bike	[number of e-bike charging]	Not available

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

10. Sustainable urban infrastructures for integration

The main source concerning Nantes Métropole urban infrastructure is a synthesis of the existing numerical infrastructure and the needs (Nantes Metropole - TACTIS, 2017). This state of the art of urban infrastructure, ICT network and needs highlight a prolific context of projects, which reveals the existence of various urban infrastructure and services.

10.1 Support structures current status

10.1.1 Civil engineering infrastructure

The civil engineering infrastructures (sheaths) are dedicated to electronic communication network. Those sheaths belong to Nantes Métropole, at the EPICE service, after their construction by urban planners. Since 2010, Nantes Métropole works on a development plan. This development is illustrated Figure 66, in January 2017 the sheaths are 210 km long. Since 2012, the sheaths are rent to operators by Nantes Networks, which give back to Nantes Métropole 60% of their benefit. The main client is Orange, which has signed with Nantes Networks since 2014.

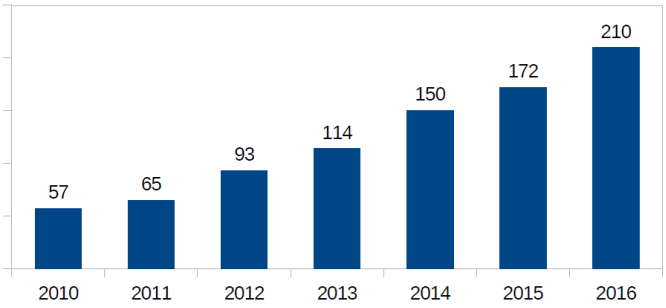


Figure 66: Evolution of the ICT networks length (in km) source: Nantes Métropole, infrastructure inventory 2017

The description tool of those sheaths is realized by Nantes Métropole on LOGICE (ICT management software) based on Géonantes. The Geographic Information System (GIS) data (network layout and as-build drawing plan in DWG format) are referenced in GIS Géonantes by EPICE service. It represents around 2Go of data for the plans.

10.1.2 Public lighting

In Nantes Métropole, the public lighting represents 94 000 lamps and 1940 cupboards. The two main issues are the energy efficiency and the service quality. The energy efficiency measure consists to replace the ageing gas-discharge lamps (25% of the equipment have more than 30 years' service long) by LEDs. **The electricity bills reach 7,7 M€ per year** (including taxes**), which represents 60% of the energy bill for Nantes Métropole.**

Public lighting uses its own sheaths, which owner service is EPICE (unit of Nantes Métropole). A long-term investment is set to refurbish 3% per year of the public lighting network. EPICE manages within Géonantes all the GIS data: lighting point, as-built plans, and cupboard.

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

10.1.3 Optic network (operated by Nantes Networks)

Nantes Métropole has built an optic network, called OMEGA. Nantes networks is nowadays partly in charge of its extension and operation, in addition of the sheaths commercialization. This Public Service Delegation (PSD) contracted in January 2012 for 25 years aims at connecting companies in economic area and town halls belonging to Nantes Métropole.

- Some interesting characteristics of this optic network:
- 730 km linear optic network
- 53 service operators
- 1200 sites connected at the end of 2016
- 16 520 companies available for connection
- 114 economic area optic coverage
- All the GIS data are dealt with NetGéo.

10.1.4 NRD optic network (numeric resource department)

The second part of the optic network is managed by the Numeric Resource Department (NRD) of Nantes Métropole. only shows public buildings on the fibre networks, privates clients are not visible on this map. One main analysis is to emphasis the fact that each commune has access to the optic fibre for their administrative sites. Lots of school of Nantes city have also access to the optic fibre. Around 150 sites are connected.

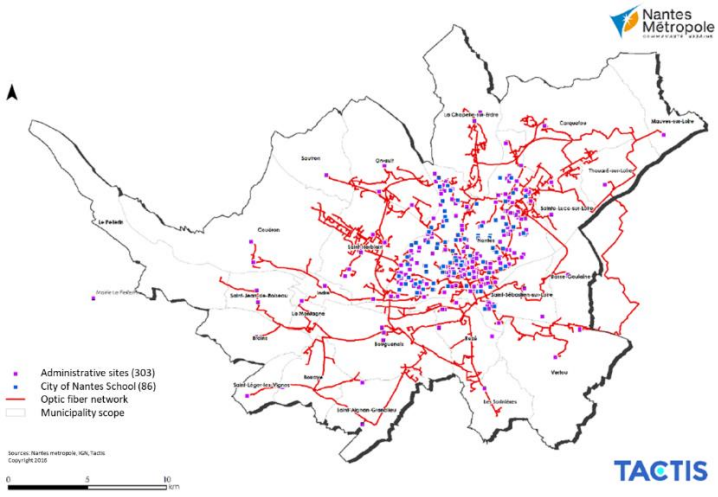


Figure 67: Priority sites locations and optic fiber coverage, source: Nantes Métropole, infrastructure inventory 2017

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

10.1.5 Traffic regulation

The traffic control transmission network has been progressively deployed since the 1970s. It is important to note that its civil engineering infrastructure is not a communication infrastructure: it is primarily intended for the passage of energy (copper network) and sensors, as well as exchanges between equipment.

Its deployment followed the extensions of transportation network. Since 1985 with the tramway development from line 1 to line 3 and then a busway in 2006 and a Chronobus in 2012-2013 (dedicated bus line). It is also extended recently with the deployment of the tram-train operated by the SNCF.

The 1100 traffic control equipment are supervised by a traffic command post. The 30 employees in charge of the operation of these structures are also in charge of the 800-field equipment, the 220 km of civil engineering infrastructures, the power supply networks and the sensors which are also part of the equipment used.

The MapInfo tool is used for the processing geographical data. 2000 Plans (civil engineering, wiring ...) are listed in 2016 in Autocad format.

10.1.6 Exploitation bus-tramway optic network: SEMITAN

The tramway network of Nantes Métropole is the third largest in France, with three lines (more than 40 km of tracks). The SEMITAN is the mixed economy company which operates, within the framework of a PSD, the public transport of Nantes city on behalf of Nantes Métropole. The numerical infrastructures belong to Nantes Métropole.

The SEMITAN digital network is logically deployed on the right-of-way of the tramway and Busway network. It represents about thirty to forty kilometres of optical fibres. Each artery is equipped on average with a cable of 64 PFON, of which about 35 PFON are used by SEMITAN. The network is structured into 6 sub-networks, which operate by ½ tramway network line as well as Busway. The Ethernet technology is used in this network.

The management of the GIS data of the SEMITAN network is carried out directly by the SEMITAN, under the software MapInfo. It is not integrated with the Geonantes Metropolitan GIS. In 2016, the SEMITAN GIS data volumes represent approximately 110 GB.

10.1.7 TETRA: radio network from SEMITAN for security team and waste collection

Historically, the TETRA network belongs to Nantes City. The audio network, tetra norm (terrestrial trunked radio), is dedicated to security teams (such as police, firefighters, ambulances). They differ from public mobile telephony systems, such as Global System for Mobile (GSM) Communications or Universal Mobile Telecommunications System (UMTS, also usually called 3G for third generation), by the speed of establishing communications, the possibility of end-to-end encryption and, on the other hand, priority and group calls.

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

The TETRA network is partially shared with the municipal waste collection system on the City of Nantes (20 equipped vehicles).

The TETRA network sites are identified by their GPS coordinates. No data from the Tetra radio network is in the metropolitan GIS (high points, base transceiver station, coverage areas).

10.1.8 DOPEA: Nantes Métropole water network operator

Concerning the water network (source Nantes Métropole, 2015. annual water report), Nantes Métropole owns 3,200 km of pipes. The knowledge rate in 2015 was 89 under 120, which demonstrate a satisfactory knowledge of the water network. The network loss is around 0.09 loss/km yearly from 2013-2016 whereas there is an increase of the connection loss fixing +5% between 2015-2016. The pipes replacement last 5 year represents 0.46% of the network, which is lower than the national replacement rate for metropolis (0.56%) explained easily with a relative youth of the network (34 years).

10.1.9 Electric, gas, heat smart metering

Today, the **electricity distribution network allows the transmission of data by Power-Line Communication (PLC) technology** and is used only for ERDF's own purposes in connection with the use of Linky meters. On the deployment of Linky counters:

- A pilot deployment was carried out on the island of Nantes in 2015.
- At sept. 2017, 37% deployment (130 000 meters) is achieved.
- The objective is the generalization by 2021 for the 370,000 customers present on Nantes Métropole

The **gas distribution network** is also the object of a concession of Nantes Métropole, but the delivery point meters are not part of the concession. The infrastructure for remote reading of the Gazpar meters being deployed is the property of GRDF and is therefore not presented in this deliverable. 175 000 meters are scheduled to be deployed between 2018 – 2022.

The **district heating networks** are also operated in the framework of PSD according to the following distribution:

- Operation of the Bellevue network (Nantes, St-Herblain) entrusted to Dalkia
- Exploitation of the Centre-Loire district heating network (DHN) entrusted to Erena
- Exploitation of the DHN of the « la Minais » joint development zone entrusted to IBEM
- Each of these networks relies on an own information system that forms part of the return goods of the PSDs and includes the sub-station metering transmission.

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

10.1.10 Pollution monitoring

Nantes Métropole air quality is watched closely by the regional association air pays de la Loire. Their methodology is depicted Figure 68. It is based on measurements, BASEMIS database and modelling. At Nantes Métropole scale, some specific measurements were achieved (see Figure 69). Thanks to this association, Nantes Métropoles is able to watch 7 days long, 24 hours a day the air quality. Annual report (indoor, outdoor, GHG emission) are available, with the detail of the City of Nantes. The results are available on www.airpl.org. In case of peak pollution, they can inform you automatically.

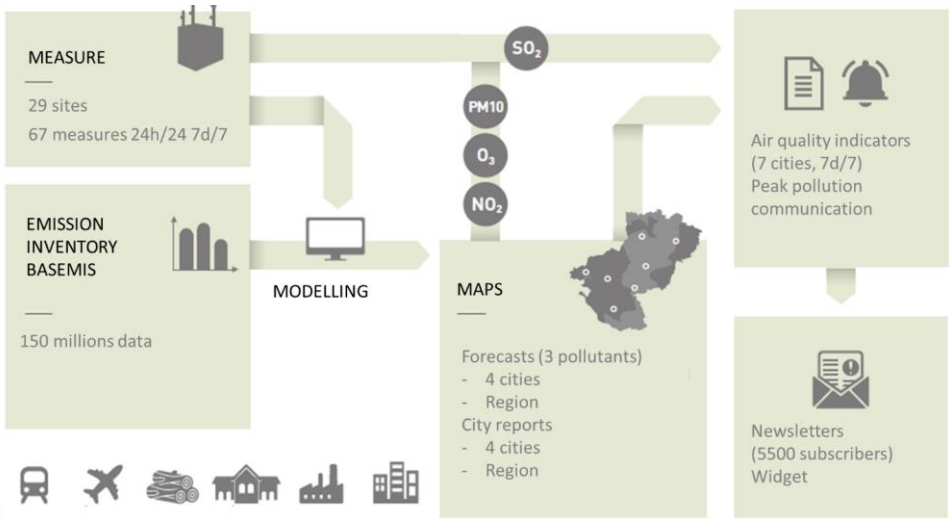


Figure 68: Air quality assessment process (source air Pays de la Loire, air quality annual report 2016)

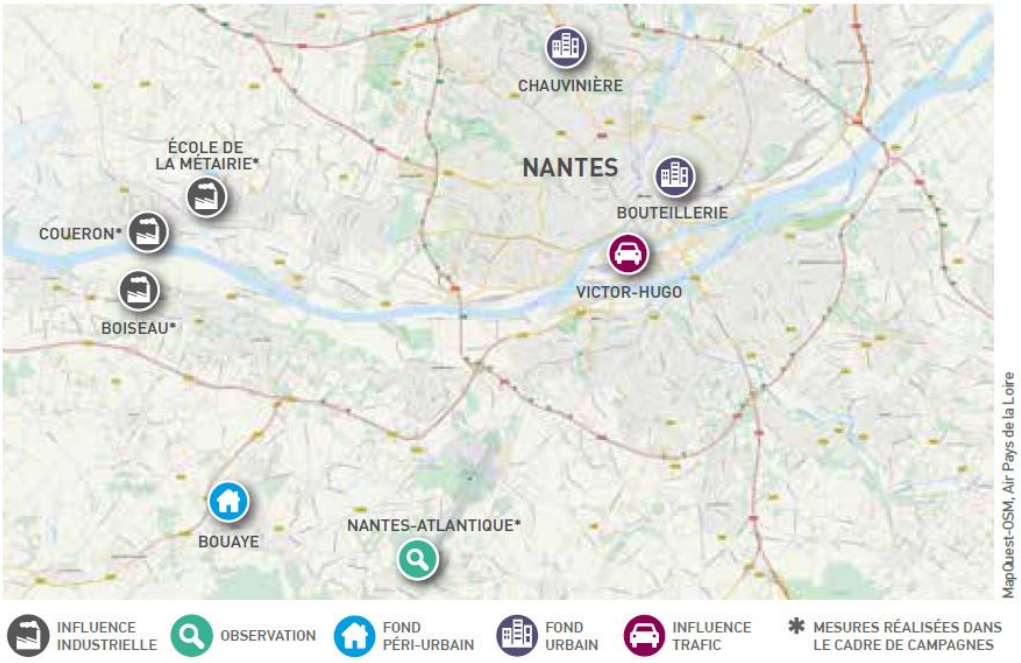


Figure 69: Location per sector or pollutants in Nantes City (source air Pays de la Loire, air quality annual report 2016

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

10.1.11 Synthesis

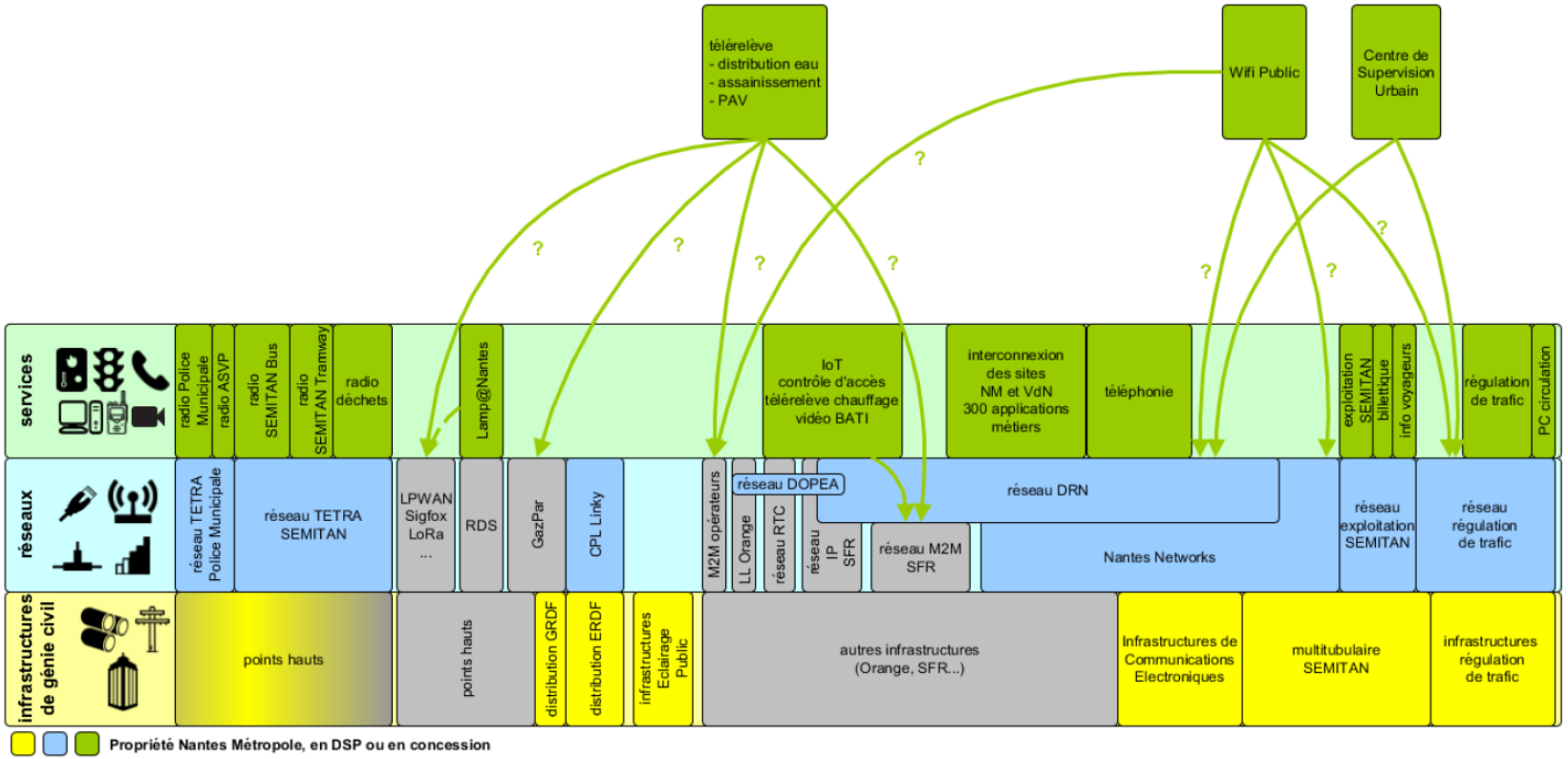


Figure 70: Overall synthesis of numerical network (source: Nantes Métropole, infrastructure inventory 201

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

10.2 Identification of potential Integrated Infrastructures Implementation

10.2.1 Infrastructure improvement and eventual numerical networking pooling

The civil engineering infrastructure will be developed around 5-10km, depending on urban operation (Ile de Nantes, south west joint development zone…), but there are only dedicated to ICT.

Public lighting demand respond may be difficult because of the current sheath (conflicting with additional ICT network) and because they are not powered 24 hours a day. One other potential highlighted could be the promoting of such existing network to build a high point mesh, with an exploitation limitation during the day (there are not powered 24 hours per day). Except certain experiments, the public lighting network in Nantes Métropole operates generally in a "blind" operating mode, that is to say it is not operable from a distance. Each of the 1940 control cabinets is equipped with either a Pulsadis receiver (50% of the territory) or an astronomical clock (50% of the territory). The Lamp @ Nantes project will provide this remote-control function and will solve the programmed shutdown of the Pulsadis signal by Enedis following the deployment of the Linky meter.

As the Nantes Networks optic network can adapt to a large typology of needs (black fibre, bandwidth with various guaranteed restoration time), it is an important technical platform for pooling all the networks operated by the Nantes Métropole and the City of Nantes, with 50% of the Nantes Métropole sites being interconnected via black fibres from Nantes Networks. Each year some sites with low speed connection are switched to the high-speed fibre. All the data related to the optic network are not referenced or not referenced yet in the same GIS tool (exploitation of the network is done within Observium tool, school are referenced into Géonantes).

Perhaps some synergies to plan between the traffic regulation with communication infrastructure.

As the bus tramway exploitation network SEMITAN is installed since 10 years, its refurbishment should be studied. Also, the securing of the optical network could be studied, especially some bus depot could be interconnected with some extension of Nantes networks line. In this core node of the network, lots of networks cross themselves such as the “trade station” and the problem is that they cannot be reached currently by the multilayer sheath. The merge from the radio frequency TETRA network to SEMITAN network is under progress. A project to meter the local waste collecting point (and also secure the access) to better manage the household waste collection which represents around 50 million € per year (tax included).

The smart meters are under deployment for electricity and will start for the gas. A mutualisation for the electricity Linky meters seems difficult with this (power line communication) PLC technology. A water metering transmission project for water metering has be identified has a core for the next years, but it has not been budgeted yet. A first step could be to target the higher water consumer (>5 000m3 per year) which accounts for 136 consumers. It is foreseen to use concentrators gazpar meters also for transmitting

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

water metering data. Another project is launched by DOPEA to detect water leaks on the perimeter of the distribution network of the City of Nantes.

10.2.2 Public Wi-Fi project

This project is intended to collect the needs of users in terms of public Wi-Fi. It is also a commitment of the president of Nantes Métropole mandate, and thus represents a strong political issue.

- An in-situ experiment will be conducted in seven locations in the Nantes metropolitan area to test the population reaction to such a solution.
- The spreading of these experiments depends on the results, taking into account in particular the effective uses and the presence of commercial Wi-Fi offers on the metropolitan territory.
- If a strategy to implement a metropolitan Wi-Fi is to be created, the connection to Nantes Networks will have to be a solution to study. Such an infrastructure could support other services than internet access for the public.

10.2.3 Parking management project

This project is under consideration (deadline Dec. 2017) to transfer the management of the 18 parking lots with access control from SEMITAN to the company Nantes-metropole Gestion Equipment (NGE). NGE was created by Nantes Métropole in 1976 by Nantes and owned by Nates metropole since 2003. They are the main parking's management actor (around 20 parking managed and inner-city parking regulation) with EFFIA (9 parking).

10.2.4 Urban Supervision Centre (USC) project

In the context of the implementation of mutualisation schemes linked to the "French law NOTRE", the concept of a Metropolitan Urban Supervision Centre (USC) has been carried by several mayors of the Metropolis. It contributed to the implementation of a metropolitan supervision centre with broad competence (video surveillance, management of public space, road traffic, ...)

The conclusions of the feasibility study and the arbitrations of implementation of the equipment strategy have been known since early 2017.

At this stage, the needs inventory revealed the following points:

- A dozen cities registered in the dynamics do not benefit from any video protection system
- Some security cameras are already installed and used. The traffic regulation control station uses 115 cameras. The SEMITAN has 70 cameras on the stations and all trains have their video surveillance cameras. NGE has a camera park for the management of closed public car parks.

The USC location should be close to the traffic regulation control station.

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

In addition, the deployment and maintenance of the cameras will be entrusted to a private company as part of a public contract. The goal is to deliver the entire device in less than 36 months. The connectivity on the cameras is envisaged on optical fibre, the objective of protection of the public space implying to privilege as much as possible the quality and the precision of the video systems.

10.2.5 Urban data platform

The project partners are Engie, Nantes Habitat, Enedis, Atlanpole, TAN, CEREMA. This project will be rolled out over a period of 3 years (2017-2020), then be subject to an evaluation period over the next 2 years (2020-2022). This 5-year long duration is atypical for this type of experimentation, and will allow the design of equipment intended to be perpetuated, while drawing feedback on business models and use cases from these new practices of the energy.

In particular, the following questions can constitute strong interactions with the reflection on the urban digital networks at the scale of the Metropolis:

- The urban platform will be co-produced between Engie and Nantes Métropole Resource Department (NRD). This co-production work should be instructive for Nantes Métropole, the ideal being that this platform is reusable for the entire data strategy of the Metropolis.
- The estimated budget of the platform is a few hundred k € (mainly human time in the form of investment)
- The partnership with Engie will not result in a closed Proprietary Platform; the conditions for the provision of energy data by Enedis are also a subject of attention.
- The platform must allow multiple externalities:
    - Fuel Alert System
    - Optimization of public energy policies (the Nantes Métropole property park could be a starting point)
    - Availability of data from the solar cadastre
    - Creation of a mobility observatory
        - Integrating decentralised energy supply and storages

A short description of the district heating development plan was already described Figure 40 in chapter. The number of buildings connected is plan to triple, from 20 000 to 60 000 buildings.

In addition, the smart meter deployment strategy was previously detailed section 10.1.9. Already nearly 40% of the electric smart meters Linky are installed. The gas smart meters are plan to be deployed between 2018 – 2022 and it is foreseen to use concentrators gazpar meters also for transmitting water metering data.

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

A research project, led by the AFUL Chantrerie, study the electric storage through the power to gas technology. It would enable to produce bio gas for extra electricity produced by RES, and this bio gas could be easily stored by being introduce into the existing gas network.

10.3 Calculation of diagnosis indicators for suitable urban infrastructures for integration

The indicators selected for suitable urban infrastructures for integration are being calculated and they are showing in the following table.

Table 16: Indicators for suitable urban infrastructures for integration

Indicator	Units	Value
Lighting system connected	YES/NO	Yes
Waste management system	YES/NO	Yes
Traffic management system	YES/NO	Yes
Parking management system	YES/NO	Yes
Public bicycles management system	YES/NO	Yes
Public transport management system	YES/NO	Yes
Number of public transport stops with real time info	%	9.4* *but 26% expected by 2018)
Compactness	inhabitants or workplaces / m2	non-available
Use of groundfloors	m2	non-available
Green and blue space	m2	9 (excluding agricultural areas)
Access to public free WiFi	%	0%
Access to high speed internet	%	50%
Number of phone connections per 100,000 inh	Connections/100.000 hab.	non-available
Number of Internet connections per 100,000 inh	Connections/100.000 hab.	non-available

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

11. Conclusions

By way of conclusion, it is possible to retain the main points highlighted by the City Audit and to analyse how they are linked to the actions that will be deployed within the MSLproject in Nantes Métropole.

Nantes Métropole, the 6th largest city in France by its population, is a dynamic metropolis, both in demographic and economic terms. Attractive, Nantes Métropole is recognized for the quality of its living environment and benefits from its proximity to the Atlantic ocean.
Its economic dynamism is based on a diversified economic fabric, both in terms of sectors (advanced industry, tertiary sector, agribusiness, biotechnology, etc.) and forms of business (large European and French groups, dynamic SMEs, start-ups, craft firms). The Nantes metropolitan area Nantes has also managed to develop an original tourist offer, by highlighting its natural heritage but also architectural and industrial.

For now many decades, public actors of the Nantes metropolitan area have also engaged a territorial collaboration on large scales.

They managed to set up a strong local governance over the years and to define a common vision of the future of the territory. This political vision provided clear guidelines for the drafting of different planning documents, first in the field of regional planning and then mobility, housing, energy and climate...

All these documents today constitute a clear strategic framework for the development of the agglomeration by 2030 and make concrete the local commitment to meeting the challenges of the 21th century. Nantes Métropole is thus recognized today as a particularly voluntary public actor in terms of taking into account the issues of sustainable development, and besides, this commitment has been awarded by several distinctions at national and international levels.

This dynamism and this voluntarism generates a certain number of challenges for the years and decades to come, among which we can mention:

- welcome thousands of new inhabitants and new activities while limiting urban sprawl, consumption of resources (land, energy, natural ...) and more broadly, by limiting the impact of the development of the agglomeration on the environment,
- meet growing mobility needs through a diversified offer adapted to all audiences, sustainable from an economic and environmental point of view,
- continue to respond to the growing wish of citizens to be involved in the strategic choices regarding the future of their city in the long term, but also to choices concerning decisions that have a direct impact on their daily lives,

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

- engage the territory and its actors in energy, ecological and digital transitions,
- continue to make progress in the management of the city, of public services and urban flows, to design and implement ever more effective public policies for the benefit of inhabitants, local actors and the territory as a whole.

Nantes Métropole's involvement in the MySmartLife project will contribute to meeting some of these challenges by testing innovative solutions in the fields of energy, mobility or citizen involvement, by exploiting the opportunities offered by ICT.

If a large number of actions will be deployed on the site of the Ile de Nantes, which will constitutes a demonstration site, the final ambition is to generalize the most promising actions - as well as those of other Lighthouse cities of the project - to the metropolitan level.

In the field of energy, the stakes relate first to the development of renewable energies in a decentralized way, with specific issues for electricity, related to the grids balance management.

In this regard, several actions developed within the MSL project will implement new solutions for electricity production from different renewable sources: solar, wind, and hydraulic (actions 8, 11, 19, 20, 21). These electricity production systems will be completed in some cases by intelligent storage and management devices, in order to ensure the temporal balance between electricity generation and demand, at both building and urban island levels (actions 6, 13, 14).

Beyond electricity generation, several actions will consist in better exploiting the potential of renewable energy production, especially about heat: digital boilers (action 7) will be installed in two buildings (social housing building and municipal bath and showers buiding) and several sites will host thermal or hybrid solar panels (thermal and photovoltaic) (actions 9, 12, 19).

One of the avantages of the Nantes conurbation lies in its district heating networks, mainly powered by renewable sources (energy recovery of waste): one of the actions will consist in developing a modeling and simulation tool (action 16), coupled with a decision support tool (action 46) to optimize the operation of the district heating network.

In the field of energy, the other major issue concerns the energy performance of built heritage.

If new construction projects are important to test innovations (actions 1, 4, 5) and inspire other future buildings (especially in Nantes where the real estate market is very dynamic), it is essential for a city like Nantes, to improve the energy performance of existing buildings.

In fact, these existing buildings will for a long time remain the main part of the built heritage of the conurbation and will therefore continue to account for most of the energy consumption of the residential sector. Thus, it is a real challenge for Nantes Métropole, both because the existing building stock (built

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

before the first thermal regulation) is important, but also because the number of collective housing in co-ownership is high (these buildings are often more complex to refurbish).

One of the key actions is therefore to test the energy retrofitting of a building in co-ownership (action 2), in particular by experimenting with third-party financing (action 33).

In the field of transport, which represents the main source of GHG emissions at the Nantes Métropole level, one of the emblematic actions will be the replacement of the current NGV buses by 24 m fully electric buses on one of the busiest public transport lines.

In addition to the very high capacity of these new vehicles (which will provide more comfort and increase the public transport offer in the Nantes conurbation), the innovation will also consist in the implementation of an intelligent energy management system (for the charging stage).

Several actions will also aim to respond to a demand for a cleaner and more personalized mobility, through the development of smart recharging infrastructures for electric vehicles (actions 24, 25, 26), or the launching of calls for projects (action 30) for new delivery solutions (to meet the challenge of last km urban logistics). In order to encourage the involvement of all local actors, an action will target companies through the development of a platform to support them in a more sustainable management of their vehicle fleets (action 29).

Regarding ICT, it will be a component of most of the actions mentioned above. But the MSL project will also be an opportunity for Nantes Métropole to develop an urban data platform, integrating existing data and those that will be collected by the new connected devices at the city level.

This should allow the development of new services for city managers (Nantes Métropole, urban operators ...), but also for the benefit of users and citizens.

Beyond the urban data platform, ICT will be used as a tools for mobilizing and involving local actors and citizens: the platform for the management of company vehicle fleets already mentioned will be completed by other actions: a web solar cadastre (action 43) will be set up to inform owners about the solar potential of their roofs and encourage them to install solar panels, new services and applications will be developed within the web portal "Nantes in my pocket" (action 39) and a new web platform will be launched (action 32) to inform inhabitants about all the financial aids they can receive (at the local, but also national levels) for the energy retrofitting of their homes.

These various actions will logically be part of the policy of citizen dialogue and citizen involvement set up by Nantes Métropole for several years now; they will more specifically complete the citizen participation scheme developed by Nantes Métropole and will enrich all the initiatives undertaken by local actors within the framework of the Grand Debate on the energy transition.

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

12. References

[1] ADEME, 2015. « Key indicator on Climate air and energy » (2015) - Chiffre clé air-climat-énergie 2015, http://www.ademe.fr/climat-air-energie-edition-2015

[2] AIR PAYS DE LA LOIRE, 2016.La qualité de l'air dans les Pays de la Loire - Rapport annuel 2015 (2016)

[3] AURAN, 2016. Les déplacements des habitants de la métropole Nantaise (2016).

[4] AURAN, 2016. Regards sur les marchés de l'habitat métropolitains - Synthèse de l'AURAN (2016)

[5] AURAN, 2017, Les synthèses de l'AURAN n°8, (2017)

[6] DIRECCTE Pays de la Loire, 2017, Direccte Stats du 11 janvier 2017 (2017), http://pays-de-la-loire.direccte.gouv.fr/sites/pays-de-laloire.direccte.gouv.fr/IMG/pdf/note_tx_de_chomage_2016_t3-2.pdf

[7] LAZAROUI, G. C., ROSCIA, M., 2012. Definition methodology for the Smart cities model. Energy 47 (2012), pp. 326-332.

[8] LOKEN, E., 2007. Use of multi-criteria decision analysis methods for energy planning problems. Renewable and Sustainable Energy Reviews 11 (2007), pp. 1584-1595.

[9] NANTES METROPOLE, 2010. Programme Local de l'Habitat 2010-2016: Diagnostic (2010), http://www.nantesmetropole.fr/deliberations/co_20100625/annexeco_25_06_10_11_01.pdf

[10] NANTES METROPOLE, 2010. Plan Climat Energie Territorial de Nantes Métropole (2010), https://www.nantesmetropole.fr/medias/fichier/0889-plan-climat-energiew_1318862758452.pdf?INLINE=FALSE

[11] NANTES METROPOLE, 2014. Plan Local d'Urbanisme Métropolitain: Présentation générale (2014), https://plum.nantesmetropole.fr/files/live/sites/plum/files/contributed/bibliotheque/documents_information/01583-PLU_2014-16pages-A4.pdf

[12] NANTES METROPOLE & AURAN, 2014. Nantes Métropole: chiffres et repères issus des derniers résultats du recensement (2014)

[13] NANTES METROPOLE, 2015. Rapport développment durable 2015 Actions Climat (2015), http://www.nantesmetropole.fr/medias/fichier/rapport-annuel-dev-durable15-nm_1447342484850.pdf?INLINE=FALSE

[14] NANTES METROPOLE, 2015. Dialogue Citoyen et co-construction: vers une nouvelle Gouvernance (2015),https://www.nantes.fr/files/live/sites/nantesfr/files/PDF/Actualites/AVN/Dialogue%20citoyen/Rapport-dialogue-citoyen.pdf

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

[15] NANTES METROPOLE, 2015. Rapport annuel sur l'eau (2015), http://www.nantesmetropole.fr/medias/fichier/rapport-annuel-eau-2015-web_1469626193831.pdf?INLINE=FALSE

[16] NANTES METROPOLE, 2015. Rapport annuel sur le prix et la qualité du service d'élimination des déchets ménagers et assimilés (2015), http://www.nantesmetropole.fr/medias/fichier/nantes-metropole-rapport-annuel-dechet-2015_1473775389625.pdf

[17] NANTES METROPOLE ET VILLE DE NANTES, 2015. Les carnets de connaissance – Environnement, Carnet Nantes, PLUm, phase d'élaboration du PADD (2015), https://plum.nantesmetropole.fr/files/live/sites/plum/files/contributed/Participer/VF/cahier%20ENVIRONNEMENT-Nantes-23-07-2015HD.pdf

[18] NANTES MÉTROPOLE, sept 2015, RES potential inventory - Diagnostic des gisements d'énergies renouvelables et de récupération

[19] NANTES MÉTROPOLE, Document socle 2016, « We are the energy transition » - la transition énergétique c'est nous (septembre 2016), https://www.nantestransitionenergetique.fr/j-explore/transition-energetique-c-est-quoi

[20] NANTES MÉTROPOLE, Nantes metropole annual report Energy 2015, confidential report.

[21] NANTES METROPOLE, 2016. PLUm: Projet d'Aménagement et de Développement Durable - synthèse (2016), https://plum.nantesmetropole.fr/files/live/sites/plum/files/contributed/bibliotheque/documents_information/PADD-Synthese.pdf

[22] NANTES METROPOLE, 2016. Dialogue Citoyen et co-construcion: vers une nouvelle Gouvernance - Point d'étape (2016), https://www.nantes.fr/files/live/sites/nantesfr/files/PDF/Publications/05-AVN/Dialogue-Citoyen/Dialogue_citoyen_Rapport_Etape_2016.pdf

[23] NANTES METROPOLE, 2016. Rapport développement durable 2016 – Biodiversité: un territoire en action, https://www.nantesmetropole.fr/deliberations/co_20161216/14_20161216_CNM_DELA_rapport_DD_2016_V1.pdf

[24] NANTES METROPOLE, 2016. PLUm: Projet d'Aménagement et de Développement Durable (2016), https://plum.nantesmetropole.fr/files/live/sites/plum/files/contributed/bibliotheque/PADD%20web%20mars%202016.pdf

[25] NANTES MÉTROPOLE - TACTIS, 2017, a synthesis of the existing numerical infrastructure and the needs (confidential report).

[26] NANTES METROPOLE, 2017. Sustainable Energy Action Plan - Plan d'actions en faveur de l'énergie durable de Nantes Métropole, Etat d'avancement 2017 (2017),

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

https://www.nantesmetropole.fr/deliberations/co_20121214/annexeco_14_12_2012_29_annexe_delib_conseil_plan_climat_SEAP.pdf

[27] NANTES METROPOLE & AURAN, 2017. Elaboration du PDU - socle de connaissances (2017), https://plum.nantesmetropole.fr/files/live/sites/plum/files/contributed/bibliotheque/documents_information/NM_PDU_DocSocleVF.pdf

[28] NANTES MÉTROPOLE, Nantes metropole monitoring emission inventory statistics communicated to the Covenant of Mayors, updated in 2017 concerning the year 2012, http://www.conventiondesmaires.eu/about/signatories_fr.html?city_id=218&monitoring

[29] POLE METROPOLITAIN NANTES SAINT-NAZAIRE, 2009. Eco-Métropole Nantes Saint-Nazaire: construire la ville autour du fleuve (2009), http://www.iledenantes.com/files/documents/pdf/publications/dossier-ecocite.pdf

[30] POLE METROPOLITAIN NANTES SAINT-NAZAIRE, 2016. Schéma de Cohérence Territoriale Nantes Saint-Nazaire (2016), http://www.nantessaintnazaire.fr/schema-de-coherence-territoriale-scot/

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

13. Annex I Nantes City Level indicators

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	Size	Size	-	km2	Land area of city	523.0
People	City characterization	Population	Population	-	Inh	Total number of persons inhabiting a city	619,240
People	City characterization	Population	Population density	-	Inh./km2	Population per unit area in the city	1,184.0
People	City characterization	Population	People > 75 years	-	%	Population elder than 75 years old	8.1
People	City characterization	Population	Average population age	-	-	Average of the age of the population (man+woman)	non-available
Planet	City characterization	Type of city	Type of city	-	-	Typology of the city under study: metropolitan, urban, suburban - Metropolitan areas are urban areas with more than 500,000 inhabitants - Urban area is a functional economic unit characterised by densely inhabited 'cities' with more than 50,000 inhabitants and 'commuting zones' whose labour market is highly integrated with nearby cities - Suburban areas correspond with a residential district located on the outskirts of a city and with a population less than 50,000 inhabitants	metropolitan
Planet	City characterization	Land use	Land consumption	Nº Buildings/Total city surface	nº build/Km2	Measure of land use intensity and urban areas density	556.9
Planet	City characterization	Land use	Land consumption 2	Total built surface/Total city surface	Km2/Km2	Measure of land use intensity and urban areas density	0.41
Planet	City characterization	Land use	Balance between residential and no-residential building use	[Built surface for terciary sector/Total build surface] x100	%	Measure of land use diversity	non-available
Planet	City characterization	CO2 target	Overall CO2 emission reduction target	-	%	That is the objective of each one of the cities according to the SEAP	30% by 2020 50% by 2030 "

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Prosperity	City characterization	Tourist intensity	Tourism intensity	Number of tourist nights per year per 100,000 inhabitants	(# of tourist nights / total population) *100,000	The ratio of tourists that spent nights at tourist accommodation establishments divided by one million of inhabitants in a year	254,436.6
Planet	City characterization	Climate	Climate koppen geiger classification	-	-	The Köppen climate classification scheme divides climates into five main groups (A, B, C, D, E), each having several types and subtypes. Each particular climate type is represented by a two- to four-letter symbol. http://koeppen-geiger.vu-wien.ac.at/pdf/kottek_et_al_2006_A4.pdf	Cfb
Planet	Local energy supply	City energy profile	Final energy consumption per capita	-	MWh/capita	-	18.59
Planet	Local energy supply	City energy profile	Final energy consumption (Transport)	-	TWh/year	-	4.12
Planet	Local energy supply	City energy profile	Final energy consumption (Buildings, equipments/facilities and Industries)	-	TWh/year	-	6.98
Planet	Local energy supply	City energy profile	Final energy consumption (Municipal)	-	TWh/year	-	0.14
Planet	Local energy supply	City energy profile	Final energy consumption (Tertiary)	-	TWh/year	-	2.83
Planet	Local energy supply	City energy profile	Final energy consumption (Residential)	-	TWh/year	-	3.96
Planet	Local energy supply	City energy profile	Final energy consumption (Public lighting)	-	TWh/year	-	0.052
Planet	Local energy supply	City energy profile	Final energy consumption (Industry)	-	TWh/year	-	2.36
Planet	Local energy supply	City energy profile	Final energy consumption (electricity)	-	TWh/year	-	2.81

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	Local energy supply	City energy profile	Final energy consumption (Heat/Cold)	-	TWh/year	-	0.27
Planet	Local energy supply	City energy profile	Final energy consumption (Fossil fuels)	-	TWh/year	-	7.53
Planet	Local energy supply	Renewable energies	Final energy consumption (Renewables)	-	TWh/year	-	0.5
Planet	Local energy supply	Renewable energies	Share of local energy production to overall final energy consumption	-	%	-	2.6%

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	Local energy supply	Renewable energies	Renewable electricity generated within the city	The share of renewable electricity produced within the city is calculated as the total consumption of electricity generated from renewable sources (numerator) divided by total energy consumption (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Consumption of renewable sources includes solar, wind, hydro, tide and wave energy, and combustibles used for electric generation, such as biomass. (ISO/DIS 37120, 2013).	%	The percentage of electric energy derived from renewable sources, as a share of the city's total energy consumption	0.10%
Planet	Local energy supply	Renewable energies	Non-RES Heat/ Cold production	-	TWh/year	-	0.075
Planet	Local energy supply	Renewable energies	RES Heat/Cold production	-	TWh/year	-	0.087
Planet	Local energy supply	City energy profile	Total buildings energy consumption per year	-	GWh/inhab. year	Residencial consumption in the city for heating and electricity uses	non-available
Planet	Local energy supply	Renewable energies	Renewable energy per carrier	-	GWh/RES_ supplier	Energy that each renewable systems provides to the city	PV : 11.30 Wind : 0.009 other biomass : 19.94

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	Local energy supply	Renewable energies	Percentage of renewable energy	RES_energy/total_energy	%	Amount of energy coming from the renewable sources	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption in the city per year	-	GWh of PE/year	Gross inland consumption of the city excluding non-energy uses	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption per capita	-	MWh/capita	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Transport)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Buildings, equipments/facilities and Industries)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Municipal)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Tertiary)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Residential)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Public lighting)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Industry)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (electricity)	-	TWh/year	-	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	Local energy supply	Energy mismatch	Maximum Hourly Deficit (MHDx)	The maximum yearly value of how much the hourly local electricity demand overrides the local renewable electricity supply during one single hour	kWh	Energy mismatch	non-available
Planet	Local energy supply	Renewable energies	Green electricity purchased	-	%	The percentage of green electricity purchased from the municipality, as a share of the city's total electtricity consumption	2.40%
Planet	Local energy supply	Energy monitoring	Smart energy meters	-	% of buildings	The percentage of buildings in the city with smart meters This indicator shows the coverage on the energy distribution network with energy meters; it could be distinguished for electric and methane or heat networks.	non-available* (*130,000 Smart electricity meters (on sept 2017), 0 gas smart meters)
Planet	Local energy supply	Potential of retrofitting	Refurbished buildings improving energy performance	-	% of buildings	Number of buildings subject to refurbishment improving their energy profile above the EPBD (Energy Performance of Buildings Directive) requirements	non-available
Planet	Local energy supply	Energy systems	Number of connections to a district heating network	It is calculated as the total number of buildings connected to a DH (numerator) divided by totalnumber of buildings in the city(denominator) .	% of buildings	Percentage of buildings connected to a district heating network of the city	8%* (8% of housing units* *other buildings such as tertiary buildings or public facilities are aslo connected to a DHN, but exact number not available)
Planet	City characterization	City environmental impact	Greenhouse gas emissions per capita	-	tonnes CO2/capita	-	3.67
Planet	City characterization	City environmental impact	Greenhouse gas emissions (tertiary)	-	Mtonnes CO2/year	-	0.40

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	City environmental impact	Greenhouse gas emissions (transport)	-	Mtonnes CO2/year	-	1.07
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Residential)	-	Mtonnes CO2/year	-	0.70
Planet	City characterization	City environmental impact	Greenhouse gas emissions in buildings, equipment/facilities and Industries	-	Mtonnes CO2/year	-	1.12
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Public lighting)	-	Mtonnes CO2/year	-	0.004
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Municipal)	-	Mtonnes CO2/year	-	0.019
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Industry)	-	Mtonnes CO2/year	-	non-available
Planet	City characterization	City environmental impact	Transport greenhouse gas emissions per capita	Transport GHG emissions, in equivalent CO2 units, generated over a calendar year / Total city population	t /(pers.·a)	Measure of the total greenhouse gas emissions per capita due to public and private transport.	1.79
Planet	City characterization	City environmental impact	Percentage of renewable energy use in public transport	[Renewable energy use in public transport over a calendar year (kWh) / Public transport energy use over a calendar year (kWh)] x100	%	Measure of the use of renewable energy in public transport.	non-available
Planet	City characterization	Water resources	Water consumption	(City's total water consumption in litres per day)/(total population)	m3/cap/day	Water resources	0.14

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	Water resources	Water re-used (rain/grey water)	[(houses with grey and rain water reuse capability)/(total number of houses)]*100%	% of houses	Water resources	non-available
Planet	City characterization	Air pollution	NOx emissions	[annual NO2 emissions (g)]/(total population)	g/cap	Air pollution	9.384
Planet	City characterization	Air pollution	PM2,5 emissions	[annual PM2.5 emissions (g)]/(total population)	g/cap	Air pollution	1.739
Planet	City characterization	Air pollution	Air quality index	((NO2_YEAR_AVERAGE/40) + (PM10_YEAR_AVERAGE/40) + (LOG((PM10daily > 50µg)+1)/LOG(36)) + ((DAYS_WITH_Ozone_8h_AVG >= 120)/25) + (SO2_YEAR_AVERAGE/20) + (Benzene_YEAR_AVERAGE/5)) / 6	index	AQI calculations focus on major air pollutants including: particulate matter, ground-level ozone, sulfur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO). It is a distance to target indicator that provides a relative measure of the annual average air quality in relation to the European limit values (annual air quality standards and objectives from EU directives). If the index is higher than 1: for one or more pollutants the limit values are not met. If the index is below 1: on average the limit values are met. NANTES is involved on this initiatives. http://www.airqualitynow.eu/index.php	0.53 (roadside index) 0.28 (background index) "
Planet	City characterization	Waste	Recycling rate	[(total amount of the city's solid waste that is recycled in tonnes) / (total amount of solid waste produced in the city in tonnes)]*100%	% tonnes	0	80.4%* (*50.95% energy recovery 19.16% material recovery 10.31% : organic recovery)

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	Noise	Exposure to noise pollution	Share of the population affected by noise > 55dB at night time	%of people	0	13%
Planet	City characterization	Waste	Amount of solid waste collected	(Annual amount of genererated municipal solid waste t/yr) / (total population)	tonnes/capita/year	Waste	0.5
Planet	City characterization	Land consumption	Brownfield use	[brownfield area redeveloped in the last year (km2)] / [total brownfield area in the city (km2)]	% of km2	Share of brownfield area that has been redeveloped in the past period as percentage of total brownfield area	non-available
Planet	City characterization	Urban Heat Island	Urban Heat Island	Maximum hourly difference in air temperature within the city compared to the countryside during the summer months	°C UHImax	Maximum difference in air temperature within the city compared to the countryside during the summer months	non-available
Planet	City characterization	Food consumption	Local food production	Share of food consumption produced within a radius of 100 km	% of tonnes	Share of food consumption produced within a radius of 100 km	non-available
Planet	City transportation status	Mobility city profile	Total number of public transport vehicles	#	Number of vehicles	Number of public vehicles that are destinated to public transport (bus, taxis…)	624* (* excluding taxis)
Planet	City transportation status	Sustainable transport	Number of Electric Vehicles (EV) in the city	Number of electric vehicles in the city per 100.000 (# EVs / total population)*100 000	n/100.000	Number of electric vehicles in the city including private, public and service (taxi and first mile) vehicles including also motobikes	0,0015-0,002 (if 100% EV)* about 0,02 (if 100% EV + hybrid)* At Loire-Atlantique department level (in 2013)

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City transportation status	Mobility city profile	Number of fossil fuelled four wheels vehicles per capita	Number of fossil fuelled vehicles (four wheels) of the city distinguishing by type (public and private) and divided by the population	n/ cao	Number of fossil fuelled vehicles (four wheels) of the city divided by the inhabitants of the city (public and private)	0.51
Planet	City transportation status	Transport problems	Traffic accidents	number of fatalities related to transportation of any kind/(totalPopulation/100000)	#/100 000 people	Number of transportation fatalities per 100 000 population in a year. Fatalities includes dead but also hospitalization	38.60
Planet	City transportation status	Sustainable transport	Public transport use	# of trips made annually in the city with public transport / total population	#/cap/year	Annual number of public transport trips per capita	210.0
Planet	City transportation status	Sustainable transport	Access to public transport	(Number of inhabitants with a transportation stop <500m/total population)*100 %	%of people	Share of population with access to a public transport stop within 500m	78%
Planet	City transportation status	Sustainable transport	Access to vehicle sharing solutions	(# vehicle for sharing / total population)*100 000	#/100 000 people	Number of vehicles available for sharing per 100.000 inhabitants	8.07
Planet	City transportation status	Sustainable transport	Lenght of bike route network	total Kilometers Of Bicycle Paths And Lanes_(Km/population)*100000	km/100000 people	Lenght of lanes in the city for bikes per 100,000 inhabitants	77.5

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City transportation status	Transport problems	Congestion	((travel times in peak hours - travel times during non-congested periods (free flow*))/travel times during non-congested periods)*100%	% in hours	Increase in overall travel times when compared to free flow situation (uncongested situation)	non-available
Planet	City transportation status	Mobility city profile	Vehicle fuel efficiency	Total energy consumed for vehicules/total amount of vehicle kilomentres completed	kWh/100km	#	non-available
Planet	City transportation status	Mobility city profile	Fuel mix	Percentage of the market share of transport fuel for each type of fuel used in given period	%	#	Petrol: 31.4% Diesel: 67.4% Petrol/LPG: 0.7% Electric and hybrid vehicles: 0.4%* * at Loire-Atlantique department level
Planet	City transportation status	Mobility city profile	Average occupancy	Average of number of passengers per vehicle per trip	number of passengers per vehicle	#	1.26
Planet	City transportation status	Mobility city profile	Average vehicle speed	Average network speed by vehicle (peak/off-peak)	0	#	non-available
Planet	City transportation status	Charging points	Total kWh recharged in the public EV charging stations.	#	kWh	Number of kWh recharged during a year in the public charging stations. It will be required to infrastructure operator and vehicle owners in order to compare this indicator with energy consumption and distance travelled.	non-available
Planet	City transportation status	Charging points	Charging points per eVehicle	Total charging points/# eVehicles	%	This indicator measures the number of public charging points related to the total amount of electric vehicles in the city.	0.15
Planet	City transportation status	Charging points	Total charging points	#	#	Total number of public charging points	30.0

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City transportation status	Charging points	Recharges per year	Number of charges/year	#/year	Usage of the recharging points	non-available
Planet	City transportation status	Charging points	infrastructure growth e-car	number of e-car charging points available	[number of e-car charging]	Total number of public charging points in the city for e-cars	30.0
Planet	City transportation status	Charging points	infrastructure growth e-bike	number of e-bike charging points available	[number of e-bike charging]	Total number of public charging points in the city for e-bikes	non-available
People	Urban infrastructures	Lighting management	Lighting system connected	-	YES/NO	Is there an automated lighting management system in the city?	Yes
People	Urban infrastructures	Waste management	Waste management system	-	YES/NO	Is there an automated waste management system in the city?	Yes
People	Urban infrastructures	Traffic management	Traffic management system	-	YES/NO	Is there an automated traffic management system in the city?	Yes*
People	Urban infrastructures	Traffic management	Parking management system	-	YES/NO	Is there an automated parking management system in the city?	Yes
People	Urban infrastructures	Traffic management	Public bicycles management system	-	YES/NO	Is there an automated public bicycles management system in the city?	Yes
People	Urban infrastructures	Traffic management	Public transport management system	-	YES/NO	Is there an automated public transport management system in the city?	Yes
People	Urban infrastructures	Traffic management	Number of public transport stops with real time info	-	%	Number of public transport stops with real time information regarding the total number of public transport stops. ICT applied to public transport needs accuracy and territorial coverage	9.4* *but 26% expected by 2018)
Planet	City characterization	Land consumption	Compactness	Relation between the usable space of the buildings (volume) and the urban space (area)	inhabitants or workplaces / m2	Relation between the usable space of the buildings (volume) and the urban space (area)	non-available
People	Urban infrastructures	Liveability of neighbourhoods	Use of groundfloors	(ground floor space used commercially/publically (in m2)/total ground floor space (in m2) *100%.	m2	Liveability of neighbourhoods Percentage of ground floor surface of buildings that is used for commercial or public purposes as percentage of total ground floor surface.	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Urban infrastructures	Green spaces	Green and blue space	{ [(Water area) + (Green space area)] / (Total land area) } * 100%.	m2	Nature and recreation possibilities The surface that correspond with green space and water spaces in the city in relation to the total surface of the city	9 (excluding agricultural areas)
People	Urban infrastructures	Communication infrastructure	Access to public free WiFi	(sum of wifi node coverage)/total city urban surface)*100%.	%	Attractiveness, accessibility of online services This indicator measures the percentage of a city's public space which is covered by a public Wi-Fi network	0%
People	Urban infrastructures	Communication infrastructure	Access to high speed internet	(Number of Fixed (wired)-broadband subscriptions /inhabitants) *100000	%	Ensure good city connectivity and the provision of efficient digital infrastructures	50%
People	Urban infrastructures	Communication infrastructure	Number of phone connections per 100,000 inh	(Number of cell phone connections /inhabitants) *100000	Connections/100.000 hab.	Total number of cell phone connections in the city in relation to the population of the city	non-available
People	Urban infrastructures	Communication infrastructure	Number of Internet connections per 100,000 inh	(Number of internet connections /inhabitants) *100000	Connections/100.000 hab.	Total number of internet connections in the city in relation to the population of the city	non-available
Governance	Governance	Urban planning	Existence of plans/programs to promote energy efficient buildings	-	Number of plans	Is there any specific plan for promoting energy efficient buildings in the city?	at least 3* *(PLUm, PCAET, PLH)
Governance	Governance	Urban planning	Existence of plans/programs to promote sustainable mobility	-	Number of plans	Is there any specific plan for promoting sustainable mobility in the city?	1* *(PDU - Urban Mobility Plan)
Governance	Governance	Urban planning	Existence of regulations for development of energy efficient districts	-	Number of regulations	Is there any specific regulation for developing energy efficient districts in the city?	1.0

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Existence of regulations for development of sustainable mobility	-	Number of regulations	Is there any specific regulation for developing sustainable mobility in the city?	1.0
Governance	Governance	Urban planning	Existence of local/national Energy Performance Certificate (EPC)	-	YES/NO	Is there any specific EPC for buildings in the city?	Yes (national)
Governance	Governance	Urban planning	Share of Green Public Procurement	-	%	Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration	non-available
Governance	Governance	Level of correspondence between local energy codes	Level of correspondence between local energy codes	-	YES/NO	Is there any discrepancy between different local energy codes for buildings?	NO
Governance	Governance	Level of correspondence among regulations	Level of correspondence with national regulation	-	YES/NO	Is there any discrepancy between local codes and national regulation?	NO
Governance	Governance	Level of correspondence among regulations	Level of correspondence with European legislation	-	YES/NO	Is there any discrepancy between local codes and European legislation?	NO
Governance	Governance	Level of correspondence among regulations	Level of correspondence with international construction standards	-	YES/NO	Is there any discrepancy between local codes and international construction standards?	NO

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Online governance data	Availability of government data	-	Qualitative Likert scale	The extent to which government information is published Likert scale Not at all – 1 – 2 – 3 – 4 – 5 – Excellent 1. Not at all: most of the information is not available to the public or only upon appointment with an expert 2. Poorly: most of the information is available to the public, but available in the form of a hard copy which cannot leave city hall 3. Somewhat: most of the information is available to the public, some in the form of a hard copy, some online. 4. Good: most of the information is available online, but structure is lacking 5. Excellent: all government information is available online and neatly structured.	non-available
People	Urban infrastructures	Quantity of open data	Quantity of open data	(# of open government datasets/ Inhabitants)*100, 000	#/100.000	Quantity of open data sets provided by city's open data portal	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Governance collaboration	Cross-departmental integration	-	Qualitative Likert scale (1 to 5)	The extent to which administrative departments contribute to“Smart City” initiatives and management. The level of cross-departmental integration will be estimated by analyzing the number of departments involved in smart city initiatives, whether by contributing financial, data sources or human resources 1. There is a silo-ed smart city governance structure, only one department actively contributes to smart city initiatives and decides on the strategy. 2. The local authority is poorly oriented towards crossdepartmental “smart city” management: officially there is no “mainstreaming approach”, some civil servants from a few departments work on this portfolio on the side or provide data for the initiatives, but there is no real strategy and commitment. 3. The local authority is somewhat oriented towards crossdepartmental “smart city” management: there is a strategy for a “mainstreaming approach” and several departments contribute in human, data or financial resources. 4. The local authority is clearly oriented towards crossdepartmental “smart city” management: there is a strategy for a “mainstreaming approach” and almost all departments provide financial, data and human resources for the smart city themes. 5. The local authority is committed towards crossdepartmental “smart city” management: there is a wellanchored mainstreaming approach” with shared performance targets and all departments are actively contributing to the smart city themes in financial, data and human resources.	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Smart city policy	-	Qualitative Likert scale	The extent to which the city has a supportive smart city policy Likert scale: Not at all – 1 — 2 — 3 — 4 — 5 — Very supportive 1. Not at all: the complete absence of a long-term smart city vision (including and absence of long-term targets & goals) from the side of the government or an opposing vision create a difficult environment for starting smart city initiatives. 2. Poor: The long-term vision of the government does, to some extent, hamper the environment for smart city initiatives. 3. Neutral: The long-term vision of the government has had no significant, positive or negative, impact on the environment for smart city initiatives. 4. Somewhat supportive: The long-term vision of the government has to some extent benefitted the environment for smart city initiatives. The city has created roadmaps and actions to support vision implementation 5. Very supportive: The comprehensive long-term vision on the future of the city stimulates the environment for smart city initiatives to a great extent.	non-available
Governance	Governance	Citizen participation	Voter participation	(number of people who voted in last municipal elections/total population eligible to vote)*100%	%	The percentage of people that voted in the last municipal election as share of total population eligible to vote	55.9

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Governance collaboration	Multilevel government	-	Qualitative Likert scale	The extent to which the city cooperates with other authorities from different levels Likert scale: Not at all – 1 – 2 – 3 – 4 – 5 - Very much 1. Not at all: there is no cooperation or coordination with other municipalities and/or other levels of government whatsoever. 2. Poorly: there is little cooperation with other authorities, but this is irregularand very dependent of the people involved. 3. Somewhat: there is some cooperation or coordination with other municipalities and/or other levels of government, which is formalized in a partnership policy. 4. Good: there is good cooperation or coordination with other municipalities and/or other levels of government, which is formalized in partnership policies and in process through regular participation in meetings. 5. Excellent: the city is a driving force in the cooperation or coordination with other municipalities and/or other levels of government, which is formalized in policy and in process through regular meetings initiated by the city.	non-available
Governance	Governance	Urban planning	Climate resilience strategy	-	Likert scale	The extent to which the city has developed and implemented a climate resilient strategy Qualitative Likert scale (1 to 7) 1.No action has been taken yet 2. The ground for adaptation has been prepared (the basis for a successful adaptation process) 3. Risks and vulnerabilities have been assessed 4. Adaptation options have been identified 5. Adaptation options have been selected 6. Adaptation options are being implemented 7. Monitoring and evaluation is being carried out.	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Existence of local sustainability plans	-	YES/NO	Is there any specific sustainability plan in the city?	YES
Governance	Governance	Urban planning	Existence of Smart Cities strategies	-	YES/NO	Is there any specific Smart Cities strategy in the city?	non-available
Governance	Governance	Urban planning	Existence of an Agenda 21	-	YES/NO	Has the city elaborated an Agenda 21?	YES
Governance	Governance	Urban planning	Signature and compliance of the Covenant of Mayors	-	YES/NO	Has the city signed the Covenant of Mayors. And Is the city complying with it? (both questions need to be aswered)	YES
People	Citizens	Channels of communication	Number of local associations per capita	Number of associations / Total city population	Number of consultations / inhab.	Total number of civic associations registered with the local authority related to total city population	non-available
People	Citizens	Channels of communication	Number of information contact points for citizens	-	Number of information points	Total number of contact points established in the city by the municipality to share information from the city to the citizens (tourism, events, mobility, environment, etc)	non-available
People	Citizens	Channels of communication	Number of municipal websites for citizens	-	Number of municipal websites	Total number of municipal websites which belong to the municipality for sharing information of the city to the citizens (citizen participation portal, open data, transparency, etc.)	non-available
People	Citizens	Channels of communication	Number of interactive social media initiatives	-	Number of social media links	Number of accounts in social media created by the municipality for sharing information about the city (e.g. news, cultural agenda, etc).	non-available
People	Citizens	Channels of communication	Number of discussion forums	-	Number of forums	Total number of discussion forums organized by the municipality dedicated to discuss with citizens about the needs, opportunities and solutions to be implemented the city	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Citizens	Accesibility of services	Access to public amenities	-	%	Basic services available close to home Share of population with access to at least one type of public amenity within 500m. Examples of the types of public amenities considered here are social welfare points, social meeting centers, theatres and libraries. (note: other public amenities such as green spaces, public recreation and healthcare facilities are already covered in separate indicators).	non-available
People	Citizens	Accesibility of services	Access to commercial amenities	-	%	Basic services available close to home Share of population with access to at least six types of commercial amenities providing goods for daily use within 500m. Commercial amenities are services/goods for daily use provided by private actors. Typical commercial amenities include shops for bread, fish, meat, fruits and vegetables, general food shops (i.e. supermarkets), press, and pharmaceutical products	non-available
Prosperity	City characterization	Equity	Diversity of housing	-	%	Diversity Percentage of social dwellings as share of total housing stock in the city	16.4%

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Preservation of cultural heritage	-	Qualitative Likert scale	Identity of place based on its history The extent to which preservation of cultural heritage of cultural heritage of the city is considered in urban planning The indicator provides a qualitative measure and is rated on a fivepoint Likert scale: Not at all – 1 — 2 — 3 — 4 — 5 — Very much 1. Not at all: no attention has been paid to existing cultural heritage in urban planning. 2. Fair: heritage places have received some attention in urban planning, but not as an important element. 3. Moderate: some attention has been given to the conservation of heritage places. 4. Much: heritage places are reflected in urban planning 5. Very much: preservation of cultural heritage and connections to existing heritage places are a key element of urban planning.	non-available
People	City characterization	Education level	Number of high edu degrees per 100,000 population	(Number of high edu degrees /inhabitants) *100000	n/100,000 inh	It is an indicator of well being and development. Number of city inhabitants with high education degrees per 100000 inhabitants. Tertiary education broadly refers to all post-secondary education, including but not limited to universities	27,109.5

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Urban infrastructures	Urban platform	Cybersecurity	-	Qualitative Likert scale	Data protection, security of ICT systems Low level of cybersecurity — 1 — 2 — 3 — 4 — 5 — High level of cybersecurity 1. Maximum one of the following conditions is met. 2. Two of the following conditions are met 3. Three of the following conditions are met. 4. Four of the following conditions are met. 5. All the five following conditions are met. 1. There has been no serious information leakage or cyberattack with ignificant negative impact on the organisation, its employees or citizens during the past two years. Serious means that it results in disclosure of information (e.g. confidential or sensitive personally identifiable information) or financial lost, due to illegal system access, unauthorized data storage or transmission, unauthorized hardware and software modifications or personnel's lack of compliance with security procedures. 2. The city makes annually a risk assessment on risks of cybersecurity and has a contingency plan against the identified risks. 3. All city personnel receive basic security training when they are employed to conduct adequately to security incidents. 4. The city has recruited personnel dedicated to cybersecurity and they have signed a security pledge. 5. Employees' devices deploy an antivirus program for mitigating malware including viruses residing in them and remote access protected, i.e. controlled with security function for intrusion prevention or intrusion detection.	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Urban infrastructures	Urban platform	Data privacy	-	Qualitative Likert scale	The level of cybersecurity of the cities' systems Likert scale Not at all — 1 — 2 — 3 — 4 — 5 — Very high 1. City doesn't follow national regulations/laws on protection of personal data. 2. City follows national regulations/laws on protection of personal data. 3. City follows relevant national regulations on protection of personal data and the EU Directive on the Protection of Personal Data (95/46/EG). 4. City follows all the relevant national and European regulations/laws related to data privacy and protection. If personal/private data is collected from citizens, proper authorisations with written agreements are made. 5. Relevant national and European regulations on data protection and privacy are followed and written agreements are made for use of citizens' private/personal data. All the collected personal/private data, especially sensitive personal data, is accessed only by agreed persons and is heavily protected from others (e.g. locked or database on internal server with firewalls and restricted access).	non-available
People	Urban infrastructures	Urban platform	Number of data publishers	-	#	Number of data publishers that publish data into the existing urban platform (e.g. website)	non-available
People	Urban infrastructures	Urban platform	Number of sensors/devices connected**	-	#	Number of IoT sensors/devices from any field that are connected in the current urban platform (e.g. website)	non-available
People	Urban infrastructures	Urban platform	Number of services deployed	-	#	Number of available services in the current urban platform (e.g. website)	non-available
People	Urban infrastructures	Urban platform	Number of available Open APIs	-	#	Number of available APIs in the current urban platform (e.g. website)	non-available

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Urban infrastructures	Urban platform	Number of available Open Data sources	-	#	Number of available Open Data sources in the current urban platform (e.g. website). Open means anyone can freely access, use, modify, and share for any purpose (subject, at most, to requirements that preserve provenance and openness)."	non-available
People	Urban infrastructures	Urban platform	Number of accesses to the urban platform APIs	-	#	Number of accesses that have been made into the APIs of the urban platforms (e.g. website)	non-available
Prosperity	City characterization	Employment	Unemployment rate	% people not working among those available for work	%	Unemployment	8.00%
Prosperity	City characterization	Employment	Youth unemployment rate	% youth (<24y) labour force unemployed	%	Youth unemployment	non-available
Prosperity	City characterization	Equity	Fuel poverty	-	% of households	Equity The percentage of households unable to afford the most basic levels of energy	non-available
Prosperity	City characterization	Economic performance	Costs of housing	% gross household income spent on housing	% in €	Equity	non-available
Prosperity	City characterization	Green economy	Green public procurement	-	%	Stimulating eco-innovation Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration	non-available
Prosperity	City characterization	Economic performance	GDP	GDP per capita	€/cap	Economic performance	32,595* * at the Loie-atlantique department level
Prosperity	City characterization	Economic performance	Median disposable income	Median disposable annual household income	€/household	Economic wealth	22,284 (in 2014)
Prosperity	City characterization	Economic performance	New businesses registered	(Number of new business registered /inhabitants) *100000	#/100.000	Economic activity, attractiveness Number of new businesses registered (including start-up) in a year per 100,000 population. An average of the last 5 years with available data	971.0

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

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Prosperity	City characterization	Innovation	New startups	(Number of startups registered /inhabitants) *100000	#/100.000	New business Number of new businesses registered (including start-up) in the last year per 100,000 population. An average of the last 5 years with available data It shows how attractive is the city for starting new economic activities	non-available
Prosperity	City characterization	Innovation	Research intensity	R&D expenditure as percentage of city's GDP	% in euros	Innovation	non-available
Prosperity	City characterization	Equity	Population Dependency Ratio	0	#/100	Economic development Number of economically dependent persons (net consumers) per 100 economically active persons (net producers)	49.8

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