



RESIN

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City Assessment Report Paris

Work Package	4
Dissemination Level	PU
Lead Partner	ICLEI – Local Governments for Sustainability
Due Date	29 February 2016
Submission Date	29 February 2016

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Deliverable No.	D4.1
Work Package	4
Dissemination Level	PU
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Date	28 February 2016
File Name	D4.1_City Assessment Report Paris_ICLEI_2016-02-29
Status	Revised
Revision	Completed
Reviewed by	Hypatia Nassopoulos EIVP Eric Luijff TNO Clara Grimes ICLEI – Local Governments for Sustainability

This document has been prepared in the framework of the European project RESIN – Climate Resilient Cities and Infrastructures. This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement no. 653522.

The sole responsibility for the content of this publication lies with the authors. It does not necessarily represent the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

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This project is funded by the Horizon 2020 Framework Programme of the European Union.

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Executive Summary

RESIN is a 3.5-year EU-funded interdisciplinary research project investigating climate resilience in European cities that was launched on 6 May 2015. The project combines existing approaches to climate change adaptation and disaster risk assessment to develop guidelines and tools to support cities in adapting to a changing climate.

Four city assessment reports written on the RESIN cities Bratislava, Bilbao, Greater Manchester and Paris will allow the cities as well as RESIN project partners to assess which adaptation and critical infrastructure protection strategies, plans and measures are already in place or planned. It will also enable a better understanding of the options and decision-support tools and products that may best be suited to the specific local context of each of these four European cities and which of them might best be tested during the course of the project. It will also enable the local government, the stakeholders in the cities as well as the RESIN partners to better understand each city's needs in the adaptation and critical infrastructure protection process.

The report presented here focuses on the situation of the city of Paris, capital of France and centre of the Ile-de-France region, with around 2.25 million inhabitants. As a dense and active city, Paris is the core of the new Greater Paris, created on the 1 January 2016. Because of its crucial economic activity, its population density but also its built environment (e.g., urban services' networks, monuments, public institutions) the city is facing challenges that are of socio-economic nature as well as others, which are more environmental, notably deriving from climate change.

Climate change may aggravate these risk factors, which – in the case of Paris – are heat waves, floods (through flooding caused by the Seine River or runoff), droughts and torrential rainfall. The City of Paris has already in the past had to deal with heat waves and flooding. Should these extreme weather events occur, then all citizens are endangered. To protect the city's critical infrastructure as well as its inhabitants and to adapt to climate change, the City of Paris has taken action. Several strategies and action plans are already being implemented, which ensue from the national (PNACC, PAPI) regional (SRCAE) and local policy-making levels (Paris Climate Actions Plan and its annex –the Adaptation Strategy-, PPRI, PCA, PCS).

These plans are implemented by numerous actors and benefit a wide range of stakeholders. Among the former are, the Council of Paris, municipal departments (e.g. DVD, DEVE etc.), operators of urban networks (e.g. ERDF, SNCF etc.), the General Secretariat of the Zone of Defence and Security as well as some research organizations (e.g. CNRS, CNRM etc.). Each one of them acts according to their responsibilities and skills to improve the resilience and adaptation efforts of the City of Paris.

For more information on the project partners, background and aims, please visit <http://www.resin-cities.eu/>.

Abbreviations of public and private actors in Paris

The abbreviations of the public and private actors involved in the City of Paris' adaptation and critical infrastructure protection processes and named in this report are listed in the table below to help the reader understand their position and activities.

The actors are listed according to the following broad categories:

- Municipal departments / organisations
- Governmental organisations
- Network operators / providers
- Research organisations and institutes

This is a non-exhaustive list as the actor landscape keeps evolving.

French Name	Abbreviation	Translation	Activity
Municipal departments / organisations			
Agence d'Ecologie Urbaine	AEU	Urban Ecology Agency within DEVE	The Agency supports the environmental transformation of the territory by coordinating the municipal actions plans for climate, sustainable food, biodiversity, noise prevention etc.
Agence Parisienne du Climat	APC	Parisian Climate Agency	Its role is to inform, advise and assist the Parisians in their efforts against climate change and for the energy transition.
Agence Parisienne de l'Urbanisme	APUR	Parisian Agency of Urbanism	APUR studies and analyses urban and societal changes and is involved in defining public policy planning and development.
Conseil de Paris	CdP	City Council	The Council of Paris is the deliberative assembly of Paris, having both the functions of a Municipal Council and a County Council.
Cellule de Gestion de Crise	CGC	Crisis Management Cell	This group, integrated into the DPP, is focusing on the management of major crisis on the Parisian territory.
Direction des Espaces Verts et de l'Environnement	DEVE	Green Spaces and Environment Department	DEVE creates, develops and manages ecological green spaces. It encourages biodiversity preservation and develops the sustainable development policy.
Direction du Patrimoine et de l'Architecture	DPA	Heritage and Architecture Department	Municipal buildings construction and renovation (schools, libraries, houses, etc.)

Direction de la Propreté et de l'Eau	DPE	Hygiene and Water Department	They collect waste, work on public space maintenance, adapt structures and operate the challenges of waste sorting, recycling, reuse, reduction. They also implement educational activities.
Direction de la Prévention et de la Protection	DPP	Prevention and Protection Department	Their focus is the protection of municipal facilities, users and staff.
Direction des Systèmes et Technologies de l'Information	DSTI	Information Systems and Technologies Department	Develop, implement and maintain the processing and transmission of information systems and telecommunications for all the administrations of the city but also for Parisians.
Direction de la Voirie et des Déplacements	DVD	Roads and Travels Department	DVD is mainly responsible for the management and operation of the public roads domain and river area of the City of Paris, in conjunction with other departments intervening in the public space.
Direction des Familles et de la Petite Enfance	DFPE	Family and Early Childhood Department	The department works on the following fields: management of institutions, prevention, in the field of health and development of children, measures for families, action planning and family education
Direction des Affaires Scolaires	DASCO	School Affairs Department	The department is in charge of the functioning and maintenance of primary and middle schools and also of the educational and extracurricular policy.
Secrétariat Général	SG	General Secretariat	The Secretariat manages and coordinates all departments of the City of Paris and monitors the implementation of the policy guidelines set by the Mayor of Paris.
Observatoire des déplacements		Travel Observatory	The Travel Observatory in cooperation with other bodies studies the travels of Paris and its surroundings and produces an annual report.
Agence d'Ecologie Urbaine	AEU	Urban Ecology Agency within DEVE	The Agency supports the environmental transformation of the territory by coordinating the municipal actions plans for climate, sustainable food, biodiversity, noise prevention etc.
Governmental organisations			
Direction Régionale et Interdépartementale de l'Environnement et de l'Energie	DRIEE	Regional and Interdepartmental Direction for Environment et Energy	DRIEE is a decentralized department of the Ministry for the Environment. It implements the state actions' priorities for environment and energy in Ile-de-France.

Ministère de l'Environnement, du Développement Durable, des Transports et du Logement	MEDDTL	Ministry of Environment, Sustainable Development, Transports and Housing.	The Ministry is in charge of environment and sustainable development (MEDDE today).
Préfecture de Police	PP	Police Department	Police related issues exclusively for Paris only coordinated by a 'Police Commissioner' ("Préfet de police"), appointed by the State.
Le Secrétariat Général de la Zone de Défense et de Sécurité	SGZDS	The General Secretariat of the Zone of Defence and Security of Paris	The Secretariat is responsible for prevention (information, planning and organisation, verification exercises), intervention (application and adaptation of planning depending on the situation) and the anticipation of the return to normality in Paris in case of an emergency.
L'Institut de Veille Sanitaire	InVS	The Institute for Public Health Surveillance	Public institution under the supervision of the Ministry of Health: the Institute combines the objectives of surveillance, vigilance and alert in all areas of public health.
Etablissement Public Territorial de Bassin Seine Grand Lac	EPTB Seine Grand Lac	The Local Public Basin Establishment Seine Grand Lac	Its main mission is to maintain low water levels thus sustaining the flow of the river Seine and its tributaries. In addition, its responsibility is to fight against the risk of inundation within the Seine water basin by mitigating flood.
Direction Régionale et Interdépartementale de l'Environnement et de l'Energie	DRIEE	Regional and Interdepartmental Direction for Environment et Energy	DRIEE is a decentralized department of the Ministry for the Environment. It implements the state actions' priorities for Environment and Energy in Ile-de-France.
Main network operators			
Electricité Réseau Distribution France	ERDF	Electricity network Distribution France	ERDF manages the electricity network distribution in France.
Gaz Réseau Distribution France	GRDF	Gas network distribution France	GRDF manages the gas network distribution in France.
Eau de Paris	EdP	Water of Paris	EdP is a public company in charge of the production and distribution of water in Paris.
EGIS Group	EGIS	French engineering group	EGIS works on various fields such as infrastructure and transport systems, planning, water and environmental issues.
Régie Autonome des Transports Parisiens	RATP	Autonomous Operator of Parisian Transports	RATP ensures the operation of some of the public transport in Paris and its suburbs.
Syndicat	SIAAP	Interdepartmental	SIAAP is a public company responsible for the

interdépartemental pour l'assainissement de l'agglomération parisienne		Syndicate for the sanitation of the Parisian Agglomeration	transport and treatment of wastewater, storm water and industrial water in the Paris area.
Société Nationale des Chemins de Fer français	SNCF	National Society of French Railways	SNCF is the French state-owned railway company for passenger and goods transport.
Syndicat des Transports d'Île de France	STIF	Ile de France Transportation Authority	STIF, carries the vision of all transports of Île-de-France (train, RER, subway, tram, "Zen" and bus T). STIF make decisions related to the development and modernization of all transports including pilot projects and entrusts their operation to transportation operators.
Compagnie Parisienne de Chauffage Urbain	CPCU	Parisian district heating company	CPCU manages the district heating in Paris
Climespace	-	Subsidiary of Engie	Climespace manages the district cooling of Paris
Véolia	-	French private company	Véolia is a French multinational dedicated to water cycle management, waste management and recovery and energy management.
Orange	-	French private company	These companies represent the four main French mobile network operators (MNO). These telecommunication companies offer mobile services or mobile internet, and have their own mobile network.
Bouygues Telecom	-	French private company	
SFR	-	French private company	
Free	-	French private company	
Research organisations			
Météo France	-	Météo France	Météo France is the French meteorological agency, a public administrative body responsible for forecasting and studying weather. It is also responsible for issuing weather warnings.
Agence De l'Environnement et de la Maitrise de l'Energie	ADEME	Environment and Energy Management Agency	ADEME is the state operator working on supporting the environmental and energy transition.
Centre National de la Recherche	CNRS	National Centre for Scientific Research	CNRS is the biggest public scientific research organisation in France. The Research Centre

Scientifique			for the Organization and Dissemination of Geographic Information (PRODIG) and the Techniques, Territories, and Societies Laboratories (LATTS) are examples of CNRS institutes.
Ecole des Ingénieurs de la Ville de Paris	EIVP	Engineering School of the City of Paris	EIVP is the urban engineering school and research centre of the City of Paris. EIVP is a RESIN consortium partner.
Lab'Urba	Lab'Urba	French research unit	This unit welcomes researchers from the Paris Est Créteil University (UPEC), from the urban engineering department of the Paris-Est Marne-la-Vallée University (UPEM) and the Ecole des ingénieurs de la Ville de Paris (EIVP). Lab'Urba is organised into 5 teams working on: urban policies and territorial development, urban cohesion, inequality & discrimination, urban planning as well as urban engineering and environment.
Institut National de la Statistique et des Etudes Economiques	INSEE	National Institute of Statistical and Economic Studies	INSEE collects, produces, analyses and disseminates information on the French economy and society.
Université Virtuelle Environnement et Développement Durable	UVED	Virtual University of Environment and Sustainable Development	UVED's mission is to produce and make available educational resources in the service of digital teaching and pedagogical innovation, in order to provide successful and equal opportunities to all students.
Associations			
Centre Européen de Prévention du Risque Inondation	CEPRI	European Centre on flood risk prevention	CEPRI is an indispensable intermediary between local governments and the state, advocating on their behalf on the issue of flood prevention and management. CEPRI publishes methodological guides and reports that gather the best techniques from around France and Europe.
Haut Comité Français pour la Défense Civile	HCFDC	French Committee for Civil Defence	The main mission of HCFDC is to prepare organisations against exceptional circumstances and strengthen their resilience.

1 Introduction

The RESIN project focuses on the adaptation and critical infrastructure protection activities of its four partner cities Bilbao, Bratislava, Greater Manchester and Paris. Each of these cities has taken on the task of adapting to climate change differently. Whilst some have already progressed further, others are just setting out on this journey. The aim of RESIN is to identify, tailor and test tools and approaches to meet each city's needs and thus support them in adapting to climate change, notably protecting their critical infrastructure from its impacts.

In December 2015 the Municipality of Paris took centre stage at the Paris Climate Change Conference, the twenty-first session of the Conference of Parties (COP 21) organised by the secretariat of the United Nations Framework Convention for Climate Change (UNFCCC) and the French government. Not only was it so far one of the most successful negotiations, the local government of Paris – represented by its current Mayor Anne Hidalgo – got to showcase its ambitious efforts over the past years and its objectives for the years to come in climate-proofing the French capital of 2.24 million (INSEE, 2012) inhabitants and its surrounding region Ile-de France. The City of Paris also led voice representing the cities around the world in the negotiations of the Parties.

In this report the efforts of Paris will be contextualised by briefly retracing the city's main urban features and establishing how and to what extent it is already and will be affected by impacts of climate change. With this in mind, the reader will get an overview of the local plans and strategies in place that support adaptation and critical infrastructure protection, as well as the public, notably municipal, and private actors involved in developing and breathing life into these plans. The city's achievements will be presented. The regional and national government policies and actors will also be touched upon where relevant for the local process in Paris. Just like any other European city, Paris is continuously working towards addressing the challenges it is still facing in adapting to climate change and protecting its critical infrastructure. These as well as the opportunities that lie within these efforts for the city will also be highlighted. The report will be concluded by presenting examples of the City of Paris' needs for adapting to climate change and protecting its critical infrastructure.

The objectives of this report are to present information on:

- the existing data and information available to understand the impacts a changing climate may have on Paris,
- the current plans and strategies in place, which solely or partly cover the field of adaptation and infrastructure protection,
- the measures that have already been implemented in these fields,
- the challenges, opportunities and requirements to continue along the path of climate change adaptation and critical infrastructure protection and overall resilience-building.

The information collected for this report was provided by the RESIN partners at EIVP in collaboration with the municipal Department for Prevention and Protection as well as the Urban Ecology Agency. The report itself was written by the RESIN partners ICLEI – Local Governments for Sustainability in close cooperation with EIVP.

Three aspects need to be kept in mind while reading this report:

- The list of actors mentioned in this report is not exhaustive and only presents the actor landscape as it was at the time of writing this report. It may change over time.
- The information presented in this report also only provides the status as it was at the time of writing. This particularly applies for sections 3.1 (on baseline information), 3.3 (on other ACC and CI protection plans), 3.5 (on Actors), 3.6 (on political commitment), 3.7 (on legal frameworks) , 3.8 (on communication) and 4.1 (on financial framework). It is subject to continuous change.
- Information presented in this report was gathered through interviews and input from the Crisis Management Cell and the Urban Ecology Agency of the City of Paris. Further, information was gathered by researching several framework documents at various spatial scales with a focus on the City of Paris level (Paris Climate Action Plan etc.) as well as regulations.

2 Paris and its features

This chapter tries to portray the main features of the City of Paris, with a particular focus on its demographic development, its housing situation, economic state as well as its transport and critical infrastructure characteristics. All statistical information in this chapter was taken from the Institute National de la Statistique et des Etudes Economiques publication (INSEE, 2012) if not noted otherwise.

2.1 Demographic development

Paris is the capital of France, yet – space-wise – it is one of Europe's smallest capitals. As it is only 105 km² in size, it is one of the densest cities worldwide. It has grown continuously in the last few decades from a population of around 2.15 million in 1990 to 2.24 million in 2012. Forecasts made by INSEE so far do not predict further growth in the future.¹ The population density within the city already lies at around 21,260 inhabitants per km², and in some of Paris' districts the inhabitant density even reaches around 41,500 inhabitants per km². The City of Paris' population will actually stagnate, even decline slightly to 2.18 million and 2.21 million citizens respectively in 2025 and 2040. Predictions for the region Ile-de France, on the other hand, indicate significant growth from 10.54 million (2012) to 12.34 million (2025) and up to 12.76 million (2040)..

Like in many dynamic European and international, capital cities, the majority of the City of Paris' population is between 25 and 39 years old, followed by the 40-to 54-year-old group. The life expectancy in the city is very high with men reaching 81.1 years on average and women even 86.1. Despite this, as the birth rate in Paris is still double its death rate with 14 births to 6 deaths per 1,000 inhabitants and the city attracts many young people to study and work, Paris is a vibrant city. Yet, today close to 21% of Parisians are over 60 years with 7% of over 75 years old.

Paris is known for its educational landscape. National statistics on education levels provide an indication: 21.2% have obtained a first diploma (BEP)² and/or Youth Training degree (CAP)³, 14.7% have a French Baccalaureate⁴ as their highest degree, followed by 13.7% with a post-graduate degree and 10.5% with a university or higher education degree.⁵

The health status of a city may determine its ability to withstand climate change impacts, such as heat waves or floods, and may hinder it in coping with them. It is therefore indispensable for a local government to know the state of its citizens' health. According to national data, health inequality, i.e. the percentage of people whose day-to-day activities are limited due to their health condition, throughout France lies at 35.4%. National data shows health inequality of 35.4%, i.e. the proportion of people whose day-to-day activities are limited due to health conditions. The percentage of disability among all age groups in the Ile-de-France region lies at 8.9%, with the lowest percentage of disability among those between 0 and 50 years old. From 50 years onwards, the percentage of disabled citizens increases more rapidly. The distribution of disability amongst men and women varies. In some age groups men seem to be more affected and women in others. Keeping all of the above information in mind, it is necessary to identify citizens' vulnerability to climate change impacts and notably identify

¹ These figures must be taken with caution because, because they come from modelling predictions which do not consider future migration.

² BTEC First Diploma - (NVQ Level 1)

³ Youth Training (NVQ Level 1,2)

⁴ Highschool graduation (A levels)

⁵ The percentages stated in this paragraph represent the percentages of the persons for whom the stated degrees are the highest degrees obtained.

the social groups that may be particularly affected by climate change impacts. Vulnerable groups are defined as groups of people whose autonomy, dignity and/or physical or mental integrity is threatened (UVED: 2007). Particularly vulnerable to flooding are the inhabitants of flood-prone areas, the elderly and people with reduced mobility. In addition to the elderly and people with reduced mobility, homeless and isolated people are very vulnerable. These groups are similarly vulnerable to other extreme weather events. In the case of the City of Paris these are mainly heat waves, droughts and torrential rain according to Météo-France. Uncertainties remain in the case of wind-related extreme events (Mairie de Paris, 2012a). After the heat wave of 2003 a registration system named “Chalex” was created, for which people vulnerable to increased temperatures and heat stress can register upfront. A detailed analysis showed that the most populated districts are also the ones with the highest number of vulnerable people.

2.2 Housing situation

Paris has around 1.32 million housing units with 20% of them being social housing. The number of building permits issued increased by 65% in 2014 (in comparison with 2013) (INSEE 2014). One of the components of the Paris Climate Action Plan is to modernise the city’s housing stock by retrofitting 55,000 units between 2008 to 2020 to reduce by the energy consumption and improve thermal summer and winter comfort. The city council has signed an agreement with public and private stakeholders to finance and build 10,000 housing units per year of which 7,000 are social housing units (paris.fr). In the Ile-le-France region 37,000 homes are built each year with a target of 70,000 units per year based on the Grand Paris Programme (RF, 2014). The Economic, Social and Environmental Regional Council (CESER) of Ile-de-France advocates the construction of 100,000 housing units within the next ten years for middle-income households. It is necessary to keep climate change impacts in mind in order to protect this (critical) infrastructure from disruption and damage.

2.3 Economic state

The annual economic productivity, the Gross Value Added, lay at around EUR 549,000 million in 2012 across the Ile-de-France region. In the same year, the regional economy grew at an annual rate of 0.3%.

The economic sector that contributes the most across the Ile–de-France region by a large margin is the services sector, followed by the comparably less significant industrial, construction and agricultural sectors. The services sector also employs the highest number of people in Paris. Over 81% of Parisians were gainfully employed in 2014, with the highest numbers employed in public administration with close to 439,000 employees. The biggest employers thereafter are in the scientific, technical and administrative support services; commercial, transport and logistical services as well as in finance, insurance and real estate services. While the number of unemployed population ranked at 8.3%⁶ in 2014 across the City of Paris, the numbers of unemployed young people aged 15 to 24 years was significantly higher at 23.4% across the Ile–de-France region.

It is important to keep these figures in mind as, among other factors, the economic stability and financial resources of citizens affect their ability to withstand and recover from climate change-induced extreme weather events. The same applies to the number of citizens dependant on state support, which in the Ile–de-France region is composed of people receiving an education allowance for a disabled child (1.47% of people under 20 years old, 2013), an allowance for a disabled adult (1.32%,

⁶ The level of unemployed people ranks lower than at the national level.

of the people between 20 and 64 years old, 2013), an active solidarity income (6.15%, of the people between 25 and 64 years old, 2013) as well as a family allowance (10.1% of the households, 2013).

2.4 Transport and critical infrastructure features

Like many other major European cities, private cars⁷ play less and less of a role as people instead opt for public transport, walking or cycling. In the City of Paris, more than half of the inhabitants (55.3%, 2012) prefer to use 'active modes of transport' (i.e. walking or cycling), followed by public transport (31.8%, 2012). Cars are only the third most popular mode of transport (10%, 2012). The number of motorised vehicles used during the morning rush hour from 7-9am has decreased significantly by 16.25% (2004-2012), while the use of public transport has grown significantly. The subway has seen a 13.3% increase, the RER train a 16.32% increase and busses an increase of 8.5%. The number of trips taken by bicycle during the morning rush hour has also increased by 34% (2004-2012). In the Ile-de France region, walking and cycling are still the preferred choice (40.2%, 2012), followed by the private cars (37.8%, 2012) as opposed to public transport (20.2%, 2012), only the third most popular mode of transport (Observatoire des déplacements, 2012).

These transport figures are relevant as more than 3.9 million people commute daily between Paris and its suburbs (STIF & DRIEA, 2010). These numbers highlight the importance of establishing, maintaining, using and protecting sustainable means of transport and infrastructure for private commuters as well as for commercial transport in and out of the city. The transport system is only one of many critical infrastructures in a city. No complete mapping of the critical infrastructure has been undertaken so far for all of Paris, but partial maps or maps specific to a topic are available from different sources.

Each of the network operators has also carried out spatial mapping in search of vulnerabilities in their systems to flood risk. Spatial flood risk and vulnerabilities were also analysed by each network operator as part of their Business Continuity Plans.

Climate change impacts such as heat waves were taken into consideration by DEVE. Spatial flood risks and vulnerabilities were also looked at by each network operator and all city departments (e.g., DVD, DASCO, DPE, DFPE) as part of their Business Continuity Plans (Préfecture de Police et Mairie de Paris, 2015).

The results of all of these mappings are not integrated into a complete mapping for the public due to data restrictions, for the sake of competition amongst the network operators as well as for national security reasons.

⁷ In 2012, on average one car was owned for every three Parisians.

3 Adaptation and critical infrastructure protection plans and strategies in Paris

The local government of Paris, the regional government of Ile-de-France and a number of public and private actors are active in designing and contributing to plans in which adaptation and critical infrastructure protection play a role. This chapter compiles the city's, region's and if relevant, private actors' main plans and strategies related to adaptation and critical infrastructure protection. One of the city's recent accomplishments is the adoption of its Adaptation Strategy, an annex of Paris Climate Action Plan, in September 2015. The strategy was published in November 2015.

3.1 Baseline information and data to formulate plans and strategies

In order to be able to develop informed plans and strategies, a city needs a sound understanding of the current state and development of its urban environment, the (potential) types, extent and frequency of climate change impacts on the city and the vulnerability of its citizens and its built environment. Conducting a city-wide assessment of climate risks and vulnerabilities can help in appraising the situation, yet it is necessary to take into consideration the challenge of gathering all the information necessary for this assessment. The City of Paris has done such an assessment as have a number of other stakeholders. These are the following.

Vulnerability and robustness of Paris in light of climate change and resource scarcity (Mairie de Paris, 2012)

After 2 years of partnerships survey involving a wide range of stakeholders including research institutes, network operators and the National Meteorological Institute, the City of Paris identified twelve types of impacts affecting it. Eight of them are climate hazards and four are related to resource scarcities. Additionally, thirteen sectors were identified that are or may be impacted. The results showed that so far the City of Paris' critical infrastructure systems have worked reliably and have proven resistant to past extreme weather events. But while considering climate change and resource scarcity, combined with urbanisation and an increase in population density, attention must be paid where parts of the city-wide system appear to be more vulnerable than others. Five major issues emerged:

1. Heat waves, which may possibly be exacerbated by the urban heat island effect
2. Floods, following heavy rains, run-off or flooding from the river Seine
3. Droughts, which may impact on the city's water sources, notably from 2050 onwards
4. Pressures on food and energy resources
5. Biodiversity preservation throughout the city

The study by the City of Paris called for further in-depth studies on health risk factors caused and aggravated by climate change impacts and a deteriorating air quality, on the robustness of the insurance system of the city administration, residents and companies that are being affected by these impacts as well as on how climate change could lead people to migrate elsewhere or come to Paris (Mairie de Paris, 2012). The study also helped formulate the local government's priorities. These priorities are listed in chapter **Error! Reference source not found.** on the Adaptation Strategy (Paris Climate Action Plan annex).

The results from this risk and vulnerability assessment provided the city of Paris with the information necessary to update its Paris Climate Action Plan in 2012. It now contains a number of addendums, each laying out the plan for a specific field or sector. The plan, for example, includes the strategy for the city's administration related to energy and climate issues, the strategy for the city's housing stock and the related energy and climate issues and – least but not all – its adaptation efforts and, since September 2015, its Adaptation Strategy.

Study of socio-economic impacts of Adaptation to climate change (ADEME, 2012)

The study published by the Environment and Energy Management Agency (ADEME) looked into the City of Paris' vulnerability to natural hazards, notably of its water resources, its environment and ecosystems, its citizens' health, its networks, its built environment and urban fabric as well as its tourism, agriculture and forestry sectors. Within the study, various parameters were analysed such as changes in the energy and food supply, the extent to which extreme weather events are included in urban planning and design, citizens' mobility, thermal comfort, water scarcity among others.

One of the priorities identified by ADEME as a result of this study included the following ones in line with the adaptation to climate change:

1. Guarantee the security of infrastructures and people.
2. Improve health and living conditions for its population.
3. Protect and optimise the management of natural resources.

Preliminary studies for the Regional Pattern of Climate, Air and Energy (Ile-de-France, 2012)

Under the direction of the Ile-de-France Region Council and its President, the Regional and Interdepartmental Direction for Environment and Energy (DRIEE) and ADEME issued a report on the regional impacts of climate change. This strategic document relied on several previous studies that have deepened the knowledge on key regional issues. The vulnerabilities assessed were those of the region related to its urban infrastructures, water resources, citizens' well-being, ecosystems and economic activities. The recommendations issued for climate change adaptation were formulated for 2020 as well as 2050:

1. Make ecosystems more resilient to face the effects of climate change
2. Prevent and manage the impacts of climate change on citizens' health
3. Reduce water consumption to ensure availability and quality of water resources
4. Consider the effects of climate change in urban planning
5. Improve the knowledge, awareness and dissemination of information for all stakeholders
6. Strengthen the resilience of the Ile-de-France region in light of climate change impacts

EPICEA (Multidisciplinary Study of the Impacts of Climate Change on the scale of the Paris area) (Météo-France, the French Scientific and Technical Centre for Building (CSTB) and the City of Paris, 2007-2012)

This jointly conducted project aimed to bring scientific light on opportunities for adaptation to climate change in Paris. The project consisted of three components: (1) An analysis of the changes in the Parisian urban climate in view of climate change; (2) a study of an extreme situation, i.e. the 2003 heatwave across the Paris area; (3) the continuation of Colombert's thesis (Colombert, 2008), an

analysis of the link between urban planning and urban climate, i.e. the development of: the Parisian territory adaptation strategies to limit high temperatures (with a focus on materials, revegetation and watering of streets).

In parallel, and subsequently, many studies were added to the results of this research project. Amongst them is the work of the Paris Urban Planning Agency (APUR) on the urban heat islands in Paris and the potential revegetation in Paris as well as more extensive research on the watering of streets within the City of Paris (Hendel, 2015).

Research work conducted at EIVP in collaboration with PRODIG and EGIS also developed a mapping of the decision-making structures in the city with regards to its critical infrastructure. It highlights the network dependencies in Paris, as shown in Figure 1 (Toubin, 2014). Two 'crash-tests' were (September 2015) and will (March 2016) be implemented to assess and improve the crisis management of all operators and service providers.

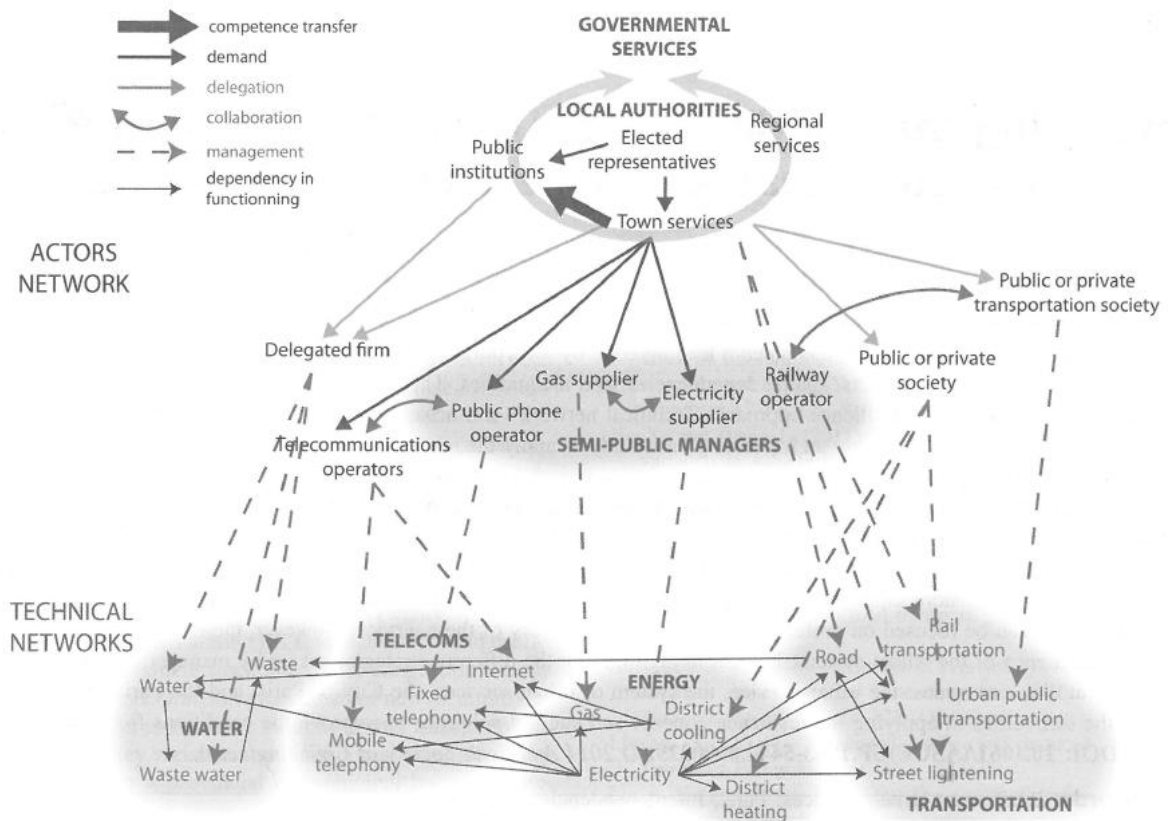


Fig. 1: Mapping of actors of the Parisian urban services and networks, and the various forms of existing interactions and dependencies between them (i.e. order, collaboration, delegation, management, competence transfer, dependencies in functioning) (Toubin, 2014)

This research activity aimed at designing and testing a methodology to improve urban resilience including both technical and organizational aspects. The work focused on urban services. As seen in the study, urban service managers' cooperation is relevant since their dependencies are a critical resilience issue. The 100-year flood of the river Seine is a major concern for Parisian authorities; however planned responses seem still slightly disconnected. The collaborative approach constructed with Parisian managers highlighted the importance of dependency management. It also helped

identifying progress margins for improvement in urban service resilience within a frame of continuous resilience improvement (Toubin, 2014).

A study of the OECD published in 2014 evaluates the consequences of flooding from an overflowing river Seine and its tributaries in the Île-de-France region. The damages of such disasters were estimated at EUR 3 billion to 30 billion in direct damages depending on the flood scenarios, accompanied by a significant reduction in GDP of EUR 1.5 billion to 58.5 billion over 5 years. The study also makes recommendations to improve the resilience and reduce the risk of facing a major flood of the Seine in Île-de-France (OECD, 2014).

3.2 Adaptation Strategy of the City of Paris

The City of Paris' most recently released planning document is its official, comprehensive Adaptation Strategy, which was adopted by the City Council in September 2015 and published in November 2015 (Mairie de Paris, 2015). The main goal of this comprehensive strategy is to respond to the most prevalent issues revealed by the vulnerability assessment to improve the resilience of the City of Paris. This strategy was developed by involving many stakeholders and network operators as well as by consulting citizens to understand and share its priorities.. Its targets, which actually represent the Adaptation Strategy's four main parts, mirror the targets defined within the Paris Climate Action Plan which were updated:

1. Protect Parisians from extreme climate events
2. Ensure the supply of water, food and energy
3. Live with climate change: more sustainable city planning
4. Foster new lifestyles and boost solidarity

Within these four main parts, the Adaptation Strategy has stipulated 30 objectives, which are underlined by 35 actions. Some of these 30 objectives are, for example (Mairie de Paris, 2015):

- Facilitate the access to refreshing spaces during summer
- Refresh the city during temperature peaks (e.g., watering pavements and squares with non-potable water, installing misting systems over public spaces, installing inflatable pools, transforming fountains into paddling pools)
- Manage the amount of water consumed
- Increase free access to drinking water in public spaces
- Turn 33 hectares into spaces for urban agriculture in Paris by 2020 (on roofs, walls, yards and squares)
- Ensure that residents do not have to walk more than 7 minutes to green spaces or bodies of water by 2020
- Conduct an extensive re-vegetation program to refresh the city
- Develop alternative storm and rainwater management options
- Integrate adaptation-related recommendations for buildings and public spaces into urban regulations

Guided by these objectives, the Parisian local government does not only intend to anticipate and prepare the city for the effects of climate change. The idea is also to use these objectives to improve the situation in Paris by promoting urban agriculture, strengthening its ecosystems and biodiversity,

improving thermal comfort during the summer months in the city by overhauling the built environment or even adapting working hours (cf. Annex 1 for a list with all objectives).

The Adaptation Strategy will be updated regularly. Also, the main directions and actions which will not be initiated now will be reinstated in the new Paris Climate Action Plan, the review of which will be carried out in 2016-2017. Monitoring through the Blue Climate reports (i.e. the annual report of the Paris Climate Action Plan) is planned to continue through the use of indicators that can be directly or indirectly related to climate change adaptation, e.g., temperature, humidity, precipitation, green surface coverage, amount of CO₂ (in tonnes) and energy (in MWh) saved per year and houses refurbished. (Bleu Climat (Mairie de Paris), 2011/2012/2013/2014, Paris Climate Actions Plan (Mairie de Paris, 2012a)).

In November 2015, the City of Paris launched its first EUR 300 million worth Climate Bond, which will solely focus on tackling climate change (it also includes a dedicated focus on financing adaptation projects).

3.3 Other plans and strategies related to adaptation

Whilst adaptation is now officially addressed in a stand-alone strategy, it is also directly or indirectly accounted for in other plans and strategies. For example, the **Biodiversity Strategy** (2011) lays the groundwork for strengthening green and blue infrastructure to promote ecological continuity, making biodiversity a structuring element of municipal action, sensitizing and mobilising local urban actors to convey to all Parisians and future generations a culture of urban ecology (Mairie de Paris, 2011b).

The annually updated **Heat Wave Plan** aims to prevent damage to citizens' health caused by high temperatures. It has developed a registration and information system to alert and protect citizens. After registering, people vulnerable to heat (i.e. people aged 75 and older, disabled people, people with health problems and isolated people) are contacted by telephone every two days during a heat wave by a mandated telecom operator to check if they are fine. The operator is obliged to make up to four calls in case registered people of the Chalex file do not respond immediately to the first call, until they answer. If needed, those in need of a cooler environment are transported to refreshment rooms, which are spaces with an air freshener to prevent the dangerous effects of the heat wave on the body, organised by the city. In 2015, around 100 people were relocated (paris.fr).

The **Blue Climate Report** is a follow-up report of the Paris Climate Actions Plan strategy with the aim of refining it further on a yearly basis. This report is the information and evaluation tool used to track all actions taken within the Paris Climate Actions Plan. Each year the Blue Climate Report provides an update on the budget execution and on the progress of the actions of the previous year and presents the city's new commitments for the year to come and the actions to be incurred in subsequent years (Mairie de Paris, 2008/ 2009/ 2011/ 2012d/ 2013/).

The **Blue Book** (2012) lays out the strategy for water in Paris. This report presents new directions for the municipality to work with partners in the preservation of water resources and development of more sustainable cities. The use of non-potable water for refreshment and the creation of spaces around the docklands are some examples of the actions proposed (Mairie de Paris, 2012e).

Plans notably related to private operators are presented in the section below dedicated to CI protection plans and strategies.

3.4 Critical infrastructure protection plans and strategies

The City of Paris itself has not yet developed a plan or strategy to protect its critical infrastructure, but several plans refer to one or the other type of infrastructure. These plans may not necessarily be authored by the city administration.

The Department of Roads and Mobility has created a **Mobile Barriers Plan**, which allows the rapid installation of mobile flood barriers to prevent flooding from the river Seine. This plan, based on the water levels reached in 1910, does not take climate change impacts into account.

A number of policies are available that apply at community, city, regional or national level and most of them are related to flooding. The **Communal Information Document on Major Risks**⁸ (DICRIM), the **Local Prevention Plan for Flood Risk**⁹ (PPRI) (République Française, 2007) and the **National Programme for Preventive Actions against Floods**¹⁰ (PAPI) all set out prevention and planning measures to avoid flood damages and losses.

Each city in France that has a PPR is usually required to have a **City Backup or Protection Plan**¹¹ (PCS) (Préfecture de Police et Mairie de Paris, 2015), which sets out the actions for communal risk management actors (e.g., mayor, elected officials, municipal administrators, volunteers) in case of a disaster or emergency, which may be of natural, technological or health nature. It mainly delineates the flow of information across the city.

There are two legal requirements touching upon critical infrastructure protection, which each larger institution or company has to fulfil. Government institutions, community councils, organisations, business, network operators, hospital and similarly big entities have to draw up an **Activity Continuity Plan**¹² (PCA). This ensures that the respective body can continue to operate in the face of a disaster or major crisis, even if this is only possible to the minimum. Public service bodies, particularly those located in flood prone areas in the city, are in addition required to develop a **Flood Protection Plan**¹³ (PPCI) following the PPRI (RF, 2007). It sets out the various measures that must be taken to reduce the respective bodies' vulnerability towards flooding. Even if it is not mandatory, the City of Paris has asked all directorates to establish PPCI for all bodies located in electric failure zones or in areas where basements are at risk of being flooded.

Every network operator has its own plan to protect the specific type of infrastructure and/or resources for which they are responsible. However, these plans are not available to the public as mentioned previously.

3.5 Actors active in and relevant for adaptation and critical infrastructure protection planning¹⁴

The local government of the City of Paris is already very active when it comes to adapting to and protecting its critical infrastructure from climate change impacts. To ensure these efforts are sustainable, the plans and activities become an integral part of the city's administration and all

⁸ English for Document d'Information Communal sur les Risques Majeurs

⁹ English for Plan de Prévention du Risque Inondation

¹⁰ English for Programmes d'Action de Prévention des Inondations

¹¹ English for Plan Communal de Sauvegarde

¹² "Plan de Continuité d'Activité"

¹³ Plan de Protection Contre les Inondations

¹⁴ Information on this section was gathered through interviews and inputs from the Crisis Management Cell and the Urban Ecology Agency of the City of Paris. In addition, information was gathered through researching several framework documents at various spatial scales and notably at the scale of the City of Paris (PCETs etc.), as well as regulations.

relevant stakeholders are involved in the planning processes, it is vital to know the actors that are on board – as well as those who may still need to be further engaged. It has to be highlighted that the list of actors mentioned hereafter is non-exhaustive.

Actors within the local government

In the City of Paris' administration the **Crisis Management Cell** of the Prevention and Protection Department deals with resilience in terms of emergency management (including extreme weather events). The **Climate-Energy-Circular Economy-Division** at the Urban Ecology Agency of the Green Spaces and Environment Department works – amongst others – on climate change adaptation. A dedicated adaptation team was created there recently.

This designated **climate adaptation team in the Climate-Energy-Circular Economy-Division of the Urban Ecology Agency** (allocated at the Green Spaces and Environment Department) is in charge of steering and monitoring the adaptation strategy in line with the Energy-Climate-Resilience mission of the General Secretariat of the City of Paris. These activities are performed in close collaboration with its Chief Resilience Officer (Mairie de Paris, 2015) (funded by the 100 Resilient Cities initiative of the Rockefeller Foundation), who reports directly to the city manager and whose mission is to work with all concerned services to design and propose a strategy to reinforce the overall resilience of the city. The piloting and implementation of envisaged measures will be entrusted to different directorates within the City of Paris administration as well as public and private partners. Amongst them are, for example, Eau de Paris, the autonomous authority of the City of Paris in charge of water management, the Institute for Public Health Surveillance (Institut de la Surveillance de la Santé Publique - InVS), Electricity Network Distribution France (ERDF), the French gas operator (GRDF), real estate developers and social landlords. Two municipal actors are directly in charge of critical networks: The DVD is in charge of roads and, as mentioned, Eau de Paris is responsible for the production and distribution of the water in Paris.

Flooding is a significant threat to Paris and the Ile-de-France region. In 2010 a **working group on flooding** was set up within the framework of a research project at EIVP (Toubin, 2014) to tackle this issue more closely. Still ongoing and organized by the City of Paris, the participants include several directions of the City of Paris Departments, the General Secretariat of the Defence and Security Zone of Paris, and the main network operators. The working group members exchange information and discuss further steps to prevent and deal with flooding events.

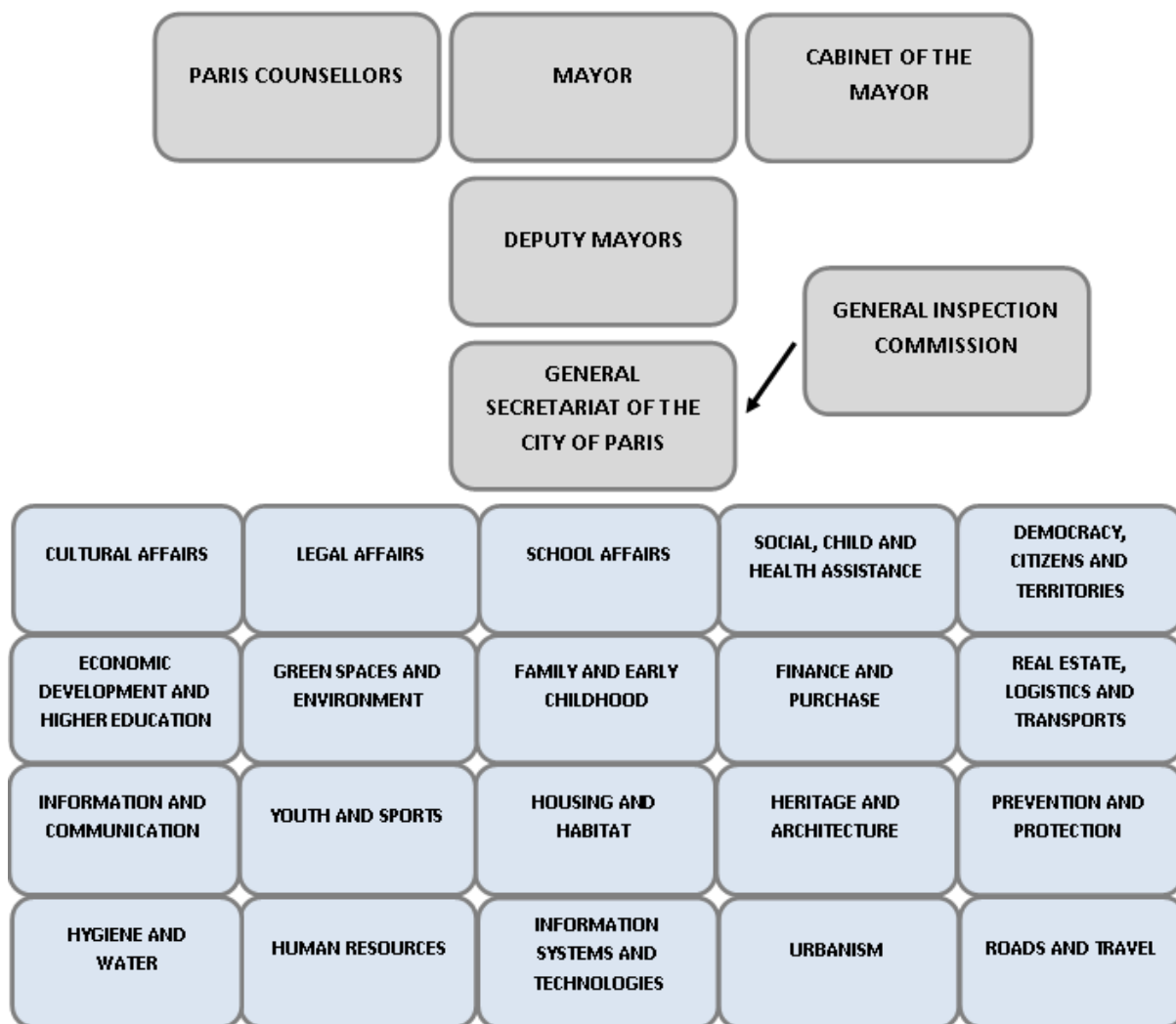


Fig. 2: Organogram of the City of Paris' administration (Directions) (City Questionnaire, 2015)

Actors in Paris, the Ile-de-France region and at the national level with an effect on the City of Paris' activities

Several private sector actors have developed plans and even are already actively implementing measures of adaptation or critical infrastructure protection. The majority of them are operators such as Veolia and Suez Environment in the water domain, the gas distribution network of France (GRDF), the electricity sector (ERDF), the Autonomous Authority of Parisian Transportation (RATP) and the National Society of French Railways (SNCF) and Regional Authority for Public Transportation (STIF) in the transport arena (mainly electrical mobility, public transport and train infrastructure). Other companies can be given as examples such as ADEME or I Care Environment, which develop tools to determine the vulnerability and risks of a territory; VINCI and Saint Gobain, which mainly produces insulation material or the Club France Développement Durable (CFDD) as a business network for sustainable innovation¹⁵.

The role and level of influence of research organisations regarding climate adaptation and infrastructure protection depends on the context, i.e. specific needs and/or concrete research/innovation projects. For this reason, organisations such as I4CE (Institute for Climate

¹⁵ The members of CFDD are companies as well as research institutes or non-governmental organisations.
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Economics), CSTB (Scientific and Technical Building Centre), CNRS (National Centre of Scientific Research), CNRM (National Centre of Meteorological Research), the Lab'Urba (of which the RESIN partner EIVP is a member), PRODIG, LATTIS, or organisations at the interface between research and operation like ADEME (Environmental and Energy Management Agency), CEPRI (European Centre on Flood Risk Prevention - Centre Européen de Prévention du Risque Inondation), HCFDC (French Committee for Civil Defence - Haut Comité Français pour la Défense Civile), EPTB Seine Grand Lac (Local Public Basin Establishment Seine Grand Lac – Etablissement Public Territorial de Bassin Seine Grand Lac) play varying roles in support of the City of Paris.

As of January 2016, a new governance body was created: Greater Paris. Based on this the communities of municipalities and communities of agglomerations will be replaced and considered as 'territories' of the Greater Paris, but without legal autonomy or autonomous tax systems (RF, 2014). To what extent that might reshuffle the actor constellation has still to be established.

Overview of actors' landscape with an impact on the efforts of the City of Paris and the Ile-de-France region

It is important to know the actors that are already involved in the adaptation and critical infrastructure protection process in the city as well as in the adjacent Ile-de-France region. Maps of influential actors created during a RESIN workshop and further developed thereafter by RESIN partner EIVP are presented below. The first one covers the actor constellation in the city's critical infrastructure protection activities and the second visualises that for the climate change adaptation processes and activities. The aim of both is to get a better understanding of which actors at varying levels are most influential for climate adaptation and critical infrastructure processes in the City of Paris. Both maps portray the actor landscapes at this report's time of writing and are subject to future changes. Knowing the constellation of the actors helps to identify existing and possible interactions between them, which contributes to further strengthening and streamlining the City of Paris' adaptation and critical infrastructure protection efforts.

Figure 3 shows those government bodies, organisations and companies which shape how the City of Paris' critical infrastructure is protected.

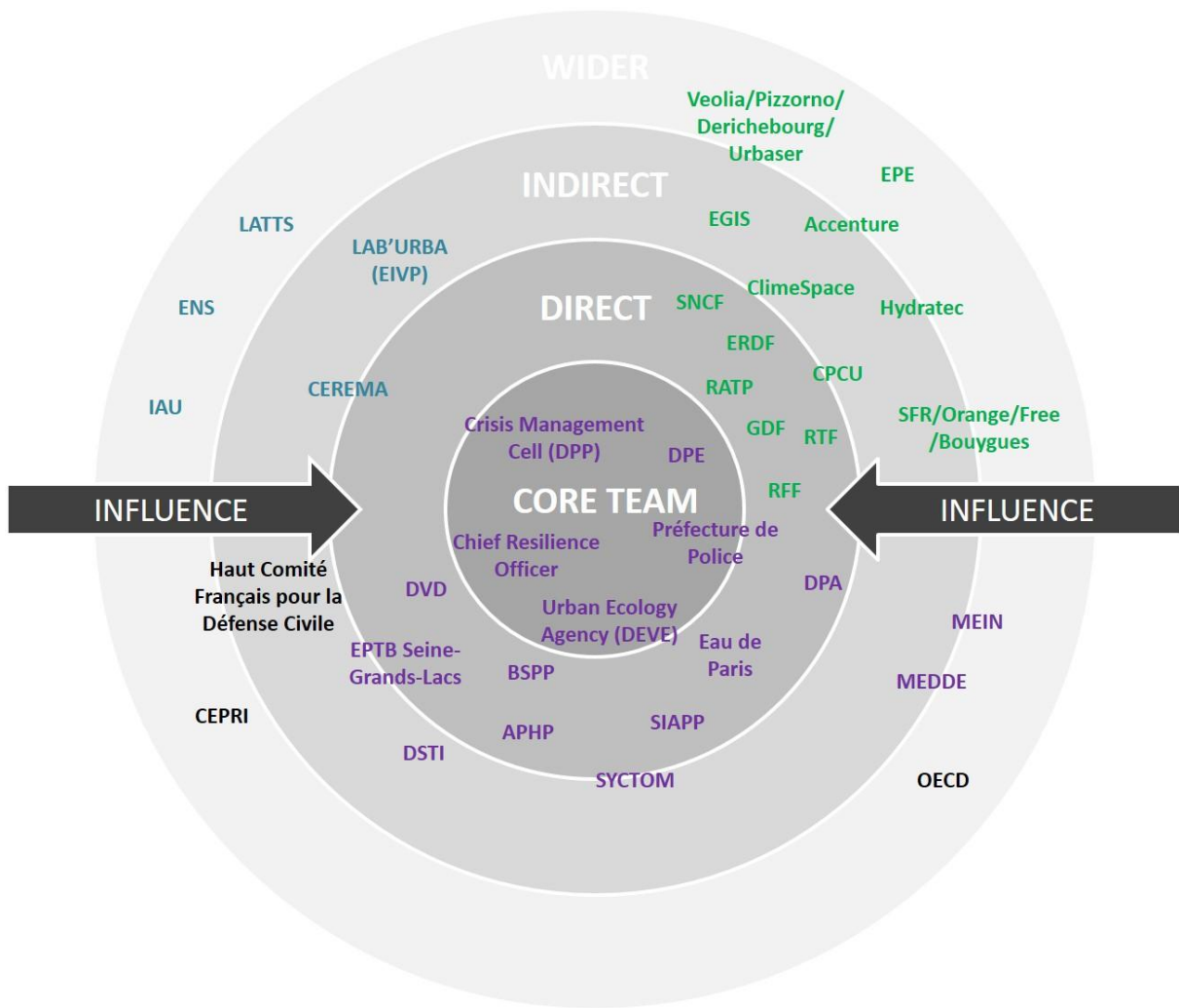


Fig. 3: Mapping of the stakeholders involved in the City of Paris' critical infrastructure protection activities (EIVP, 2016)

Figure 4 depicts the level of influence of the actors currently involved in the city's climate adaptation activities.

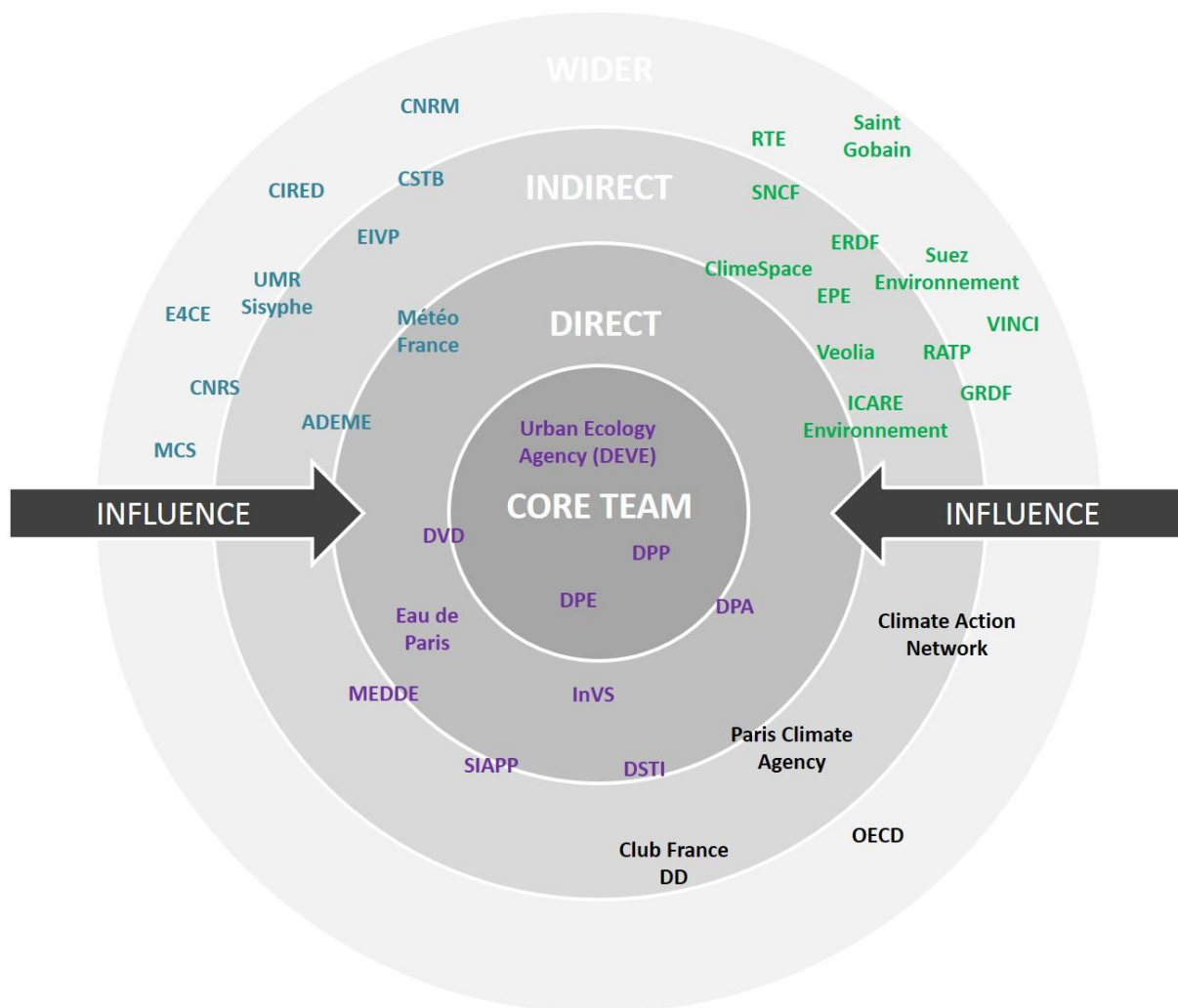


Fig. 4: Mapping of the stakeholders involved in the City of Paris' climate adaptation processes and activities (EIVP, 2016)

There are four levels of influence, which derive from the template provided during the RESIN workshop as guidance for EIVP as implementing partner for the City of Paris. They are as follows:

- The **core team** refers to key actors directly involved in the adaptation process and in critical infrastructure protection.
- Actors allocated to the **direct circle of influence** have a direct influence on the process of adaptation and critical infrastructure protection.
- The actors assigned to the **indirect circle of influence** have an indirect influence on the process of adaptation and critical infrastructure protection.
- Those with even an even more indirect influence on the processes are allocated to the **wider circle of influence**.

The actors can be categorised into municipal departments or public companies (purple), private companies (green), research institutes (blue) and associations or other institutes (black).

3.6 Political commitment and decision-making for adaptation and critical infrastructure protection

The Mayor of Paris, Anne Hidalgo, supports and advocates mitigation and adaptation to climate change – not only at local, but also at national and international level, as seen at a COP 21 meeting targeting cities in December 2015. The City Council of Paris adopted the Adaptation Strategy and continuously lends support in this arena. It has also signed the Compact of Mayors and the Covenant of Mayors and has become a member of AIMG, C40, Energy-Cities, ICLEI – Local Governments for Sustainability and UCLG.

3.7 Legal framework for planning and implementing adaptation and critical infrastructure protection

The success of a city's efforts also greatly depends on the legislation that is in place to back the local government. Supportive policies and legislation at national and regional level make a difference.

Legal frameworks for adaptation

The Ministry of Ecology, Sustainable Development, Transport and Housing of the national government of France adopted the **National Adaption Plan to Climate Change** (PNACC) based on Article 42 of the law No. 2009-967 of 3 August 2009 relating to the implementation of the Environment Round Table (Grenelle de l'Environnement) in 2011. The plan presented concrete, operational steps to prepare France to cope with and take advantage of new climatic conditions for the time period 2011 to 2015 (MEDDETL, 2011).

Climate change adaptation is now included in the general principles of several planning documents. Since the 2010 law '**Grenelle 2**', which established the Regional Scheme for Climate, Air and Energy (SRCAE) and the Paris Climate Actions Plan (Articles L.222-1, 2 and 3 of the Environmental Code and Article L.229-6 of the Environmental Code), these documents have to include measures contributing to adaptation to climate change and have to be developed in consistency with the planning documents.

The Article L.101-2 of the Town Planning Code now states: "[...] In accordance with the objectives of sustainable development, the action of public authorities in urban planning aims to achieve the following objectives: [...] Fight against climate change and adaptation to this change [...]" (RF, 2015). However, while adaptation to climate change now appears in the general principles of most planning documents, the legislation give editors of planning documents the freedom to determine the practical modalities of how this concept is integrated into these documents. The local legislation like the **Local Plan of Urbanism** (Plan Local d'Urbanisme - PLU) is firstly a strategic document. But it is also a regulatory document laying out the development of land parcels and regulating building permits and demolition permits, but it also provides the basis for climate change adaptation contributions. According to the code of urbanism, the PLU has to take into account the fundamental guidelines of Paris Climate Actions Plan (RF, 2009b). This has been the case since 2008 after the adoption of first Paris Climate Action Plan in 2007

At regional level, a **Regional Scheme for Climate, Air and Energy (SCRAE)** (Ile-de-France, 2012), developed jointly by State services (DRIEE), the Region and ADEME, contains guidance for adapting to and mitigating climate change. The SRCAE is not only part of regional reference on energy and air quality but also a toolkit to help communities define concrete actions on their territory. The **Paris Climate Actions Plan of the City of Paris** is compatible with the SRCAE for the Ile-de-France region (RF, 2010). Strictly speaking, however, the PNACC, the SRCAE and the Paris Climate Actions Plan

are not legal frameworks per se, but they support the implementation of adaptation plans and measures.

Both the PNACC and SCRAE plans influence the City of Paris's plans in so far as they predefine priorities and state concrete actions to be implemented at local level for each sector (MEDDETL, 2011 and Ile de France, 2012). Amongst these priorities and actions there are some which are also relevant for the City of Paris.

Last, following the recent publication of the "Notre law" in 2015, a new framework named "Regional Scheme of Planning Sustainable Development and Territorial Equality" ("chéma régional d'aménagement, de développement durable et d'égalité des territoires (Sraddet)) was established, combining SCRAE as well as the "Regional Scheme of Intermodality" and the "Regional Scheme of Prevention and Management of Waste". The Climate Air Energy Plan ("Plan climat air énergie territorial (PCAET)"), which is defined in the Article L. 222-26 of the Environment Code and further developed in the articles R. 229-51 à R.221-56 as well as the Energy Transition Law published in 2015 are also being applied.

Legal frameworks for critical infrastructure protection

In France, nearly all public entities in charge of planning and operating critical infrastructure protection have been privatised. As the data of critical infrastructure operators is often classified information (e.g., the location of electrical substations), decisions are often made by these operators themselves or at the national level. Still, there are a number of laws, regulations and codes providing the legal framework for protecting the City of Paris critical infrastructure.

The most relevant pieces of legislation regarding critical infrastructure are:

- **Code of Homeland Security:** The Code obliges critical infrastructure operators (for electricity, water, communications, transport) to take the necessary measures to provide for the priority needs of the population in crisis (including obligation of operators to protect their infrastructure from the risk) (RF, 2012).
- **Defence Code:** It defines the security of the critical infrastructure related to the production and distribution of essential goods or services, or infrastructure that could pose a serious danger for the population (RF, 2005).
- **Environment Code:** The Environmental Code deals with networks through the prevention of pollution and risks related with a construction. As part of this code, a platform managed by INERIS is accessible by critical infrastructure operators to provide information and data regarding their networks. This platform is also accessible by the cities.

3.8 Communication throughout planning processes

To achieve its ambitions in the field of adaptation and critical infrastructure protection, the City of Paris communicates its plans and activities and engages relevant stakeholders to join in. It can be highlighted that the City of Paris has organised many information and dissemination events and campaigns.

In 2009, the fiction project '+ 2°C – Paris invents itself' ("Paris s'invente") exhibited twenty photomontages, one for each district of Paris, which imagine the city of the 22th century (paris.fr). This 'Paris of the Future' was conceived by the collective of architects 'And Then' ("Et Alors"), which based their work on the IPCC studies. They were also supported by local expert from the Urban Ecology Agency. These architects created an experimental and exploratory method to imagine Paris in 2100

taking into account a temperature increase of 2°C. The City of Paris also organised the 'Parisian Energy and Climate Days' ("Journées Parisiennes de l'Energie et du Climat") for several years. Professionals provided advice to visitors to help reduce their energy consumption and minimise their impact on the climate. Animations and exhibitions were also featured in the forecourt of the City Hall (paris.fr). In addition, various presentations in conferences (e.g., at the Resilient Cities Forum, UNFCCC, TEM) lectures and other events were conducted by the Urban Ecology Agency. They dealt with questions related to climate change, notably adaptation.

In addition, the Prevention and Protection Department and the Police Department are planning to create a communication strategy on the flood risks based on the obligation defined by the article L 125.2 of the Environment Code (RF, 2004). The mayor also has to communicate about major risks to the citizens every two years. The city administration has also become active on this part and intends to target small business units more by informing them about the risk of flooding.

4 Implementation of adaptation and critical infrastructure protection measures

Although the Climate Change Adaptation Strategy has only been adopted recently, the City of Paris is already implementing measures.

Amongst the activities underway are for example (Mairie de Paris, 2015):

- Re-vegetation of public space and land authorised by the Paris City Hall (DEVE)
- Promotion of the use of non-potable water for watering green space, cleaning gutters, washing pavements and sidewalks and cleaning sewers (under test) authorised by the Paris City Hall (DPE, DEVE)
- Development of space throughout the city for urban agriculture authorised by the Paris City Hall (DEVE) and implemented together with non-governmental organisations and residents
- Natural refreshing of municipal buildings authorised by the Paris City Hall and put into action by the Department for Heritage and Architecture (DPA) (e.g. the air conditioning in the City Halls is running through refrigeration recovery from the non-potable water network; natural ventilation, choice of suitable cooling materials or geo-cooling are also used)
- Implementation of the Heat Wave Plan authorised by the Paris City Hall and put into action by the Department for Prevention and Protection (DPP)

When it comes to protecting the City of Paris' critical infrastructure, each network operator and urban service provider has its own protection strategy in case of a flood event. Depending on the type of network or service, measures can be the following:

- Protecting key technical facilities from water
- Sheltering movable critical equipment
- Halt the supply of services

4.1 Financial framework for implementation

The Paris Climate Action Plan is a comprehensive strategy. The same applies for its annex, the Adaptation Strategy. This is why there is also no specific budget for its implementation: All directorates have to in their actions take into account the City of Paris' climate commitments. The funds for measures, which are directly or indirectly linked to adaptation, are part of the respective department's overall budget tasked with implementing measures. These budgets are approved by the Paris City Council and then distributed to the departments. It is important to note that to finance investments, the City of Paris established a EUR 300 million worth Climate Bond. With this bond the local government will be able to finance specific climate-related projects (e.g., revegetation) in Paris. Linking up to the previously mentioned measures, a number of examples of department budgets for critical infrastructure protection are listed below:

- The Department for Prevention and Protection (DPP) commissions safety and renovation works (e.g. securing electrical infrastructure) for which it receives a reimbursement by the national government for half of the expenses incurred by the city (according to the PAPI plan) within the limit of EUR 2,285 million.
- The Department for Prevention and Protection (DPP) also receives financing from the 100 Resilient Cities campaign from the Rockefeller Foundation to finance the full-time position of a Chief Resilience Officer for a period of two years. His/her job is to co-ordinate the actions of all services working on resilience.
- The Department for Roads and Mobility (DVD) had several years ago received an initial budget envelope of around EUR 6 million for investing in new mobile flood barriers.
- The Green spaces and Environment directorate has a specific budget of EUR 35 million to finance extension of public green spaces (+30ha) and plant new trees (+20,000).

4.2 Monitoring and Evaluation of adaptation and critical infrastructure protection measures¹⁶

With the Adaptation Strategy in place, the City of Paris has also reinforced its monitoring and evaluation process to establish how effective and successful the measures are that the city planned in addition to the Blue Climate reports. A technical committee will oversee the technical implementation process and meet several times a year. The annual steering committee, chaired by the elected in charge of the environment, sustainable development, and the Paris Climate Actions Plan, will monitor the process at the same time.

The Paris Climate Actions Plan also includes a monitoring and evaluation procedure. The annual activity report 'Blue Climate' describes the information and evaluation of the year's actions. As the Adaptation Strategy is an annex to the Paris Climate Actions Plan, its monitoring and evaluation procedures also apply to it. The results found in the report influence the actions of the next year. A complete evaluation assessment was also completed before the revision of the Paris Climate Actions Plan in 2012 (Mairie de Paris, 2012).

The monitoring and evaluation process is organised differently in the field of critical infrastructure protection. Here every network operator is in charge of the monitoring and evaluation of their respective plans and measures. The resulting report is usually not publicly available. The electrical network operator ERDF, however, evaluated the impact of its measures taken to tackle the risk of flooding and heat waves. They found that the area of potential disruption for a 100-year flood has decreased since measures have been taken on the network.

A simulation game event called ECOP15 took place in September 2015. It was conducted with the majority of the stakeholders affected by flood and responsible for critical infrastructures or urban services. A wide range of actors from public entities, private companies and organisations and operators participated. The exercise received political support and the Mayor, Anne Hidalgo, made an appearance. A similar exercise – this time simulating a 100-year flooding – will be conducted in the mid of March 2016.

¹⁶ Information on this section was gathered through interviews and inputs from the Crisis Management Cell and the Urban Ecology Agency of the City of Paris. In addition, information was gathered through researching several framework documents at various spatial scales and notably at the scale of the City of Paris (PCETs etc.), as well as regulations.

5 City of Paris' challenges, opportunities and achievements in adapting to climate change impacts and protecting critical infrastructure

Based on the Paris Climate Actions Plan report (2012), various other reports as well as interviews with and inputs from municipal officers, various challenges and opportunities particularly for climate change adaptation, were identified. Amongst the **challenges** are:

- **Finding sustainable means of cooling** the City of Paris during heat wave episodes to protect its citizens, particularly vulnerable social groups. Based on climatic projections, longer and more frequent heat waves will probably occur. Therefore refreshment will be the challenge, particularly for vulnerable people.
- **Protecting the City of Paris against the increasing flood risk** caused by run-off or from high water levels in the river Seine. Flooding is indeed a major issue for Paris, notably the centennial flood risk, which could be exacerbated by climate change.
- **Promoting the local production of energy and food supply** and diversifying it whilst reducing the overall consumption. This challenge is indeed increasingly becoming important with regards to the resource scarcity risk.

Of the **opportunities** that lie in adapting to possible climate change for the City of Paris, two very relevant are:

- **Reviewing current efforts** (e.g., measures implemented such as re-vegetation, use of specific cooling materials, insulating buildings). Such efforts can be further developed, integrated and streamlined into the overall Climate Change Adaptation Strategy
- **Promoting the 'out-of-the-box', more integrated thinking** towards a multi-risk view to strengthen the City of Paris' adaptation efforts

Like any other city in Europe, the City of Paris' administration also continuously works on tackling its challenges and identifying opportunities to better protect its critical infrastructure. In this field the city is continuously working closely together with and relying on the work of the national (with a footprint in Paris) and local critical infrastructure operators and other influential actors. The challenges and opportunities are based on the input by the Head of the Crisis Management Cell of the City of Paris and reviews of several framework documents:

Some of the **challenges**, which can be stated when it comes to protecting the City of Paris and its surrounding critical infrastructure, are:

- **Establishing Continuity of Activity Plans (PCA)** to ensure that all basic services and infrastructures continue to work in the wake of an emergency or disaster
- **Being aware of and limiting dependencies** amongst actors and issues, which need to be taken into account when working on critical infrastructure protection. These dependencies must be known and limited in order to minimise cascading failures in case of a crisis.

- **Promoting coordination** between all relevant municipal and private actors as well as networks operators

There are also many **opportunities**, which lie in protecting the City of Paris' critical infrastructure. Amongst them are, for example:

- Having all types of relevant actors and stakeholders (i.e. public bodies, critical infrastructure operators, private sector companies, etc.) **interact will not only produce synergies but also improve the level of protection and resilience**
- Promoting an 'out-of-the-box', **more integrated thinking towards a multi-risk view** to strengthen the City of Paris efforts to protect its critical infrastructure and go beyond mainly addressing flood protection and heat wave reduction

6 City of Paris' needs for adapting to climate change impacts and protecting (critical) infrastructure

Based on the achievements so far, the challenges it is still facing and the opportunities that come with adapting to climate change and protecting its critical infrastructure, some needs to carry on adapting to climate change and protecting critical infrastructure can be identified.

Readings done and inputs from municipal officers collected by the RESIN partners at EIVP show a selection of needs to improve the City of Paris' adaptation efforts (Fig. 5):

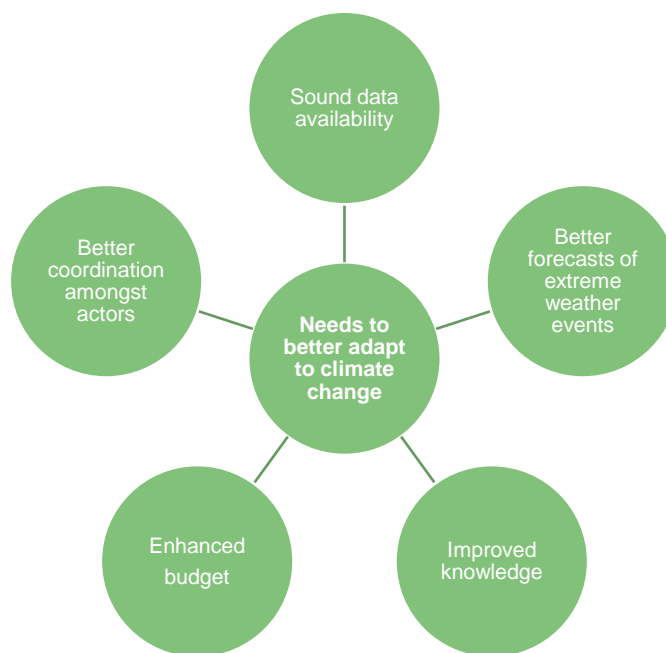


Fig. 5: Examples of Paris' needs to improve adaptation efforts

1. **Sound data availability:** Working based on reliable and comprehensive data is important to have a clear vision of the current situation and model the future (i.e. temperatures, weather events, technical solutions, dependencies, networks, vulnerable groups, etc.). Specific forecasts for 2050-2070 made by Meteo-France are already available.
2. **Better forecasts of extreme weather events:** Access to detailed, reliable forecasts of extreme weather events significantly contribute to an adequate and relevant adaptation strategy.
3. **Improved knowledge:** It is imperative to deepen the knowledge on climate change, climate change risk and adaptation solutions, possible co-benefits as well as possible contradictions between different options (i.e. mal-adaptation).
4. **Higher budget:** Budgets will have to continuously be invested in order to put in place additional, reliable, effective and relevant adaptation measures, but also to consolidate the monitoring and evaluation of implemented measures.
5. **Better coordination amongst actors:** The coordination between the different actors with a role to play in the adaptation strategy of the City of Paris is also a key point for the success of it.

With input by the Head of the Crisis Management Cell of the Parisian administration, a selection of needs to better protect the City of Paris’ critical infrastructure can be determined (Fig. 6):

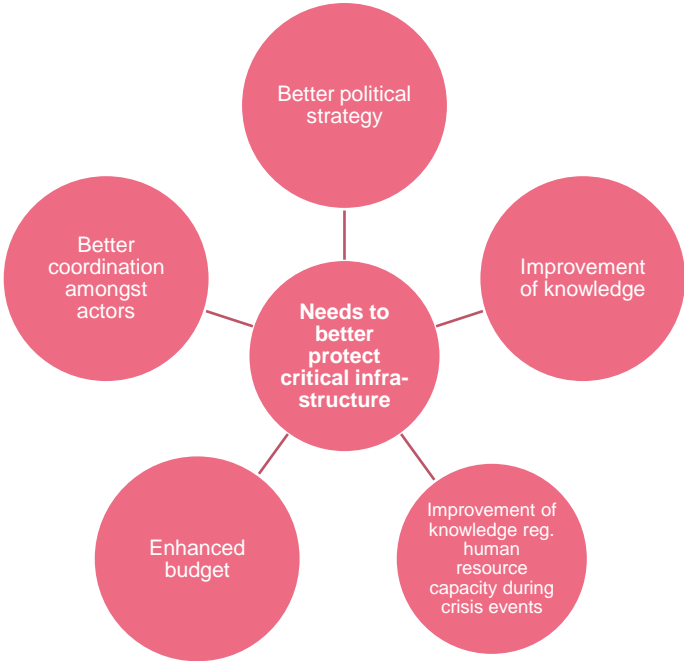


Fig. 6: Examples of Paris’ needs to improve its critical infrastructure protection

1. **Better political strategy:** The City of Paris needs to further develop a clear and detailed policy regarding the protection of critical infrastructures taking into account national critical infrastructure sectors and critical elements or services..
2. **Improvement of knowledge:** Deepening the knowledge on subjects like cascading effects, co-benefits as well as possible divergences between actors offer valuable information.
3. **Improvement of knowledge regarding human resources:** It is beneficial to gain more knowledge on the human resource capacity which is available and can be mobilised during a crisis event.
4. **Higher budget:** Higher budget need to be made available to be able to invest and thus continue to put in place reliable, effective and relevant critical infrastructures measures, but also to continue ensuring the monitoring and evaluation of these measures.
5. **Better coordination amongst actors:** The coordination between the different actors with a role to play in the critical infrastructure protection strategy of Paris is also a key point for the success of it.

ANNEX

Annex 1 – Objectives of the Climate Change Adaptation Strategy

Objectives of the Adaptation Strategy	
1	Improve the information and instructions provided to Parisians and visitors in case of extreme events
2	Ensure the continuity of public services in case of extreme weather events
3	Facilitate access to refreshing spaces in summer
4	Refresh the city during temperature peaks
5	Continue anticipating and protecting Parisians against floods, storms, extreme cold events and fire
6	Anticipate the development of new diseases in Paris
7	Water consumption management
8	Ensure water supply continuity in case of extreme weather events
9	Strengthen free access to drinking water in public spaces
10	Implementation of 33 hectares of urban agriculture in Paris in 2020
11	Guarantee the food supply of Paris
12	Ensure the conditions of access to energy for all
13	Triple the share of renewable energy in Paris in 10 years and increase the production of energy recovery
14	Improve resilience of energy and telecommunications networks to climate hazards
15	Insure no more than 7 minutes' walk from a green breathing space or water by 2020
16	Expand the use of water in public space
17	Multiply swimming spots
18	Conduct an extensive re-vegetation program to refresh the city
19	Impose a guarantee of summer comfort in new buildings
20	Develop alternative storm/rainwater management

21	Integrate adaptation related recommendations of buildings and public spaces in urban regulations
22	Promote small disused railway belts as recreational spaces and biodiversity reserves
23	Improve the water quality of the Seine
24	Arrange new working schedules for public facilities
25	In periods of heat waves, adjust working conditions for the most difficult jobs
26	Develop teleworking
27	Make Parisians aware of new behaviours related to adaptation
28	Encourage solidarity among citizens towards the most vulnerable population of Paris
29	Develop cooperation between local governments on adaptation
30	Anticipate climatic migration

Annex 2 – Actions delineated in the Climate Change Adaptation Strategy

	Actions of the Adaptation Strategy
1	Maintain and enhance the Heatwave Plan
2	Open round-the-clock parks and gardens during the summer
3	Implement water mist systems in public spaces frequented during heat waves
4	Create shade structures (and coolness pathways) in public spaces
5	Adopt and implement a master plan for the use of non-potable water and its network
6	Drill new wells to access the deep water table in Paris
7	Develop new drinking water fountains
8	Develop urban agriculture gardens on water tanks
9	Achieve 25% of food consumed in Paris produced in Ile-de-France by 2050
10	Continue the work begun with farmers and communities in catchment areas of potable water
11	Achieve the Sustainable Food Plan aims
12	Develop a multi-stakeholder Plan to fight against fuel poverty / precarious energy situations
13	Consolidate the territorial energy strategy
14	Strengthen the presence of water in urban development
15	Create new water mirrors on large Parisian squares
16	Reactivate and facilitate access and use of decorative fountains
17	Create four new indoor pools and two new open-air swimming pools in Paris
18	Open natural bathing sites
19	Implement innovative solutions for “re-vegetation”
20	Select and plant new plant species adapted to future climate
21	Design parks "adapted to climate change"

22	Implement passive cooling solutions in Parisian buildings
23	Develop the district cooling network
24	Create construction repository adapted to climate changes
25	Ensure the protection of buildings against flood risk
26	Implement the Rain Plan in Paris
27	Reduce the waterproofing of the docks during their refurbishment
28	Integrate adaptation to climate deregulation in the PLU (Local Plan of Urbanism)
29	Use "Saint Vincent de Paul" district as an exemplary eco-district in adaptation
30	Launch a reflection on the future of the Paris ring road ("périphérique")
31	Adapt the opening hours of public services and working hours of agents to weather episodes
32	Experience the recovery and the reuse of rain water in new construction operations
33	Promote food production on forgotten spaces (e.g. balconies)
34	Create a fund for cities and communities to strengthen international solidarity
35	Study the anticipation of climatic migration process at the metropolitan level

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