

CITY OF  
PARIS

[PHOTO]

COMMUNICATION AT THE COUNCIL OF PARIS  
FACING THE CLIMATE EMERGENCY AND THE HEAT PEAK  
PARIS DEPLOYS ITS “URBAN COOLING” STRATEGY

The climate that we know today is changing and will continue to change all through the XXIth century. Rain and violent winds, flooding, droughts, heatwaves, our city must already face more and more frequent and intense climate phenomenon. These are the first signs of a major upheaval. It is therefore urgent to prepare and adapt. And as reminded by the recent report “Adapting France to the Climate Change by 2050: Declared Emergency” by the foresight delegation at the Senate, the territories, and the cities, in particular, are on the front line of this fight.

In Paris, the average annual temperature is increasing and will continue to increase by 2°C to 4°C by the end of the century. In this context, Paris must prepare to live through hotter summers.

The past few years, we observed heatwaves almost every year in Paris: 40°C were recorded in July 2015: the latest heatwave ever documented happened at the end of August 2016; in June 2017, a particularly precocious heatwave occurred during the school year; in 2018, an 88 days long heatwave was observed. In 2019, we just lived through a first heatwave, even though the summer season is only just starting.

In the next decades, the heatwaves will increase in frequency and in intensity and will last longer, between May and September. Météo France projects that there will be up to 26 days of heatwave warning a year by the end of the century, that is to say, episodes during which the temperature exceeds 31°C during the daytime and never goes below 21°C at night, for a minimum of three consecutive days. For the most intense events, the heat peaks could be more than 4°C above the hottest peaks observed the past few years.

The heatwaves can be combined with drought phenomenon and tensions on the water resource. In addition, they accentuate the degradation of air quality. It is therefore vital to take into consideration the increase in average temperatures in the interaction with other phenomenon and in the particularities of its impact in urban settings.

In Paris, the heatwaves are amplified by the Urban Heat Island phenomenon (UHI), that is to say, the difference in temperatures observed between a city and the suburban or rural territories surrounding it. During the last heatwaves, we observed a difference of more than 8°C between Paris and nearby cities such as Melun, and up to 12°C at night, with comparable differences between the center of Paris and the Bois de Boulogne and Vincennes. A differential of 1 to 2°C was even observed in the parks and gardens in the heart of Paris – depending on the size and the cooling advantages of the green areas. Three factors are preponderant in this phenomenon: the method of occupation of the grounds – mineral or vegetal surfaces, the radiative and thermal properties of the materials as well as their ability to reflect the solar radiation and, lastly, the urban morphology, that is to say, the size, the height of the buildings, the orientation and the exposition to wind corridors. The thermal breezes, wind phenomenon

that appear during a heatwave period, unequally hitting the territory: some quarters, such as the center of the right bank of Paris, are real “basins” where the air pollution and heatwave meet and are reinforced due to the absence of wind (APUR). Other factors can influence this phenomenon, such as the heat, in relation to human activities (energy loss, warm air due to the air conditioning, industrial activities, transportation), or the low presence of water.

Yet, the shape of a city does not change as fast as the climate. Therefore, the climate evolutions combined with the effect of Urban Heat Island constitute a public health concern of high priority for Paris. Since 2003, each year, the heatwaves lead to premature deaths. The 2003 heatwave provoked 70,000 deaths in Western Europe, with an excessive mortality rate of 141% in Paris during the first two weeks of the month of August in comparison to the average of the same period between 2000 and 2002. 1,070 deaths were directly attributed to the heatwave in Paris. Santé Publique France established the contribution of the UHI and the atmospheric pollution to this catastrophe a posteriori. According to the projections, the summer of 2003 could be a “normal” summer in 30 years. In 2018, during the two periods of 5 days of high heat, Santé Publique France noted an excessive mortality rate of +15%. It must be reminded that in a heatwave period, an increase of +1°C of the temperature at night leads to a doubling of the risk of increase of deaths among vulnerable populations.

There are many symptoms: sleep disruption at night (deteriorated sleep, insomnia), dehydration, headaches, cramps, fatigue, feeling faint and loss of consciousness, dry skin, etc. They become worse in the absence of wind, when the humidity level is high, in the presence of pollution in the atmosphere and by Urban Heat Islands (UHI). The people at risk are babies and children under 5 years old, the elderly or those suffering loss of autonomy, people suffering from chronic illnesses, pregnant women, people living on the street, people who work outside and doing a physically demanding job, and those who do not have access to cool places – due to the poor insulation of their living space, if they are homeless, etc. Other nuisances worsened by the heatwave, such as air pollution, accentuate these risks.

Therefore, it is urgent to reinforce the resilience of Paris against these hazards, firstly to protect the Parisians’ health, and especially that of the most fragile.

This challenge can only be taken on in a global and transversal manner. Thus, Paris largely mobilizes the municipal directions and the territory actors, and commits to an ambitious approach for which the purpose is to turn this risk into opportunity, in all of the domains of municipal action.

The implementation of the responses takes root in numerous applicable strategic and regulatory documents, such as the National Heatwave Plan (2004)– but also, in Paris since the first Climate Plan in 2007, a strategy of adaptation to climate change (2015), a Paris Health Environment plan (2015), a Resilience Strategy plan (2017), a Territorial

Climate Air Energy Plan (PCAET, 2018), of the “Paris Rain” plan (2018) and a biodiversity Plan (2018).

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It is appropriate to present these many ongoing actions, while drawing perspectives to complete and improve them, in three principal fields:

- First, by raising awareness, training the inhabitants, accompanying the most fragile, and counting on the willful commitment of the Parisian population,
  - Adapting the infrastructures, the public space, the buildings, and the urbanism,
  - Mobilizing the collective intelligence and innovation to improve the solutions.
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## **I – MINDFUL, TRAINED, ACCOMPANIED AND UNITED PARISIANS**

### **RAISING AWARENESS, TRAINING**

The first response to the high heat is human. The body's thermoregulation assumes a behavioral dimension (staying hydrated, wearing appropriate clothing, etc.) as well as a physiological dimension (shivers or perspiration, etc.). Thus, it is a matter of raising awareness about the simple actions to protect everyone's health.

The City of Paris fully takes part in this effort. It continues to relay key messages on the reflexes to adopt in a period of the seasonal watch (from June 1<sup>st</sup> to September 15<sup>th</sup>): drinking water regularly, eating in sufficient quantity, wetting one's body and using fans, maintaining a cool accommodation, not drinking alcohol, checking on relatives, and avoiding physical strain.

These recommendations of Santé Publique France are widely displayed (posters in public spaces, in establishments receiving the public in the City of Paris, flyers, internet, and social media) and via the citizen relays. On the Internet and the “Extreme Paris” application, which provides people with real-time information regarding the risks of the heat depending on their location (estimation of temperature in the air), their profile (fragility, vulnerability to high heat), shows the nearby places where they can refresh and the coolest paths they can choose for their trip by foot.

In addition, the City develops training modules to understand climate change, its effects in Paris and how to act in order to adjust to high heat. Done in partnership with the

Parisian Climate Agency, these training sessions are open to anyone. **They will be generalized in the framework of the “Climate Volunteers” program.**

In addition, as part of the education policy, the City, in partnership with Météo-France, proposes some modules and workshops in the schools and secondary schools about creating green spaces, in order to familiarize children with these issues during their childhood, following the example of the “École Météo” project, elaborated in partnership with the Paris Regional Education Authority, which uses meteorology to raise awareness about the current climate issues.

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#### A WISH TO SEE THE EVOLUTION OF THE LEGAL DISPOSITIONS REGARDING THE “EXTREME HEAT” PLAN, CALLED “CHALEX”.

The law of June 30, 2004, and the following application decrees established a warning and emergency plan in each department to benefit the elderly and those who are disabled during a period of heatwave watch, from June 1<sup>st</sup> to September 15<sup>th</sup>. In 2018, the plan was active for 12 days. It is the mayors’ responsibility to put a plan in place to identify the vulnerable population. The City compiled a file on a volunteer basis of these people. There are 8,000 individuals registered today, too little in regards to the public potentially concerned – there are 170,000 people aged over 75 years old in Paris – despite the information campaigns, the offer of cool rooms in the city’s equipment and the dedicated transport from their place of residence, thanks to the municipal automobile transportation. Once again, this summer, 41 cool rooms will be available to welcome these people (19 in the district city halls, 7 in EHPAD and 14 in the clubs and restaurants of the Social Action Center). In case of high heat and of proven needs, the city will collaborate with hotels and museums to provide 13 additional cool rooms.

The City meets its legislative and regulatory obligations thanks to the plan put in place after the trauma of the crisis in summer 2003, but it is clear that it is not enough to meet the objectives that were set at the beginning. **The City wishes to call upon the State for an evolution of the legal framework of the heatwave plan.** Several questions are raised in Paris, including the elaboration a more efficient system to identify and follow up on the vulnerable people and offer adequate solutions to their needs. The demographic evolutions, notably the aging of the population (in Paris, the part of the population aged 60 and over increased by 13% between 2007 and 2014), reinforce this need of efficiency of the plan.

Additionally, the City pays a particular attention to the homeless. For them, this summer, water ramps are provided, more than 5,000 flasks are handed out and showers and toilets are also provided, notably at the day center at Porte de la Chapelle, managed by

the Salvation Army, open 7 days a week from 8 am to 7 pm during the whole summer season, in order to allow the people to shelter from the heat and have showers to cool down.

The City of Paris also makes the municipal “Bains-douches” in private stalls available free to everyone and increases the opening hours in case of a heatwave. The 16 “Espace Solidarité Insertion” day centers also increase their opening hours in case of a heatwave. The roaming teams are reinforced to ensure vigilance and to go towards the homeless, and redirect them to these services as well as hand out flasks.

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Generally, social inequality, crossed with the environmental risks and the lack of access to care contribute to the apparition of areas of socio-environmental fragility in Paris. **The accompanying of these quarters will, therefore, be a priority for the development of cooling solutions.**

## ACCOMPANYING THE DESIRE OF CIVIC COMMITMENT

The disintegration of social cohesion is a challenge that is non-dissociable from climate issues because it weakens the territory as a human ecosystem. The international scientific literature reveals that, no matter what crisis the territories are subjected to, their capacity of resilience is determined by the capacity of their inhabitants to know one another and help each other, thus through the social ties.

Solidarity constitutes an indispensable response to adapt Paris to high heat, thanks to mutual assistance and kindness, notably on the neighborhood scale. The City of Paris put several plans in place to accompany these desires of the citizens.

Paris en Compagnie is a free service accompanying the elderly that was open in January 2019 and calls for the citizens' mobilization to accompany elders in their daily trips (going on walks, going to the museum, going to their doctor's appointment, etc.). This experimental service, initiated and financed by the City of Paris, is carried by a group of three partners, Les Petits Frères des Pauvres, Autonomie Paris Saint Jacques and Lulu dans ma rue. Paris en compagnie is associated with the City in case of a heatwave to relay the information campaigns to the Parisian seniors.

15,000 Parisians declared themselves as Climate Volunteers for the citizen vote on the PCAET of Paris in June 2018, ready and eager to act in a concrete manner for the climate. Training sessions to “adapt Paris to the high heat” are provided to them and invite them to gain knowledge of the implications of an increase in temperatures in Paris, to identify the levers available to them to take action on their scale and help their neighbors. As part of the platform “Végétons Paris” (Let's create green spaces in Paris), citizens contribute to cooling Paris through projects to create green spaces in

Paris in public or private places, shared gardens, etc; notably thanks to the “Permis de végétaliser” (license to create green spaces). The gardening lessons at the House of gardening, as well as the courses for adults at l’École Du Breuil, also bring awareness to Parisians about these issues. Following the strong citizen mobilization of the two editions of the Night of Solidarity, the Solidarity Factory opened its doors this past May 14. After having already trained 500 Solidarity Volunteers, they will soon offer workshops and training to help homeless people. As of this year, 100 Volunteers of the Solidarity Factory are especially trained to help homeless people during the summer. At the end of this course, solidarity associations will propose engagement missions to Volunteers during the summer. Their backup is a great help to help fragile people, for whom summer is as dangerous as winter.

**The Volunteers of Paris plan, made up of volunteers, is the subject of experimentation in the 4<sup>th</sup> district and will be progressively broadened to all of Paris.**

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As part of this experimentation, citizens who attended several training sessions (life-saving techniques, fight against exclusion, climate change, accompanying elders, creating green spaces, rise of the Seine, etc.) are invited to lead concrete missions to respond to high heat: participation in the creation of green spaces, diffusion of information regarding the islands and cooling paths with the shopkeepers and neighbors, as well as accompanying older people to cool rooms. Trained in life-saving techniques, they will be even better capable to act in case of an emergency (dehydration, dizzy spell).

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## II – ADAPTING THE INFRASTRUCTURES, THE PUBLIC SPACE, THE BUILDINGS, AND THE URBANISM

### “ISLANDS AND COOL PATHS”

Since 2015, Paris is committed to work in partnership with Météo France, Santé Publique France, École des Ingénieurs de la Ville de Paris, École Du Breuil, Agence Parisienne du Climat, and APUR, in order to identify the “cool” places or equipment, and in this way map out the “cool islands and paths”. The “cool paths” are places to stop at or rest at, accessible to everyone and identified as a cool place in Paris, compared to other places around them in a warm or heatwave period. The 24 hours a day opening of parks and gardens in the summer since 2016 is the first response. This summer, 922 cool islands, including 218 accessible at night are available to Parisians (outside bathing and swimming pools, libraries, museums, cult places, cool rooms, green spaces, water fountains and atomizers). A dedicated application called Extrema identifies the nearest cool islands in real-time.

In addition, APUR made a list of cool islands that are not accessible to the public, which are some potential places to stop at to cool down (shaded places that are not equipped with zebra crossings, ornamental squares that are fenced in, etc.). **From 2020, a program to make these cool islands accessible will be studied and deployed**, so that all inhabitants are within a 7 minutes’ walk from a cool island (currently 92% of the population is within a 7 minutes’ walk from a cool space).

The “oasis” courtyard program is in line with this and financed in partnership with the European Commission, its purpose is to turn the schoolyards in primary and secondary schools into cool islands (green permeable spaces with water spots and shade) and

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to progressively make them accessible to the surrounding neighborhoods, in priority to the vulnerable people, outside of school hours. There are therefore 760 schoolyards, the most connecting public equipment on the territory, which will be turned into cool islands open to the public, which has already been achieved by cities such as Athens, Barcelona or Tel Aviv. **The possibility of replicating the concept in other equipment managed by the City or its partners (SNCF, State, Region, AP-HP, social lessors, congregations, dioceses, etc.), gives the occasion to enter into a common task by 2020.**

It must be noted that the “cool paths” are pedestrian itineraries linking the cool islands during a hot or heatwave period, and on which the felt temperatures are cooler in comparison with the nearby environment. Listed in the Extrema application, these itineraries allow the guiding of the inhabitants and visitors on their trips.



## COOLED DOWN PUBLIC SPACES, SUITABLE TO THE CLIMATE CHANGE AND VECTORS OF WELL-BEING

In order to cool down the city, there are daytime strategies that handle the problem in a preventive manner by preventing it from warming up, shade by urban canopies, water spraying on the exposed surfaces, light-colored materials that do not absorb heat as much... Moreover, there are nighttime strategies, which consist in accelerating the cooling down process at night: permeable grounds for evaporation purposes, etc. Depending on the chosen solutions, the spaces will gain in thermal comfort at different times.

Today, the public space is in big part dedicated to motorized circulation. Since 2014, measures are in place for a better sharing of the public space and better air quality. Measures such as the “zones 30”, that are meeting zones of the “Paris Respire” (Breathing Paris) quarters, giving pedestrians access to the road along the riverbank, the arrangement of Parisian places, the creation of 11 vegetal streets, are measures that help reduce pollution in the air as well as the heat produced by automobile circulation.

In addition, the City of Paris maintains its objective to put an end to the circulation of diesel vehicles in Paris by 2024 and of thermic vehicles in 2030 thanks to the implementation of a restricted zone of circulation, which will soon be a metropolitan measure. In order to reduce the emission of heat from the vehicles in case of a heatwave, the City will give instructions to the Prefecture for limiting the circulation of the most polluting vehicles during heatwaves, in compliance with the objectives of the PCAET.

At the same time, particular attention will be brought to the deployment of ventilation and air conditioning in the underground, the tramway, and buses that are currently being renewed, as well as the ecological performance of these solutions. **A first assessment and perspectives will be proposed in close partnership with RATP by 2020.**

Since 2014, the City of Paris rearranged streets for children, of which the rue du Retrait in the 20<sup>th</sup> district is a good example), edible, permeable, sportive, intelligent,

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cooled down, welcoming, appeased, etc. On the basis of these experiences, a model of planning for the nearby public spaces allow the integration of these objectives as a whole on one street or public space: conceived by the inhabitants, suitable to the climate change, and in favor of social ties. The planning project for the rue Blanchard in 2019 in the 20<sup>th</sup> district is a pilot of this model of “resilient” public spaces.

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**In order to adapt public spaces to high heat, Paris will continue developing solutions founded on nature, water, materials and the valorization of urban networks and the underground.**

First of all, the vegetation lowers the temperature in the air through evapotranspiration and provides a substantial summer comfort thanks to the shade provided by the trees. It is the most efficient solution to cool down the city, with particularly important local effects around the parks. The 20,000 trees, as well as more than 30 hectares of green spaces that will be opened for the Parisians between 2014 and 2020, are as many responses.

The progressive opening to the public of spaces such as the Petite Ceinture Railway offers new cool paths in the heart of the capital for Parisians to enjoy.

Beyond the development of these green spaces, it is the choice of the vegetal varieties that must be suited to the climate change. By 2030, the objective is to increase the index number of canopies by 2%, or more than 20,000 additional trees.

The planting of urban forests, true freshness refuges during the hot days, will be favored. **This will begin with plantations place de l'Opéra Garnier, on the square of the Hôtel de Ville and Gare de Lyon, as well as on the banks, and will continue thanks to work in concertation with the inhabitants and the district city halls in 2020.** The City of Paris, in collaboration with the district city halls, will launch a campaign to identify parcels from which to remove the asphalt. Sites have already been identified and are being studied in the 12<sup>th</sup> (avenue des Terroirs de France) and in the 10<sup>th</sup> (near the canal Saint-Martin). Two projects will be taking place this summer rue Maurice Ravel (12<sup>th</sup>) and rue Coulmiers (14<sup>th</sup>) and then rue de Jessaint (18<sup>th</sup>). Also, in front of two schools with "oasis" courtyards, sidewalks will be stripped off and replaced with green spaces with the help of school children.

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A study initiated by the City in 2018 will enable us to know, by 2022, the varieties of trees that are the best suited to the climate's evolution in Paris: their resistance to hydric stress (limiting the need for care and watering, and therefore the water consumption), their shading capacity, and thus their cooling power!

In 2014, 28.6% of the territory was made of permeable green spaces. By 2030, this number will be brought to 50% of the territory, in compliance with the objectives of the Biodiversity Plan. For this purpose and within the scope of the work done around the Parisian drainage basins, in 2019 the APUR is in charge of the production of a cartographic map of permeable surfaces. This contribution will allow us to fight against the UHI effect while favoring biodiversity, and better management of rainwater. The "Permis de végétaliser" plan, in place since 2015, allows everyone to take part in the creation of green spaces in Paris.

**In order to amplify this dynamic, from the start of the school year, Parisians will be able to apply for a "Permis de végétaliser" (authorization to create green spaces),**

**in order to plan and maintain parts of sidewalks from which the asphalt will have previously been removed by the City.** The City of Paris will launch annual campaigns to remove asphalt from sidewalks. The City of Paris will make some ditches for in-ground plantations and Parisians will be able to plant rose bushes, flowers, climbing plants, etc.

In order to adapt to high heat, making water visible and accessible is a major lever. The plan is to build 50 new wet zones by 2030, in compliance with the commitments of the PCAET and of the Biodiversity Plan. Some ornamental basins could be used as paddling pools.

Paris will also continue with the creation of valley gutters, ponds, and rain gardens, in the framework of the “Paris Pluie” plan (Paris Rain plan). There are 209 ponds and wet zones in Paris, with 21 of those wet zones created since 2014. These transformations enable the cooling of the city, but at the same time, they promote the proliferation of mosquitoes which constitutes a major health risk,

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linked with the capacity of some of these dipteran species to transmit diseases. Their conception and maintenance will include a particular attention to prevent them from becoming larval dens.

**The City and ARPUR will study the opportunity of a return to service of ornamental fountains through the supply of non-potable water (as is the case for the Trocadero fountain).** The opening of new natural bathing spots also gives the opportunity to cool down, which is already possible since 2017 in the basin at la Villette, and will be possible in the Seine by 2025.

These new bathing options are proposed in addition to an ambitious effort to “swim in Paris”, started in 2015. This way, 3 ephemeral basins installed this summer in sports equipment (Lagrange 12<sup>th</sup>, Elisabeth 14<sup>th</sup>, Lumière 20<sup>th</sup>) complete the offer of free bathing spaces all summer long.

**By 2020, the City will study the opportunity of a plan increasing the accessibility of Parisian swimming pools in the event that the Heatwave Plan is triggered.**

Also, this summer, in addition to the 1,200 drinking fountains, a strengthened plan of cooling by water is deployed in the public space with Eau de Paris: 48 atomizers, 2 new models of fountains/equipment offering atomization and drink in the 4<sup>th</sup> and 13<sup>th</sup> district, and 36 prototypes of 2 in 1 fountain (drink and spray) temporarily hooked up to fire hydrants. The latter responds to the problematic of the untimely opening of these hydrants, therefore they are put in place in coordination with the Paris Fire Department, guaranteeing the quick withdrawal in case of intervention.

It is indispensable to adapt the Parisian roads and the materials they are made of to the high heat. During summer 2018, the thermometer went up to 65°C on the ground rue du

Louvre in Paris! The black asphalt, which is dominating, presents the double fault of its oil-producing base and bad thermal performance: it absorbs heat, restitutes it at night, and does not allow for the infiltration of rainwater. Furthermore, it deteriorates quickly and can melt in case of high heat, provoking additional nuisances and dangers.

These realizations gave us the opportunity to test surface materials with better thermal performances: on the seven reconfigured places, in the “oasis” courtyards, on the cycle paths, or even as part of the project financed jointly with the European Union LIFE Cool & Low Noise Asphalt. The latter allows the experimentation of 3 prototypes of road coatings with improved phonic and thermal qualities in the 15<sup>th</sup> and 8<sup>th</sup> districts since October 2018.

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The first results will be assessed after the summer of 2019. The lighter color of the coating combined with the spraying of the road in case of high heat limits the release of heat at night, and its acoustic properties attenuate the noise which discourages the opening of windows. This effort will continue with a reinforced mobilization of the companies of public works on the territory, in order to accompany the transition towards simpler and more suitable materials. Several innovating materials are currently being tested by the materials test Laboratory.

From the end of 2019, the City will continue the analysis of the lack of cool islands with particular attention to the public spaces that are sunnier than average, where the planting of trees is difficult because of the morphology of the streets or underground networks. On this basis, **a plan will be proposed as soon as 2020 to develop the shade in Paris.** It will be a matter of studying the recourse to artificial sun-shelters: taut canvas in colors with a low solar factor, wood or photovoltaic sun-shelters, pergolas, and the opportunity to use the public lighting infrastructure against which to build these structures.

**This reflection will be integrated to the current works on the street furniture and the future public lighting market.** It will draw inspiration from the propositions already made by Parisians as part of this year’s participatory budget, in the manner of the “Protégeons-nous du soleil” (Let’s protect from the sun) or “Paris met les voiles contre les canicules” (Paris sails away from the heatwaves) projects.

Lastly, the contribution of the underground networks and the subsoil to the cooling of public spaces is a wonderful opportunity to adapt Paris to the high heat. The non-potable network is an essential and structuring element. The masterplan adopted by the Council of Paris in 2015 envisages its rehabilitation and modernization, as well as the development of new uses for it. Among them, the spraying of the pavement, sidewalks and places, already experimented, provides more comfort for pedestrians. **A reutilization of this network within joint ownership properties and with the connected lessors, for the purpose of watering and cooling, will also be studied.**

A cooling system connected to the non-potable water network and cooling the temperature is currently being tested.

Underground, the quarries network presents a fresh and stable temperature all year long. In 2020, the City will launch a study to assess the valorization potential of the temperature of this underground to produce refreshment in the summer: climatic wells, climatic benches, etc. **A climatic bench in earth reinterpreting the**

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**principle of the Canadian well by using the air from the quarries network will be tested in the near future. Lastly, the valorization of the cooling network to cool down in the public space thanks to innovative furniture, such as the cool islands proposed since 2018, constitutes an offer of potential service as part of the development of this network.**

## TOWARDS A RESILIENT URBANISM

Exemplary urban planning projects concerning the adaptation to climate change are currently ongoing in Paris.

The Saint-Vincent-de-Paul (14<sup>th</sup>) project, first carbon-neutral and resilient urban project, will integrate the summer comfort and the cooling of free spaces through the creation of green spaces, the reinforcement of the presence of water and the choice of materials over 3.5 hectares by 2020.

The Chapelle Charbon planning operation in the North East of Paris (18<sup>th</sup>) envisages 6.5 hectares of park, conceived as a new resilient park, adapted to the extreme climate conditions. 3 hectares will open to the public in 2020.

The 18 hectares that can be converted for the Bercy-Charenton (12<sup>th</sup>) project will also be resilient. 0 emission and 0 carbon; by 2025-2030, on a space that is very artificialized today, a particular attention will be brought to the retention of rainwater, favoring the cooling of the site as well as to the creation of new green spaces such as the Parc de la Rapée on 2 hectares, the pedestrian promenade, and the created green public spaces.

The transformation of the seven big Parisian places with water jets, atomizers, and other fountains, and an increase in the vegetal permeable surface.

In addition, the Eiffel Tower project, presented on May 21<sup>st</sup>, proposes a backdrop with trees, lawns and resting places conducive to well-being and relaxation, which will extend well over the Trocadero promenade. The consultations that took place from June 5 to July 13 will enable to continue the discussion about the integration of these logics to the Local Urban Masterplan.

Lastly, the 4.5 kilometers of the Seine riverbanks were opened to pedestrians, providing them with a unique and cool setting thanks to the creation of green spaces and the proximity to the river, a true and precious wind corridor for the nocturnal cooling of Paris. Within the scope of the urban renewal projects, the risks linked

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to the climate change, and particularly the high heats are systematically taken into account, following the example of the “Portes du 20<sup>ème</sup>” project and the transformation of the doors into “places”. The Study of the Health Impact that took place on this territory showed high demands in cooling solutions in the accommodations and the public space. These teachings will be applied in the planning operations of the Python-Duvernois sector as well as Porte de Montreuil. These studies, for which the methodology was proposed by the WHO, will be done more and more as part of other planning operations like that of the Porte de la Villette (19<sup>th</sup>).

### **The climate priority also has a place in the regulatory documents in Paris.**

From the modification of the PLU (Local Urban Masterplan) of July 2016, article 15 made it possible to integrate environmental dispositions in order to better translate the objectives of the Climate Plan, of the Biodiversity plan, or even the Rain Paris plan. This rain zoning and the new sanitation regulations play a particularly important regulatory role when it comes to adapting to climate change thanks to better management of water at its source.

The exigence of creating free spaces and open ground spaces never ceased to increase during the past few years. The POS (ground occupation plan), which was replaced by the PLU in July 2006, demanded that 50% of the surface of free spaces be done in open ground. The 2006 PLU took this exigence to a ratio between 60 and 70% depending on the quarters in Paris, the most deficient ones having to meet the highest expectations. This increase in percentage was also applied to require a larger surface of free spaces.

The modification of the PLU in June 2016 was the occasion to increase once again the requirements of open ground spaces by increasing this requirement to 80 and 90% of surfaces of free spaces. The possibility to transform open ground surfaces into green roofs is limited to only 20% of required open ground surfaces (2 m<sup>2</sup> of green terrace for 1 m<sup>2</sup> of open ground surface).

The PLU also facilitates the creation of green spaces in buildings: the creation of green spaces on terraces measuring more than 200 m<sup>2</sup> and urban agriculture projects or substrate reproducing the qualities of natural grounds for those measuring more than 500 m<sup>2</sup>.



The PLU also envisages dispositions enabling the adaptation of new constructions to high heat: conception limiting air conditioning needs, simplicity, thermal insulation, and appropriate ventilation systems. The new constructions must be conceived to allow natural cooling (double orientation, occultation systems for bay windows, etc.).

The PLU is also an endeavor to guide the operations on existing buildings (rehabilitation, modification, height increase) through the obligation to improve thermal insulation, preserve natural ventilation and improve the thermal comfort in the summer, notably by preserving from insolation, in priority through the installation or improvement

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in facade of the occultation systems such as wind-braces, Venetian blinds or louvered shutters. For constructions as a whole, it is highly advised to limit the effects of the sunbeams through the use of appropriate materials, and the conception of projective green roofs on the existing buildings is allowed while ensuring their visual integration. Therefore, such surfaces may be included in the calculation of regulatory surfaces in accordance with article 13. Today, it is a question of going further by integrating the objectives of the new PCAET in a more concrete manner: increase of the number of buildings connected to the cooling network, systematic integration of a component in relation to summer comfort in thermal renovations.

These recommendations will be integrated in all of the urbanism documents, in addition to planning operations and innovative urban calls for proposals managed by the Direction of Urbanism. It is the subject of the study of a Planning Orientation and Programming for the climate, for which the project of deliberation 2019 DU 92 proposes the launch principle. Its elaboration would be included within the framework of modification or revision of the PLU to be launched in 2020, in order to make these objectives a legal obligation. The climate adaptation issue is as crucial as the attenuation of carbon emission. It is therefore proposed to orient the new measures depending on the territorial diagnosis of the heat islands and to act on the creation of green spaces on buildings and free spaces as a priority. The latter will need to be articulated with the issues of the green and blue infrastructure.

Some other orientations could also be developed in order to encourage the use of construction materials with strong inertia, or even the preferential recourse to collective air conditioning systems.

## COOLING BUILDINGS

There are more than 115 hectares of green roofs, walls, and facades in Paris. If the physiological and behavioral adaptation of people is primordial, comfort also depends on parameters regarding the inside of buildings: the temperature of the air, the building's walls, the speed of air and humidity. If it is not taken into account from the conception, the thermal management of the building can lead to a response that is energy-consuming, polluting and producing heat: self-contained air conditioning.



Parisian buildings also have some advantages regarding the subject of heat with many old buildings (55% of accommodations are located in buildings that were built before 1914), with important inertia and efficient natural ventilation systems. In order to improve comfort in the summer now while alleviating the climate change of tomorrow, it is imperative to plan work or living spaces that are naturally comfortable, that is to say bioclimatic, without turning to air conditioning.

For over a year, work has started to characterize the adaptation of buildings in the face of climate risks in Paris. Themed workshops are taking place as part of the Paris Action Climat (Paris Climate Action) plan.

One of them is about real estate and planning. Presented by the Observatoire de l'Immobilier Durable (Sustainable Real Estate Observatory), its purpose is to offer a frame of reference of real estate

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adapted to climate change and a tool to help with decisions by the end of 2019, by relying on a community of professionals in construction, tertiary real estate promotion, social lessors, planners, etc. When it comes to the summer comfort, this document will highlight passive solutions: bioclimatic conception, creation of green spaces, sun protection, light materials, efficient ventilation, and respect of the order of a cooling temperature of 26°C before triggering an ecological cooling system. **In the short term, the City of Paris will add a “summer comfort” section to all of the thermal renovation projects it manages or that require its authorization.**

In private accommodation, it relies on the Parisian Climate Agency to accompany the shared ownership properties in the renovation of these buildings. The **“Ecorénovons 2” plan will evolve towards a larger consideration of the summer comfort in the recommendations for building renovations**, which the thermal regulations skipped until now.

Concrete recommendations will be formulated for the shared ownership properties: the choice of materials used to insulate a roof (dense, bio-sourced, cellulose wadding or wood wool) in order to delay the propagation of heat in the accommodation; in case of renovation or façade restoration, the light-colored paints, the creation of green spaces, and more performant carpentry.

These elements accompany the usual recommendations: closing the blinds during the daytime, using economical devices and energy-saving lightbulbs, bringing freshness and shade with houseplants, ventilating in the evening and using fans to circulate the air during the daytime, and lastly, avoiding the use of self-contained air conditioning that release hot air into the atmosphere and are particularly energy-consuming and inefficient. The heat peaks in apartments are often shifted in relation to the street, the question of the pace of life (naps, work hours) is therefore complementary to any building response.

**In addition, the City and the lessors will study the possibility to cool down collective rooms in some residences thanks to equipment or planning to make true “cool rooms” out of them.**

**In public buildings and equipment as well as accommodations, the development of customary and passive solutions is a priority.**

The municipal patrimony will be assessed in 2019, which will enable the setting of priorities by 2020. Since 2018, a team of Energy Ambassadors accompanies the occupants of public buildings in their usages and better management of thermal comfort. They will contribute to the elaboration of this assessment. The deployment of thermometers as well as connected temperature probes

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will continue in the next few years. If these measures show a persistent discomfort, work on the building will be considered.

In priority, passive solutions: outside sun protections (wood blinds, louvered shutters), insulation of lofts or facades, installation of air circulators (fans with and without blades) or creation of green spaces on the roofs and facades.

Depending on the state of the building, these works will be completed with interventions to replace existing outside carpentries with ones providing better performances, a system able to be opened in presence of the public, or a system enabling safe and natural ventilation at night.

We will also consider the creation of one or more air extraction points, the installation of innovating solutions such as airflow windows (triple-glazed windows allowing ventilation with a natural regulation of temperature) that will be tested before the end of the year as part of an exemplary operation in Ivry Levasseur in the 13<sup>th</sup> district. We will study wind chimneys, the rainwater collection for the watering and cooling, and in some cases, we will propose to paint the facades and roofs in light colors in order to increase their albedo (while preserving the visual comfort patrimonial characteristics of Paris).

Specific work will be done on the cooling of outside spaces thanks to water, shade, the creation of green spaces and surface materials (following the example of the “oasis” courtyards program developed in schools and secondary schools). **A workgroup will be launched from 2019 with the Architectes des Bâtiments de France to address the patrimonial questions in regards to the summer comfort in Paris.**

**Depending on the buildings and in view of the climate evolutions, the summer overheating could persist despite these adjustments.**

In this case and if the inside temperature exceeds 26°C, in compliance with the recommendations of the ADEME, the recourse to cooling systems will be necessary. The connection to the collective cold distribution network will be studied as a priority, as well as the recourse to renewable energies or energy collection, in order to avoid the self-contained and individual modes of cold production as much as possible. All buildings will be concerned, notably the building with high energy performance (BBC,

passives, BEPOS) for which the lack of inertia and airtightness increase the heat in periods of overheating, which leads to the overconsumption of air conditioning. Some equipment for which the specific use demands it (servers, auditoriums, conservation of works of art or historic archives, a technical impossibility for the users to open the carpentry) could resort to these technical refreshing installations.

If a cooling system is installed, in accordance with the recommendation of the ADEME, the difference between outside and inside temperatures should not exceed 5°C to 7°C. It will then be a matter of experimenting with solutions such as Canadian wells, adiabatic cooling, aero-voltaic hot and cold sensors, gas absorption heat pumps, atomizers, geo cooling. Finally, it will be a matter of increasing the number of municipal buildings (new and restored) connected to the urban cooling network, in compliance with the objectives of the PCAET and the imperative of preservation and protection of specific use of equipment.

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This strategy will take into account the typologies of public equipment as well as referential standard scenarios to calculate depending on the current and future use (ex/ hours, number of days, month of the year, number of students per class, etc.), because of the increase in the shared use of public equipment. This will constitute a wonderful opportunity to reinforce the offer of outside and inside cooling islands (cool rooms), day and night, in order to welcome the people most vulnerable to high heat. **This real strategy for summer cooling within the municipal patrimony will be offered by 2020.** It will be divided into three parts: common practice, measures regarding the buildings and specific cooling solutions.

## DEVELOPING THE COOLING NETWORK

Since 1991, the City of Paris has put in place a delegation of public service for the production, transportation, storage and distribution of frigorific energy through an ice water urban network. This public service is confronted with two challenges today: the climate imbalance and its impacts on matters of public health leading to an increased demand for thermal comfort in the summer in Parisian buildings and the imperative of carbon neutrality in 2050.

Nationally, the air conditioning market shows a continuous increase (+8% in 2017), the consumption in Parisian stores doubled in 20 years, and the needs of cold will increase because of the climate imbalance and summery heat peaks, and a cold consumption of 3.5 to 4 TWh/year is projected by 2050, compared to 2 to 3 TWh/year today. Today's increase in this demand is seen in the development of individual and self-contained air conditioning and refreshing systems that are not very efficient nor performant. These systems send the

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heat back into the public space, emit greenhouse gas and pollutants into the atmosphere, while the cold network presents ecological performances (energy gain, water management, decrease in chemical products and risk of legionella, etc.).

In 2017, the cold network covers 456 GWh/year that is around 20% of the estimated consumption of tertiary buildings (offices, stores, public equipment, hotels...).

With the delegation of public service ending in 2021, the Parisian collectivity must define its strategic choices for the future of this public service: the synthesis between the climate emergency, the search for new users, the limited use of self-contained and individual air conditioning, and the taking into account of financial elements.

The development of the network constitutes a triple opportunity.

→ First of all, the existence of this network and its production and storage sites, the first in Europe, is a major asset. This network belongs to the collectivity and presents recognized advantages in relation to self-contained air conditioning systems, and high environmental and energy performances (output, valorization, ENR (renewable energy), reduction of the UHI).

→ Then, the concession's perimeter currently only covers 43% of the Parisian territory. Therefore, the extension of the perimeter to cover 100% of the Parisian territory constitutes an opportunity.

→ Lastly, the increase in the offer of the collective, public or private equipment, and public services induces a quality assurance despite the climate hazards. In addition, when the aforementioned customary or passive solutions are no longer enough in the equipment, especially if they host fragile and vulnerable people, their connection to the cold network will be a priority.

The concession of the cold network for which the deliberation 2019 DVD 70 proposes the renewal and envisages its development in line with the network's masterplan, in accordance with the PCAET's objectives, in a balanced manner and adapted to the needs of evolution. This way, the City of Paris is able to define a renewed strategy, as well as a desire of transparency and permanent communication with the elected individuals, associations and users, regarding the social, economic and environmental benefits of this network.

To succeed, three goals were set:

→ The first one is to propose an offer adapted to the public and users who do not have an efficient service at this time: public or private buildings hosting sick people (hospitals, medical centers, clinics)... The conditions to access the service and the price list applied to these specific uses will be carefully examined by the collectivity upon the renewal of the delegation of public service.

→ The second goal consists in looking for a model of development reinforced regarding the ecological performance. This way, the new production installations will have to meet the following expectations: evaluation of the needs of the buildings to connect taking account the simplicity and the alternative solutions, the diversification of the outlets for

the fatal heat inherent to the production of cold through the sharing of the works with the Parisian heat network or the non-potable water network, for example.

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The goal of 100% renewable energies in the energy mix will be maintained.  
→The third goal is to limit the equipment in self-contained and individual air conditioning. One of the concession's challenges consists of gaining a significant percentage of users of these solutions, through a commercial approach that is suitable with the needs of the territory. It is also a question of developing advice and instructions for current and future users in order to reduce the cold consumption, in compliance with the recommendations of the ADEME.

**In this context, and considering the positive assessment of the ongoing DSP and the Collectivity's objectives, the City of Paris proposes to renew the delegation of public service for a duration of 20 years for the future contract. It is the subject of the deliberation 2019 DVD 70 that is presented to you at this Council.**

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### III – IMPROVING THE GOVERNANCE OF THE TERRITORY TO RESPOND COLLECTIVELY TO THE EMERGENCY

#### THE CONTINUITY OF THE PUBLIC SERVICE IN CASE OF HEAT PEAKS

The increase in the frequency, duration, and intensity of the extreme heat calls for the adaptation of the mode of functioning of the administration in order to ensure the continuity of the public service.

Since 2004, the City of Paris has a guiding principle in regards to the organization of the services in case of a heatwave. Each year, a "heatwave briefcase" is elaborated in a collaborative manner by the different municipal directions precisising the particular measures. Its purpose is to provide each service with the tools to handle heatwaves, maintain the public service and protect the most fragile users. For example, as prevention, the services hosting young publics (daycares, schools) get prepared by obtaining fans (all schools will have them this summer), flasks, pitchers, thermometers and occulting curtains, blinds, wicker blinds, and shading fabrics in order to improve the summer comfort. The instructions of the Heatwave Plan and good reflexes are also transmitted to the parents.

In addition, the City of Paris will particularly continue to accompany its employees, notably those who work outside, in order to adapt the work conditions in case of activation of the level 3 Heatwave Plan. It is a matter of protecting people's health and safety at work, by increasing the time slot during which they can work, decreasing the uses generating heat (computers, strong lighting, cooking apparatus), revising the work

rhythm by including additional breaks, reducing prolonged efforts, proposing a cold restauration (the ASPP – administrative restaurants adapt its menus during heatwaves), favoring teamwork and avoid isolated work, reporting the difficult tasks to another day or during more favorable times of the day in regards to the climate, providing fresh water near the workstations or provide a cool room to the employees

**Paris could also draw inspiration from Japan where, in the summer, the “official dress codes” are revised**, in particular for men who traditionally have fewer options during the summer: civil servants and employees of private companies are encouraged to come to work without ties, jackets, and closed shoes and to favor short shirts, Bermuda shorts, moccasins or sandals. This leeway in the dress codes limits the need for cooling and therefore it limits the need for air conditioning!

## INVESTING IN THE URBAN COOLING

The City of Paris has a carbon neutrality objective for 2050 and wishes to align its actions on the objective of the Paris Agreement, by fully integrating the energy-climate challenge and in particular the adaptation to climate change into its budget and financial plan.

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In addition, **the investment programs of the next mandates will integrate a frame of reference regarding the adaptation to climate change and urban cooling to its objectives**. It is notably the objective of the application of the City of Paris for the integrated LIFE program: the "P.A.R.I.S 2026" project aims to solicit 10 million Euros in subventions from the European Commission for the implementation of the adaptation section of the PCAET and Paris' Resilience Strategy. If it is the laureate, this project, filed in the spring 2020 will enable the financing of pilot actions in the cooling domain, define the indicators to accompany the decisions and assess the actions' impact, and lastly, value the co-benefits of these actions in other domains such as health, and the decrease in vulnerability of infrastructures.

## SUPPORTING INNOVATION AND RESEARCH

In 2007, the City of Paris financed one of the first bursaries for international research regarding the understanding of the development of heat islands in an urban setting and the tools to decrease their impact. In 2011, the EPICEA (Multidisciplinary Study of the Climate Impact at the Conurbation Scale) project enabled the scientific demonstration and confirmation of positive relations between the presence of water, natural spaces, light materials, and urban cooling. These works combined with international exchanges that took place within the Cool Cities Network of the C40 enabled the acceleration of municipal choices in regards to the development of green spaces and the continuity to develop the islands and cool paths program.



In 2016, in order to bring innovative projects capable of bringing concrete responses regarding the heatwaves to the surface, the City of Paris joined forces with Paris&Co to launch a call for projects regarding the Adaptation to Climate Change, in partnership with ADEME, the Parisian Climate Agency, Eau de Paris (Paris Water) and the network of 100 Resilient Cities. This led to several experiments. Among them, the “Lisière d’une tierce forêt” project (Alterelia & Fieldwork Architecture), aims to fight against the UHI by decreasing the accumulation of heat in the ground and cooling the air by evapotranspiration (concentration of trees). More recently, the “Quartier d’innovation” of the Urban Lab allowed the experimentation of an urban canopy, a green corolla allowing cooling public spaces down and making them greener. In the framework of the call for proposal “FAIRE Design”, in partnership with the Pavillon de l’Arsenal, several laureates chose to take part in this challenge. For example, the AeroSeine project, a cooling vent connected to the Non-Potable Water network, has just been installed in the 20<sup>th</sup> district (Studio Isabelle Daeron),

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or even the “arbre de pluie” (rain tree) prototype, which allows a fun cooling of the public space (Sound Anything / Artists & Ingeniors / Immaters).

More recently, the public company Eau de Paris launched an open-innovation platform and a challenge dedicated to cooling down through drink and atomization. Among the laureate propositions, one will be tested this year in the 4<sup>th</sup> and 8<sup>th</sup> districts, and a second one in spring 2020. The first one proposes low-pressure atomization and drink, and the second furniture providing seats, drinks, and high-pressure atomization fed by a solar panel. The whole of these challenges and calls for proposals allows the testing of solutions, their use, their cooling impact, their cost, etc., before generalizing them on the territory. **The City will ensure to support young companies as part of experimentation partnerships in order to test some new solutions to adapt to high heats.**

In order to assess the impact and efficiency of these experimental or permanent solutions, the City builds partnerships with the academic and scientific sectors. As part of CIFRE thesis, the analysis of thermal behaviors of materials is done in partnership with the Laboratoire Interdisciplinaire des Energies de Demain (LIED) of the University Paris-Diderot.

To assess its different “urban cooling” projects, the City invested in fixed weather stations, allowing longitudinal measures, and the LIED leads thermal walks on site. Météo France, l’Atelier Parisien d’Urbanisme (the Parisian Urbanism Workshop), the Ecole des Ingenieurs de la Ville de Paris (School of Engineering of the City of Paris), the Agence Parisienne du Climat (Parisian Climate Agency) and Santé Publique France (Public Health France) accompany the process of characterization, evaluation and mapping of the islands and cool paths. Some projects, such as the “oasis” courtyards or the “resilient” street, are the subject of global evaluation. For example, the “oasis”



courtyard program is evaluated by a multidisciplinary team of Météo France, the LIED, and Sciences Po, as well as internal experts, in order to take into account all of the physical, sociologic and ecosystemic parameters of the proposed solutions.

## SHARING THE GOOD PRACTICE WITH THE ACTORS OF THE TERRITORY, AND OTHER COLLECTIVITIES.

Thanks to the Paris Action Climat (Paris Action Climate) charter, the City creates synergies with the private signatories who wish to orient their practices in the direction of the objectives of the PCAET. During multi annual themed meetings, they build a true network of involved actors, who discuss the good practices and forge tighter links with the collectivity. It is notably through such a network that the tertiary sector, the main consumer of self-contained air conditioning, can be mobilized in the fight against the UHI, contributing to the reinforcement of the green infrastructure on its premises, renovate it and improve thermal insulation.

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Within this framework, and in partnership with the Agence Parisienne du Climat (Parisian Climate Agency) and the Observatoire de l'Immobilier Durable (Sustainable Property Observatory), the City also reunited the actors of planning and of the Sustainable Property, building, renovation and building management professionals, following the example of Amundi Immobilier, Bouygues Immobilier, Covivio, FFB Grand Paris, Poste Immo, SEMPariSeine, etc. On June 24, 2019, these actors were reunited at the Pavillon de l'Arsenal and shared their cooling solutions for buildings. In order to define the success indicators of these actions, and to develop tracking tools, the City regularly exchange with expert organizations: ADEME, AFD, CDC, Institute for Climate Economics, I-Care, Energy Cities, The Institut d'Études Avancées (Advanced Studies Institute), etc.

This knowledge, this network of actors and this experience make Paris a pioneer city in the field of adaptation to climate change and of urban cooling in particular. By exchanging its good practices, its expertise and its tools with the surrounding territories within the Metropole du Grand Paris (Greater Paris Metropole), national and international networks, Paris will continue to improve its responses to the challenges of the XXIst century.

This sustained agenda, just like the imperatives we are confronted to in order to reinforce Paris' resilience, is already carried and will continue to mobilize the whole of the municipal directions in the coming months, for the service of Parisians.

For more information, go to [paris.fr](https://paris.fr)!

## CAPTIONS OF IMAGES IN THIS DOCUMENT

### **PAGE 10**

Top: Interface of the Extrema application.

Bottom: “Oasis” courtyard, Daumesnil preschool (12<sup>th</sup>), Charles Hermite preschool (18<sup>th</sup>) and Riblette school (20<sup>th</sup>)

### **PAGE 12**

Top: Planning project for rue Blanchard (20<sup>th</sup>)

Bottom: “Urban forest” project, Hotel de Ville square (4<sup>th</sup>).

### **PAGE 13**

Top: Authorization to create green spaces: distribution and poster.

Bottom: Bathing in Seine - projections

### **PAGE 14**

Left: Fountains connectable to fire hydrants. Eau de Paris.

Right: 2 in 1 Fountains laureate of the innovation challenge. Eau de Paris.

### **PAGE 15**

Performance of the “Cool & Low Noise Asphalt” coating.

### **PAGE 16**

Planning projects for the seven Parisian places.

### **PAGE 19**

Realization of a green wall (18<sup>th</sup>).

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PARIS COLD URBAN NETWORK

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“Lisière d’une tierce forêt” project – Alteralia & Fieldwork Architecture