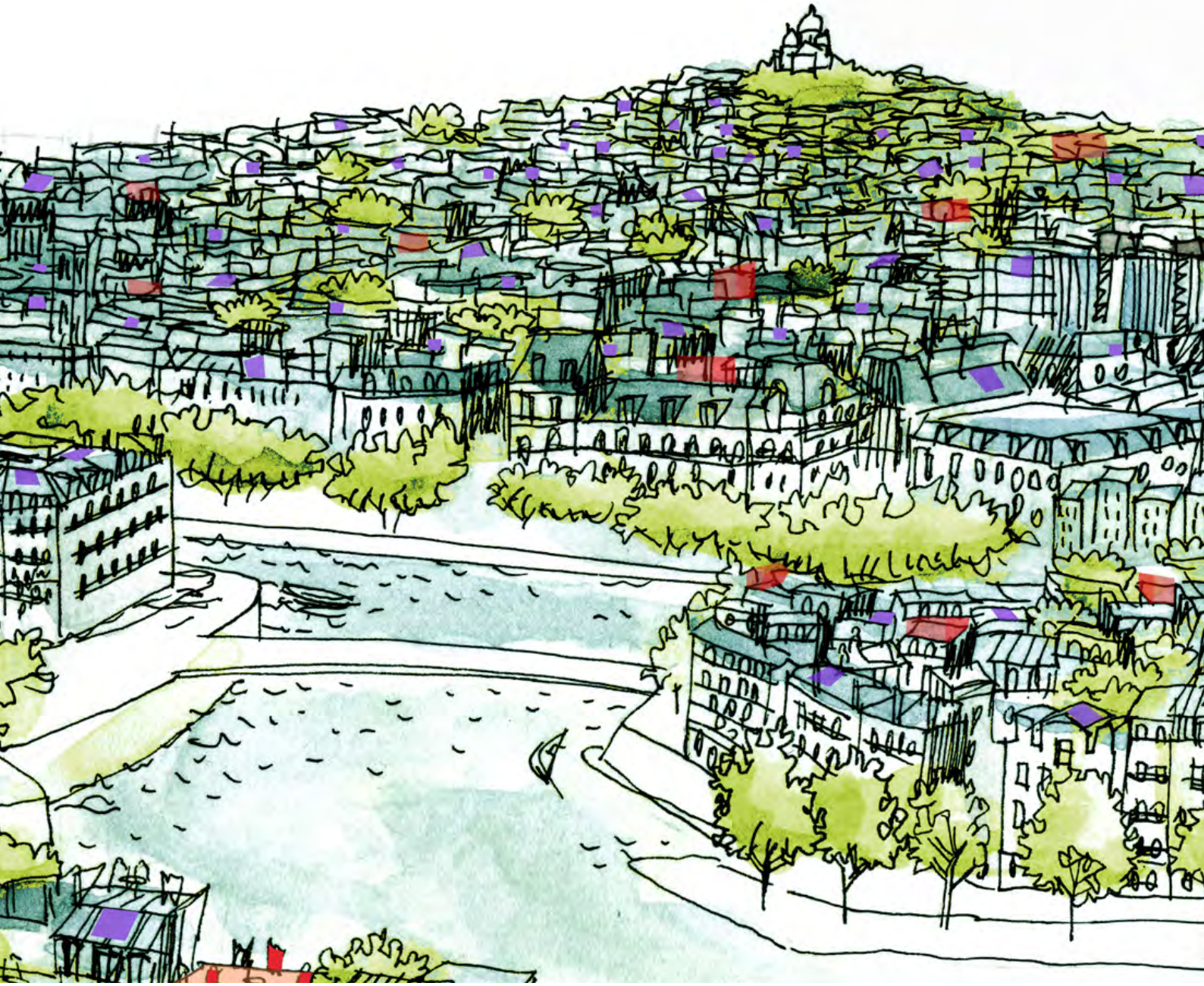
PARIS, AN AIR OF CHANGE

Towards carbon neutrality in 2050

Comprehensive report



elioth egis conseil QUATTROLIBRI BUILDING GREEN BUSINESSES MANA

MAIRIE DE PARIS

Study commissioned by the City of Paris as part of its reflections on the construction of a carbon-neutral city.



PREAMBLE

This document is a contribution by the Elioth consortium (with Quattrolibri, Mana and Egis Conseil) to the preparation of the City of Paris's strategy to achieve carbon neutrality by 2050. This study is designed to be a contribution to the debate: the measures it contains are proposed purely for guidance and commit only the members of the consortium. The actions and strategies described correspond to a body or package of actions that can be considered as describing one carbon neutrality strategy: politicians and citizens will surely propose many others.

With humility, what we are delivering is not a bible, but more of an Aladdin's cave: a source bubbling with opportunities, challenges, questions, innovations, different trajectories, ideas and stories.

The scale of the task explains the number of pages in this report: we have explored the ramifications of achieving the goal of carbon neutrality in 34 years, which spread into all the areas of human activity, housing transport, energy of course, but also waste, food, culture and leisure, business models, agricultural systems and biodiversity.

The issues dealt with in this report go far beyond the scope of the powers of the City of Paris authority: the issues around food, for example, raise challenges relating to land use planning and the redeployment of farms well beyond the boundaries of Paris itself, affecting places and business models over which the City has no authority. Therein lies the challenge of the mobilisation around the goal of carbon neutrality. Although it is to Inner Paris that the different sources of emissions aggregated in our calculations are attached, the solutions that need to be found will have ramifications that are much more widespread.

Producing this carbon neutrality strategy has involved a large amount of specialised technical and scientific work to arrive at both objective mitigation trajectories for each issue and the modelling of the changes in carbon emissions offsetting and capture and storage. This version of the report includes little detail about the important work of modelling and simulating trajectories carried out using the «R» software. The outputs from the model used are available in digital form. We are convinced that our model will be a useful instrument for testing other scenarios, estimating in more detail the sensitivity of other parameters and providing a long-term simulation model for the next few years.

The report covers the «story» of carbon neutrality in several thematic, sociological, chronological and political and then expert forms in the methodological note:

- Section 1 (the challenge) and Section 2 (the Paris 2050 vision) are intended in particular for specialists in local action, elected officials, technicians, future analysts, climate policy specialists or organisations providing public services (water, electricity, transport, etc.);

- The themed stories in Section 3 (all about carbon neutrality, 3.1) are intended for professionals in the different areas, as well as experts, consultants and urban planners;

- The sociological stories (3.2) are intended for the general reader: in this section, you will no doubt recognise yourself in one of the 18 characters described; you will then be able to refer to the description of the measures by theme to find out more about the different stages in the story;

- The conclusion is open to any reader and contains a wide-ranging set of milestones for the process of implementing the key measures in the transition.

Our conclusion is unambiguous: achieving carbon neutrality is within our reach. The prospect of doing so justifies all the energy and vitality of our recommendations, but also the radical nature of some of them. We emphasise, through the story of the families, the huge diversity of individual trajectories, which added together will shape Parisians' emissions in the future. This document is an invitation to produce many different spin-offs from it: a television series, a digital simulator, theatre plays, investment funds, political conferences, neighbourhood consultations.

On behalf of the consortium

Raphaël Ménard, Elioth

Julien Dossier, Quattrolibri





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INTRODUCTION

INTRODUCTION

Paris has set itself the goal of achieving carbon neutrality by 2050, with an important interim milestone set for 2030.

In 2016, as the Paris Agreement comes into effect, and as Paris takes over tenure as Chair of C40, Paris is already entering a new era. Paris intends to radically change the impact of Parisians' lifestyle on the climate, whilst carrying the whole metropolitan area with it in the dynamics of change.

In line with the commitments made at the COP21 in 2015, this report sets out the strategies for achieving the following ambitions: to reduce the City of Paris's greenhouse gas emissions by 80% by 2050 and to develop a carbon neutral model. As a pioneer in the field, the City of Paris has set itself a set a course full of hope in the face of the climate emergency, centred on four themes:

1) **An energy transition for the metropolitan area** via a massive reduction in energy demand and a massive reduction in the use of fossil fuels. A regional transition that will create local jobs, a dynamic that will catalyse the setting up of new-generation energy loops, as well as renewed partnerships with rural authorities to go beyond the target of 100% renewable energies.

2) **Low-carbon buildings, better insulated and consuming less energy**, massively using renewable energies. A built fabric and public spaces that take account of biodiversity, plant life and water in the city environment, whilst respecting the built heritage. Buildings prepared to cope with the vagaries of the climate, that are pleasant to live in and meet the most ambitious of objectives in terms of very low-carbon construction or renovation.

3) **Clean transport:** a quieter city without the constant hum of traffic. Considerably improved air quality and a decisive drop in polluting emissions. And above all, the more pleasurable experience shared, soft modes of mobility offer citizens.

4) **Raising citizens' awareness of the implications of their consumption choices on their carbon footprint**. For example, by eating less meat, more seasonal food produced locally by an agriculture that respects the soil and ecosystems, by making responsible choices when purchasing consumer goods and by prioritising local loops that help to sustain the metropolitan circular economy.

The goal of carbon neutrality by 2050 lays a path over 34 years, punctuated by milestones, each of them preparing the next one and serving to adjust the measures included in the stages to come based on the results achieved in the previous stages, in particular with regard to the economic and social context. **34 years is shorter than it might seem: it is the current electoral term plus five others**, a shorter period than has passed since the election of François Mitterrand in 1981!

So here is a trajectory, that of a strategy that we hope will appear as desirable, one that will enable us to reshape metropolitan lifestyles into something more sustainable, whilst reasserting the importance of the links between areas.

The City will catalyse actions that are not directly within its remit: an example would be the carbon footprint of food choices, which is mainly dependent on the public's awareness of the issues. This is why we have chosen to present scenarios seen from the point of view of the city's inhabitants: reducing emissions to nil will be the sum of a diverse range of individual trajectories.

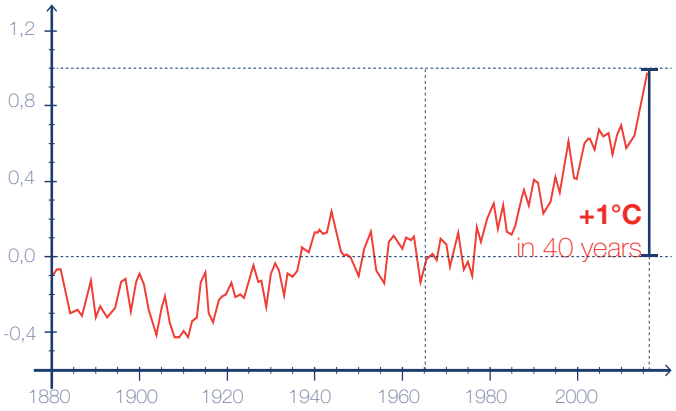
This is of course a collective project that cannot be seen in isolation, rather only in terms based on solidarity, both at metropolitan level and at national level and even at continental and global level. Adapting to climate change, the issues relating to resilience, anticipating climate-induced migration will be essential markers in this strategy. **Carbon neutrality can also be driving force to work towards a blueprint for a new society**, a project that four million hands will be involved in, which will overturn certain practices whilst reinforcing others, a project that will be the fruit of the creativity and inventiveness, but also the generosity of the people of Paris.

Let's begin with an air of change!



1/ THE CHALLENGE

THE CLIMATE STATE OF EMERGENCY



Mean global temperatures compared to the mean for 1880-1920
according to James Hansen and Makiko Sato

CHALLENGE 1: URGENCY AND DURATION

The climate state of emergency requires both short-term crisis management and a management mechanism for the long term.
In the short term, the issue is the race to achieve carbon neutrality. The faster we act, the higher the likelihood of keeping global warming below 2ºC.
In the medium term, it is necessary to plan the transition and its deployment over the 34-year period (i.e. this parliamentary term and the next five).
In the long term, a project for a fossil-free post-2050 will also have to emerge.


Seine high water, June 2016
©WillG75

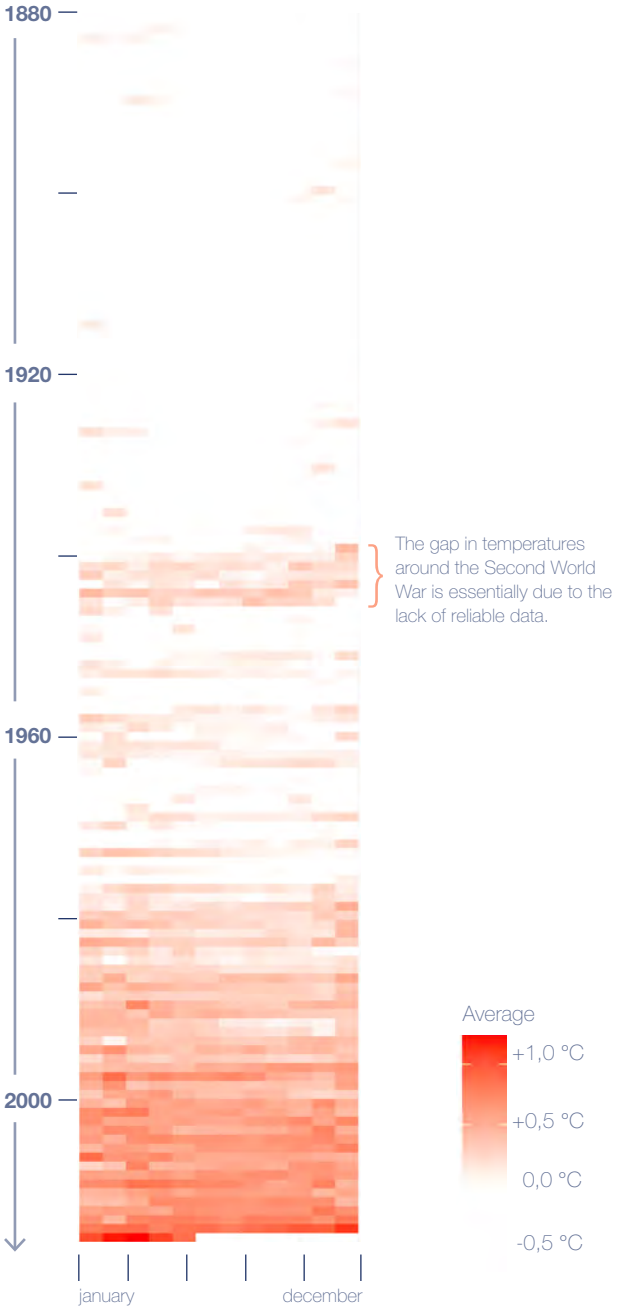
CHALLENGE 2: ENTERING A NEW ERA

Carbon neutrality implies leaving the fossil fuel era behind, an enterprise that will have consequences for every area of human activity: transport, construction, food supplies, energy, industrial production.
We are not without solutions - it is possible to attain this goal.
34 years' time - this is the **near future**, and yet it is a very **different future** that is taking shape: with more frugal, more efficient production, cleaner air, more local exchanges based on more solidarity, a more resilient society.
It is a **reasonable and rational project, a collective one that can unify the people of Paris**, businesses and the public authorities.


Drought in Haute Marne, June 2011
© Isl@m - wikimedia commons

CHALLENGE 3: THE MOBILISATION OF CITIES

Cities are on the front line.
They produce the most emissions. The world's cities contain more than half its population and environmental footprint is disproportionate to their surface area. If we changed nothing, it would be necessary to cover 5% of France with forests to neutralise Paris's carbon footprint!
But it is cities and their populations that can **mobilise, that can implement the solutions, that can overcome the obstacles** and objections and show that it is possible to rise to these challenges and inspire hope



August 2016 is the **380th consecutive month** to exceed the mean temperatures of the 20th century.
For the **15th year in a row**, August was the hottest month on record since 1880.
15 of the 16 hottest years since records began in 1880 have occurred since 2001.

There is no chance of these sequences being natural, unaffected by human activity.

THE ESSENTIALS

Global warming is happening and it is human-induced. Its consequences call for large-scale mobilisation: the **climate state of emergency**.

In 2016, the concentration of greenhouses gases in the atmosphere exceeds 400 ppm and the resulting rise in temperatures has already reached +1.3°C compared to 1880.

The Paris Agreement signed at COP21 and ratified in 2016 sets a **goal of not exceeding 1.5°C** and, above all, of keeping the 2°C above pre-industrial levels by 2100.

At the current rate of increase, the 1.5°C target will be passed in 2030 and that of 2°C will be passed in 2050.

Alarm bells are ringing everywhere: runaway climate change demands that we speed up the pace at which we reduce our emissions.

Now. It is still possible to act.
Massively. We have solutions.
Globally. Our partners are mobilised.

Rob Hopkins
Lecturer on permaculture, founder of the *Transition Network*, writer

To be really capable of acting on climate change, we urgently have to start moving towards a more local and resilient economy. Also, as the European Economic and Social Committee recently emphasised, we have to recognise that the Paris Agreement on climate change that came out of COP 21, will be implemented not by the COP negotiators, but by civil society.



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Matthieu Auzanneau, Director of the Shift Project, a think-tank specialised in the carbon transition and author of *Black Gold, the Great History of Gold* (La Découverte, 2015), guest blogger at Le Monde newspaper, «Oil Man, Chroniques du début de la fin du pétrole»

«A city like Paris with no CO_2 emissions? A flight of fancy, a utopian idea! Yes, but the challenge set by the Paris Agreement on climate change requires us to transform that utopian idea into a coherent policy.

It is up to our generation to invent the post-carbon world. And that process is a new lease of life Paris can offer the world, a road that France and Europe must pave if we are to prevent the ruin of living conditions on Earth.»

1.1 / THE CLIMATE STATE OF EMERGENCY

IN A NUTSHELL

Global warming is happening and its consequences are already serious enough, including for Paris, to justify large-scale mobilisation: a climate state of emergency.
This state of climate emergency means that we have to manage a limited carbon budget to ensure that we do not exceed an emissions threshold and thereby maintain a probability higher than 66% of not exceeding a global temperature rise of 2°C, which is the critical threshold above which runaway climate change is considered as out of control.

1.1.1/ THE CLIMATE CHANGE MECHANISM AND ITS SCALE

Climate change is human-induced[1], mainly caused by the extraction and combustion of fossil hydrocarbons and amplified by intensive agricultural practices. The gases resulting from these activities which cannot be absorbed by natural ecosystems (oceans, soil, forests) will be stored in the atmosphere for several generations. The accumulation of these gases in the atmosphere modifies its role as a thermal regulator for the planet: they block out a part of the solar radiation reflected back by the planet, which contributes to warming the atmosphere, the oceans and the emerged lands, and to modifying the water cycle at global level. The accumulation of greenhouse gases in the atmosphere is measured in ppm (parts per million), with a reference threshold of 280 ppm for the pre-industrial era. 2016 saw concentrations exceed the 400 ppm threshold at every site on the planet where measurements are taken.

The result is a planet that was 0.98°C warmer in 2015 than the mean temperature for 1951-1980 and 1.3°C warmer than in 1850. In 2016, global warming is expected to be between +0.92 and +1.14°C[2].

To find out more on the subject of this section, see the IPCC's Fifth Assessment Report on the climate, which details the different interactions between the consequences of climate change[3].

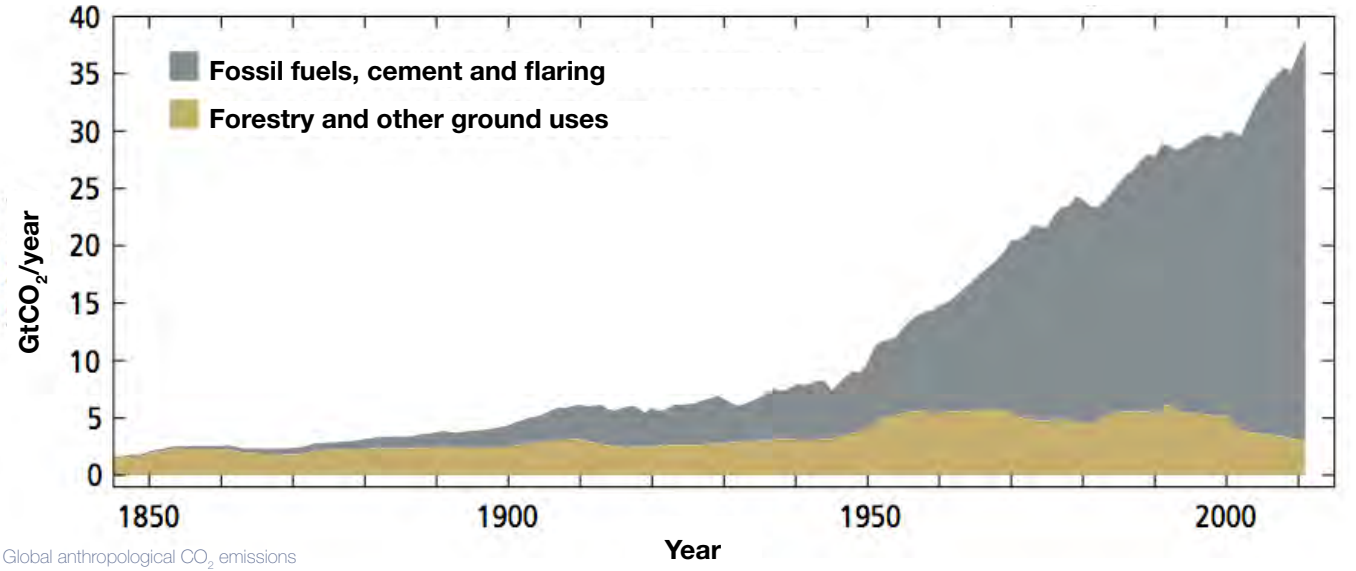
1.1.2/ CONSEQUENCES OF CLIMATE CHANGE

The first group of consequences concerns the rise in temperature.

The melting of glaciers, the Arctic and Antarctic sea ice and the Greenland ice sheet are the most obvious signs of climate change. These changes then amplify the rise in temperatures in return: white ice is replaced by darker surfaces - ocean, rocks - which absorb more of the sun's heat. The water released by the melting glaciers in the Antarctic and Greenland flows into the oceans causing the sea level to rise, amplifying the dilation of the liquid surfaces induced by the rise in temperatures. In 2016, the mean sea level was 19 cm higher than in the pre-industrial era, while the melting of all the ice in Greenland over several centuries alone would lead to a 7 m rise in sea level.

Although this would be disastrous for low-lying areas of the world (Pacific atolls, Florida…) the rise in sea level is not the most critical factor in global warming in the short term (its irreversible nature means that it is a major risk factor in the long term). It is the modification of the water cycle that is affecting emerged lands to a much greater effect, as of now.

The second group of consequences relates to extreme climate events with a direct impact on human activities.



Global anthropological CO_2 emissions
Source : GIEC's 5th rapport

[1] cf. IPPC (Intergovernmental Panel on Climate Change) mandated by the United Nations Framework Convention on Climate Change (UNFCC)), which served as a reference for the Paris Agreement signed at COP21, 2015 [online], *http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_fr.pdf*

[2] World Meteorological Organization, Extraordinary global heat continues, 2016, [online] http://public.wmo.int/en/media/news/extraordinary-global-heat-continues

[3] 5th IPCC report

More frequent droughts and heat waves on emerged land lead to evaporation of the moisture in the soil and lower absorption of precipitation, precipitation that in turn becomes more intense – the accumulation of heat in the oceans triggering hurricanes and tropical storms. These events affect not only coastal regions, but also the catchment basins of major rivers, the most densely populated zones on emerged lands. These events reduce the productive capacity of agricultural land: drying of crops, destruction of forests and extensive pastures, acidification of the soil, increased salinity of groundwater, etc. The historic drought that affected Syria between 2007 and 2010 displaced 1.5 million people, first towards Syrian cities (which were therefore faced with a massive population influx of over 50% in less than 8 years), then outside Syria following the regime's repression of the civil rights movements from 2011 onwards[4].

The temperature increases are particularly extreme in the Gulf states. Peaks over 50°C are now recurrent,[5] and they will be the norm by 2050, which suggests that the region will become uninhabitable[6]. Tens of thousands of people will have to leave in the short term (for total populations of 31 million in Saudi Arabia, 78 million in Iran, 91 million in Egypt, to mention only the countries with the biggest populations).[7]

In the short term, it is mankind's ability to feed itself that is at stake, and already it is leading to famines, wars and mass population migration.

The third group of consequences concerns the water cycle.

On the one hand, the oceans are becoming acidic beyond their capacity to absorb CO_2. This acidity impacts on the formation of the shells and carapaces of crustaceans, the smallest species of which are at the base of the food chain of numerous halieutic resources.
On the other hand, ocean currents are changing under the dual effect of the polar ice melting (which leads to a change in the salt content of the surface waters, which modifies both surface currents and deep currents) and warming, which is particularly pronounced at the Poles (a temperature of +0.7°C was recorded at the North Pole on 30 December 2015, 23°C higher than the mean temperature)[8], which modifies the heat exchanges. Ocean currents are essential vectors of the reproduction and regulation of marine species.

Finally, the rise in atmospheric temperatures causes an increase in the temperature of the surface waters and therefore the dilation of the oceans, and consequently a growing phenomenon of submergence of the lowest-lying coastal areas, whilst evaporation becomes more intense, aggravating the frequency, severity and impact of hurricanes and storms.

The changes to the ocean cycle, coupled with the overexploitation of most commercial marine species, are leading to a fall in the production of halieutic resources and to extreme climate events.

Coastal populations are particularly badly affected: 44% of the world's population lived less than 150 km from a coast in 2010, including 625 million people who lived in low-lying coastal zones, i.e. at altitudes of less than 10 m.[9]

[4] KELLEYA Colin P., MOHTADIB Shahrzad, CANEC Mark A., SEAGERC Richard and KUSHNIRC Yochanan, *Climate change in the Fertile Crescent and implications of the recent Syrian drought,* 2015, [online], *http://www.pnas.org/content/112/11/3241.full?sid=f2963fc5-195b-4a4a-90c7-500540322339*

[5] PAL Jeremy S. and ELTAHIR Elfatih A. B., Future temperature in south-west Asia projected to exceed a threshold for human adaptability, 2015, [online], *http://nature.com/articles/doi:10.1038/nclimate2833*

[6] ibid.

[7] The World Bank, Population total data - Egypt, [online] *http://data.worldbank.org/indicator/SP.POP.TOTL?locations=EG*

[8] National Snow & Ice Data Center, *Arctic Sea Ice News & Analysis, 2015 in review,* 2016, [en ligne], http://nsidc.org/arcticseaicenews/2016/01/2015-in-review/

[9] Sustainable development knowledge platform, [online], *http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/oceans_seas_coasts/pop_coastal_areas.pdf et http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118571*

1.1.3/ INTERACTION WITH HUMAN ACTIVITIES

In the short term, agriculture and fishing are the human activities that are hit the hardest by climate change.

We can already measure the severity of these impacts, which will be amplified by the rise in temperatures (inevitable, for physical reasons) concomitant with the increase in population (likely, for demographic reasons) over the rest of the century.
The consequences – direct and indirect - of climate change are amplified by their impact on human activities, as these in return aggravate the effects of climate change.

The loss of arable lands, due in particular to drought or flooding and submergence, leads to a need to cultivate other areas, and therefore to deforestation.

Deforestation by humans to gain more agricultural land, in particular for livestock farming, induces an emission factor: immediate release of greenhouses gases (GHGs) by fires (this is what makes Indonesia the 5th largest emitter in the world, due to massive deforestation)[10], subsequent emissions due to intensive exploitation of the soil (a phenomenon particularly visible in Brazil, where deforestation has created huge spaces given over to cattle ranching, a high-emission activity that is responsible for 50% of the country's emissions).[11]

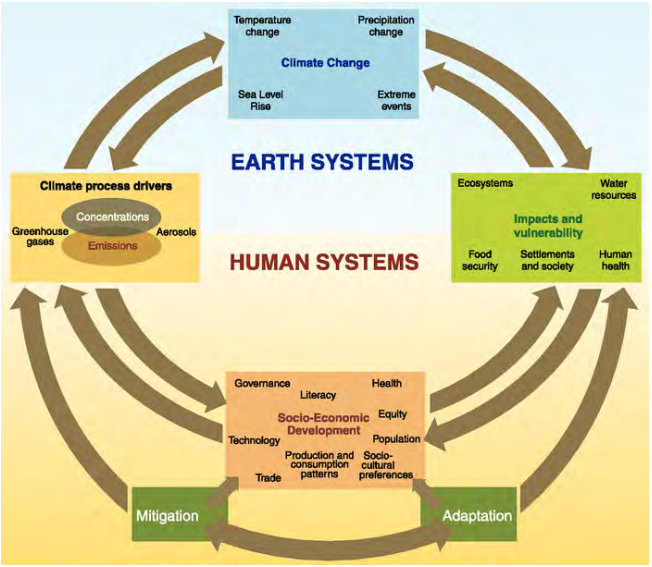


Illustration : Représentation schématique des facteurs humains de l'évolution du climat, des effets sur le changement climatique et des réponses apportées, ainsi que de leurs corrélations.
Source : Intergovernmental Panel on Climate Change (IPCC), https://www.ipcc.ch/publications_and_data/ar4/syr/fr/fig/figure-i-1.jpeg

[10] World Resources Institute, *Forests and Landscapes in Indonesia*, [online] *http://www.wri.org/our-work/project/forests-and-landscapes-indonesia/climate-change-indonesia*
[11] BUTLER Rhett, *Amazon cattle ranching accounts for half of Brazil's CO_2 emissions*, 2009, [online] *http://www.amazonrainforestnews.com/2009/12/amazon-cattle-ranching-accounts-for.html*

The urbanisation of populations, caused in particular by the collapse of local ecosystems (cf. historic drought in Syria) and the loss of food crops in rural areas, is accompanied by changes in diet, changes that are all the more significant as they are sustained by the globalisation of Western practices, leading to a greater proportion of meat in diets, and therefore more pressure on the soil to produce the vegetable proteins necessary to livestock farming (which represents a ratio of 1 to 7 between the surfaces necessary for a vegetarian diet and those necessary for a meat-based diet).

The growing distance between lands producing food for human consumption and the zones where it is consumed increases the distances over which food produce must be transported, distances which today are covered by carbon-emitting modes of transport, which therefore also contribute to greenhouse gas emissions.

The poorest populations are the most exposed to the effects of climate change and therefore the most vulnerable, with no safety net, and so the most likely to become refugees or IDPs (Internally Displaced Persons).

1.1.4/ GLOBAL WARMING AND BIODIVERSITY: A VICIOUS CIRCLE

The effects of climate change weaken ecosystems and contribute to deteriorating their mechanisms:

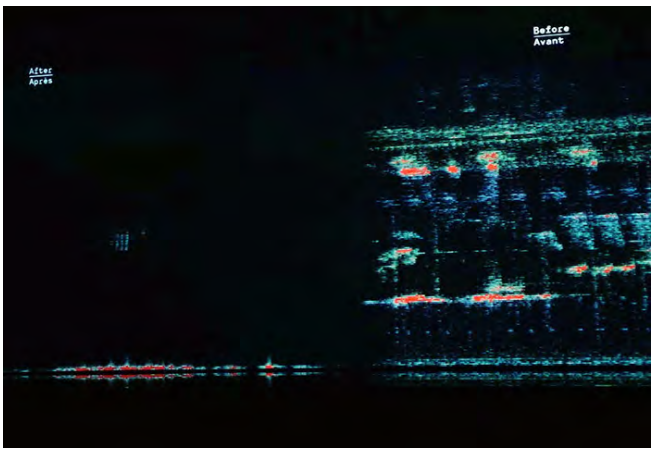
Periods of drought and heat waves weaken forests, causing them to lose their capacity to absorb and fix carbon and even to release the carbon stored in them during forest fires (a forest fire such as the Fort McMurray fire in Canada represents 85 million tonnes of CO_2eq, to be compared to total of 732 million tonnes of CO_2eq for Canada).[12] The thawing of the ground at the Poles releases not only the methane stored in them, but also bacteria and viruses (such as anthrax), leading not only to a further accumulation of greenhouse gases, but also to major risks to human health and the ecosystems we depend on, whilst also rendering unstable the human infrastructures that have been built (villages, roads, pipelines, etc.).
The changes in ocean currents, coupled with uncontrolled overfishing, lead to an expansion of predator species (jellyfish) or algae, which reduce the amount of oxygen available in the oceans (cf. phenomena on the South American Pacific coasts, in Greenland, on the coasts of Oman or Florida).[13]

The gravity of the effects induced by the consequences of climate change are measured by the scale of the loss of biodiversity, a loss that is all the more spectacular for also being accelerated by human activities.

The combination of the direct and indirect effects of climate change and human activities explains the fact that the Earth is entering the 6th mass extinction phase. Deforestation and artificial land use aggravate the loss or destruction of species' habitats, a phenomenon that primarily affects amphibians. Species are disappearing at a rate not seen since the disappearance of the dinosaurs, with 10% of known species having become extinct in the last 20 years and 38% of species currently being considered at risk of extinction.[14] The "Soundscape" recordings made by Bernie Krause (see photo of his installation opposite) are particularly illustrative, for both marine and terrestrial recordings. Bernie Krause has recorded the sounds of nature in the same spots at intervals of several years. This enables him to measure the extinction of species by the disappearance of sounds, and even the silence that sometimes replaces the concert of animals.

The loss of biodiversity is being worsened by dietary practices that concentrate production on a reduced number of varieties to meet the specifications of the large-volume buyers, themselves dictated by the centralised production units of the food industry. The loss of indigenous varieties in turn means a loss of genetic diversity and therefore of resilience in the face of bacterial attacks, predatory insects or extreme climate episodes: indeed drought-resistant varieties have deeper roots and therefore longer growing times and lower yields than the fast-growing varieties currently preferred by the food industry. The loss of biodiversity, amplified by the loss of hedgerows and auxiliary habitats, increases the vulnerability of crop species even more.

The result of these agricultural practices and drought episodes can, at local level, lead to the loss of the arable topsoil ("dust bowl" effect), a loss which is doubly critical from the climate point of view: first, the topsoil provides the gaseous interface with the atmosphere and is no longer able to capture and store the gases emitted, and second, the time needed to replace and reconstitute the arable layer is very long, thereby reducing the margin of manoeuvre for mitigation and adaptation measures accordingly.



The image shows the recordings of various songs/sounds of different species. The zones to the left shows the loss of biodiversity: the species have disappeared, their songs are dead.
Recorded on the peninsula of OSA (Costa Rica in 1989 on the right and in 1996 on the left)
source : The Creator Project, http://thecreatorsproject.vice.com/en_uk/blog/listen-to-extinct-habitats-preserved-by-an-ex-hollywood-composer

[12] MOONEY Chris, *The Fort McMurray fire's stunning pulse of carbon to the atmosphere*, 2016
[13] Welch Craig, *Ocean Slime Spreading Quickly Across the Earth*, 2016, [online] *http://news.nationalgeographic.com/2016/08/toxic-algae/*
[14] Center for Biological Diversity, The extinction crisis, [online] *http://www.biologicaldiversity.org/programs/biodiversity/elements_of_biodiversity/extinction_crisis/*

1.1.5/ FROM THE VULNERABILITY OF ECOSYSTEMS TO THEIR COLLAPSE

In addition to the seriousness of the effects induced by the direct and indirect consequences of climate change amplified by other human activities, **the abrupt acceleration of climate phenomena could push to their collapse certain ecosystems which haven't had time to adapt**.

93% of the Great Barrier Reef in Australia is affected by coral bleaching, which scientists believe is irreversible in at last 22% of cases, and 36% of the world's coral reefs are affected by severe bleaching[15]; in addition to the disappearance of the coral, it is the entire ecosystem their presence maintains that is threatened (25% of marine species depend on coral reefs), and consequently the livelihood of some 500 million people is at stake.

The first species to migrate on earth are bacteria, viruses, fungi and insects, which proliferate all the more in the new environments when these are left fragile by climate events and the loss of biodiversity.
Trees are therefore on the front line: it is trees that move the most slowly, and become vulnerable to bacterial and insect attacks when subject to water stress. Their vulnerability is further amplified by the rapid disappearance of bees and pollinators, accelerated by the effects of agrochemicals (especially neonicotinoids)[16], coupled with the spread of insect pests (varroa mite, Asian hornet).

The migration northwards of the processionary caterpillar has reached the forests of the Paris basin[17], forests which are needed to absorb a part of local emissions and to be capable of counterbalancing the urban heat island effect.[18] Likewise, ash trees are being attacked by a fungus (chalara fraxinea) which causes the leaves to redden and then drop off[19], whilst the plane trees along the famous Canal du Midi are falling victim to a fungus called canker stain disease[20], which is complicated if not impossible to treat.

Not to mention the destruction of habitats and ecosystems, whose collapse can also be the result of a disruption in the water cycle induced by climate change. All that is needed is a series of climate episodes that disrupt the process of flowering, pollination and fructification for a crop to be wiped out. This is how three quarters of the vineyards in Bourgueil, and half of the vineyards in Indre et Loire lost all their production in 2016 - as a result of a sequence of climatic calamities "never seen before by winegrowers": frosts in April halted flowering; the intense rain (100 mm in May and as much again in June) that followed interfered with pollination of the few flowers that had survived; a lack of rain in July, following by a heatwave and sunscald had a disastrous effect on production.

The loss of biodiversity thus chips away at the three elements that are most instrumental in absorbing greenhouse gas emissions: firstly, the oceans (71% of the Earth's surface), then the forests and finally the soil. In some cases, the impact is even doubly negative, when the "carbon sink" becomes a source of emissions (forest fires, etc.).

[15] Climate Council, *Australia's Coral Reefs under threat from climate change*, 2016 [online] *http://www.globalcoralbleaching.org/wp-content/uploads/2016/05/Australias-Coral-Reefs-Under-Threat-From-Climate-Change.pdf*

[16] BOTÍAS Cristina, DAVID Arthur, HORWOOD Julia, ABDUL-SADA Alaa, NICHOLLS Elizabeth, HILL Elizabeth et GOULSON Dave, *Neonicotinoid Residues in Wildflowers, a Potential Route of Chronic Exposure for Bees*, 2015, [online] *http://pubs.acs.org/doi/abs/10.1021/acs.est.5b03459*

[17] French Ministry of the Environment, Energy and the Sea *Front d'expansion de la chenille processionnaire du pin*, 2015, [online] *http://www.developpement-durable.gouv.fr/Front-d-expansion-de-la-chenille.html*

[18] CIESLA Willima M. study for the FAO, *Le Climate Change, Forests and Forest Management: An Overview.* - Chapter 8 - The role of forests in mitigating the effects of climate change, 1997, [online] *http://www.fao.org/docrep/v5240f/v5240f0c.htm*

[19] Ouest France, *Les frênes menacés d'extinction en Europe*, 2016, [online] *http://www.ouest-france.fr/environnement/les-frenes-menaces-dextinction-en-europe-4128477*

[20] L'officiel du Canal du Midi, *Le chancre coloré du platane*,[online] *http://www.plan-canal-du-midi.com/le-chancre-colore-du-platane/*

[21] SIMON Catherine, *Vignoble : on ne trinquera guère au millésime 2016*, 2016, [online] *http://www.lanouvellerepublique.fr/Loir-et-Cher/Actualite/Economie-social/n/Contenus/Articles/2016/09/05/Vignoble-on-ne-trinquera-guere-au-millesime-2016-2828596*

1.1.6/ THE CONSEQUENCES OF CLIMATE CHANGE FOR PARIS

This eco-systemic reading is necessary to understand the risk to which Paris is exposed, in order to perceive the scale of the impacts on the city, which go far beyond the purely temperature-related issues. While the disappearance of polar bears, or the polar ice-cap or a possible rise of a metre or two in the sea level may leave the Parisian unmoved, knowing that he is "safe" from these physical and biological phenomena, it is the social effects of climate change and its consequences on biodiversity that will arise in the short term.

It is Parisians' quality of life and the functioning of the Paris economy that are at stake.

	Local consequences	Remote consequences
More frequent extreme climate phenomena: floods, droughts, heat waves	• More and more severe impacts on built infrastructures (interruption, damage, destruction), testing more and more strongly the capacity to cope with the increased thermal stress (cold in particular, cf. Guide IEC Elioth), to insure these infrastructures and fund their adaptation of replacement • Impact on the comfort of outdoor spaces, and urban comfort more generally (heat island effect), • Impact on human health: excess mortality of vulnerable people in heat waves (elderly people living alone, especially), victims of flooding, etc	• Impact on the electricity supply: reduction in electricity production capacity (difficulties cooling thermal power stations due to the rise in the temperature of rivers, incidents on the distribution network due to the heat of the ground, etc.). • Impact on supplies of domestic and imported crops (vines, but also cereals, coffee, cocoa, tea) • Impact, above all, on refugee migration (65 million refugees in 2016)
Deterioration or even destruction of biodiversity	• Impacts on Paris's «biological infrastructure» due to the proliferation of insect pests, bacteria, fungi (weakening the trees in parks and gardens, attacking floors and roof frames in old buildings/ timber buildings, etc.) • Impacts on the «assets» capable of absorbing part of local emissions (mitigation policies) and also capable of reducing the heat island effect (loss of shade and cool spaces in city centres, loss of forest on the outskirts)	• Increased vulnerability of ecosystems induced at once by extreme climate phenomena and by the loss of biodiversity (particularly sensitive for marine species, which are victims of both warming of the oceans AND overfishing) • Worsening poverty and increased vulnerability of populations to extreme climate phenomena, making them even more likely to migrate



©Arnaud Bouissou

Benoît Leguet, Director General of I4CE

« What we will need to see, taking account of the efforts made by the stakeholders in the energy and transport sectors, is whether these actions are on the right trajectory to reach carbon neutrality by 2050. In this forecasting exercise, it will be crucial to identify which key moments and which important decisions will be decisive for the associated reductions in emissions and to verify the resilience (ability to cope with the impacts of climate change) of the measures taken. Based on a precise mapping of these moments and decisions it will be possible to set milestones for the dynamic planning of actions to adapt, renew and develop coherent metropolitan areas with an appropriate and carbon neutral trajectory.»

1.2 / REQUIRED TRAJECTORIES

IN A NUTSHELL

Our carbon budget has been calculated after deducting emissions already emitted from the threshold defined by the Paris Agreement. This budget is calculated at the global level in gigatonnes of CO_2 ($GtCO_2$).

We can still emit 800 $GtCO_2$ if we want to maintain at least a 66% chance of capping the temperature rise at 2°C, but only 200 $GtCO_2$ for the same probability of remaining below a 1.5°C rise.

The different global trajectories that would allow these targets to be met arrive at relatively similar conclusions for the 2050 deadline: dividing emissions by 4 compared to the current level, then emissions that become «negative» by about 2070, by which time mankind should be taking more carbon from the atmosphere than it emits.

1.2.1/ LEARNING TO MANAGE OUR CARBON BUDGET

We emit 39.7 Gt of CO_2eq per year. We therefore need to divide these emissions in half by 2032 for the 1.5°C pathway (2038 for 2°C), and aim for 0 Gt net by 2050 for the 1.5°C pathway (and 2065 for the 2°C scenario). The carbon budget must be compared to the emissions that would be induced by exploiting the reserves of fossil hydrocarbons (here we are not talking about resources, only the reserves that are known and can be exploited using currently known techniques).

It is notable that these trajectories are totally contrary to the continued exploitation of the hydrocarbon reserves already in use (developed reserves), not to mention exploration, which absolutely must stop, since our known reserves already exceed the carbon budget (942 Gt).

Global emissions trajectories corresponding to the blue pathway: a 2 in 3 chance of not exceeding 2°C in 2100, to the red pathway: a 1 chance in 2 of not exceeding 1.5°C in 2100.

Global carbon budgets for two global warming pathways:

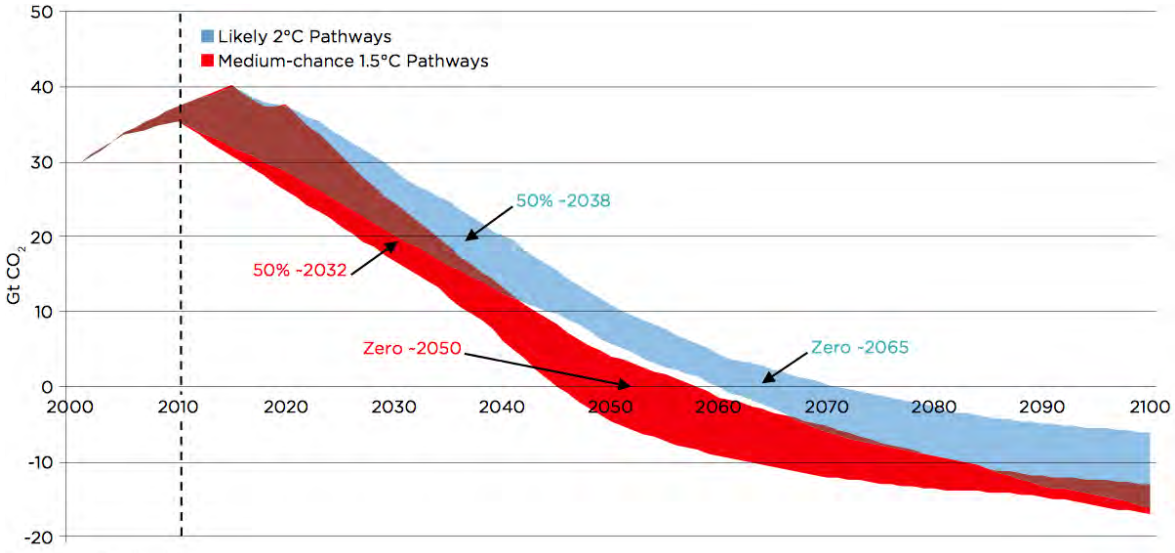
	2 °C	1,5 °C
Probability of success	2in 3 chances	1 in 2 chances
Budget in 2011	1 000	550
Emissions 2012-2015	157	157
= Budget in 2015	843	393

Sources : IPCC, Global Carbon Project

1.2.2/ THE IMPORTANCE OF THE 2030 MILESTONE IN ACHIEVING THE 2050 GOAL: WHY IT IS NECESSARY TO TAKE STRONG AND FAST ACTION

The last IPCC report proposes only one pathway, which keeps the rise in the temperature of the globe to under 2 degrees: the "RCP 2.6". The pathways are only scenarios based on figures that do not attempt to imagine the means of arriving at these results. The "RCP 2.6" shows that it is possible to achieve, even if the path is not really the most likely at the moment. However, it does presuppose a scenario with a drastic reduction in emissions as of now, a total abandonment of fossil fuels from 2035 onwards and the achievement of negative net emissions in the second half of the century and at the latest by 2070. Paris must achieve 0% fossil fuels very quickly.

CICERO (the Centre for International Climate and Environmental Research, based in Norway) points out, furthermore, that the emissions reduction curves are becoming more and more difficult to stick to, due to the postponement of emissions reduction measures.
The reduction curves have become considerably more difficult to achieve than they would have been in 1995, because our emissions have continued to rise and the time left to achieve carbon neutrality has contracted. The Shift Project has, moreover, published an estimation of the consequences of further delays in implementing ambitious transition policies: the mean rate (without sequestration) has today reached 5% a year. If we wait for 2025, the effort required to reduce emissions will be twice as intense (9.4% a year), and if we wait for 2033, it will be necessary to reduce emissions by 30% a year



Source « *the sky's the limit* » http://priceofoil.org/content/uploads/2016/09/OCI_the_skys_limit_2016_FINAL_2.pdf

1.2.3/ CHOOSING A PATHWAY MEANS CHOOSING A LEVEL OF RISK

We are faced with three possible scenarios:

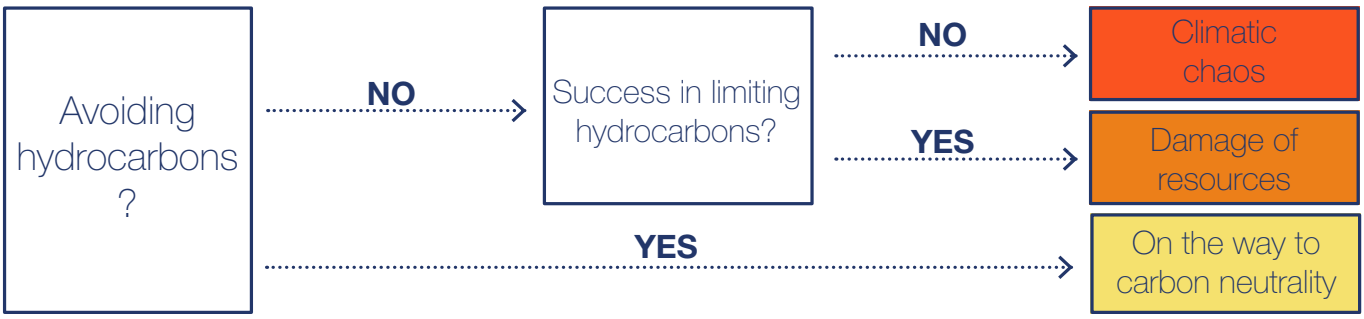
- A quick, planned abandonment of hydrocarbons (= carbon neutrality by 2050). Massive investments, backed by a political leadership with a mobilised population.
- A delay in abandoning hydrocarbons, then massive actions by States (to make up for lost time) (= "INDC" commitments). Major economic risks (between $14 and $100 trillion worth of financial assets exposed to a risk of losing value)
- No abandonment of hydrocarbons (= Business as usual). Climate chaos. Uncontrolled population migration, famines and economic collapse.

The least risky scenario of the three consists of managing a quick, planned abandonment of hydrocarbons. This is the driving force behind carbon neutral strategies.

As a result, it becomes imperative not to touch 30% of gas, 50% of oil and over 80% of coal, bearing in mind that these stocks must be managed over the long term, not only for the critical transition period.[1]

The longer it is before reduction measures are implemented, the more the carbon budget will be reduced, and the more the portion of the fossil resources exploitable in the interval will be reduced. It is therefore necessary to consider the previous thresholds as minimum thresholds that presuppose a rapid reduction in emissions, at a much faster rate than at the present time.. The curve for abandoning fossil fuels compatible with the 1.5°C target requires a ramp-up in renewables, to make up for the loss of hydrocarbons.

85% OF HYDROCARBON RESERVES CURRENTLY DEVELOPED MUST STAY IN THE GROUND TO MAINTAIN A FIFTY PER CENT PROBABILITY OF STAYING BELOW +1.5°C.



According to : «the sky's the limit»http://priceofoil.org/content/uploads/2016/09/OCI_the_skys_limit_2016_FINAL_2.pdf

85% OF HYDROCARBON RESERVES CURRENTLY EXPLOITED MUST REST UNDERGROUND TO ALLOW A 50% CHANCE OF STAYING BELOW 1.5°C

[1] MCGLADE Christophe, EKINS Paul, *The geographical distribution of fossil fuels unused when limiting global warming to 2 °C*, 2015, [online] http://dx.doi.org/10.1038/nature14016



COP 21, Paris, 2015
© COP PARIS

Thomas Buberl
Chief Executive of Axa

«While two thirds of the world's population of 9 billion will live in cities by 2050, these will be both the main sources of pollution, accounting for 70% of global greenhouse gas emissions, and the inhabited areas most vulnerable to climate-related risks. Our expertise as insurers enables us to measure the scale of the risks that the world's population will face if the actions undertaken after the Paris Agreement don't meet this essential challenge. Against this background, reinforcing the resilience of big cities constitutes one of the major priorities in combating climate change.»

1.3 / THE MOBILISATION OF CITIES

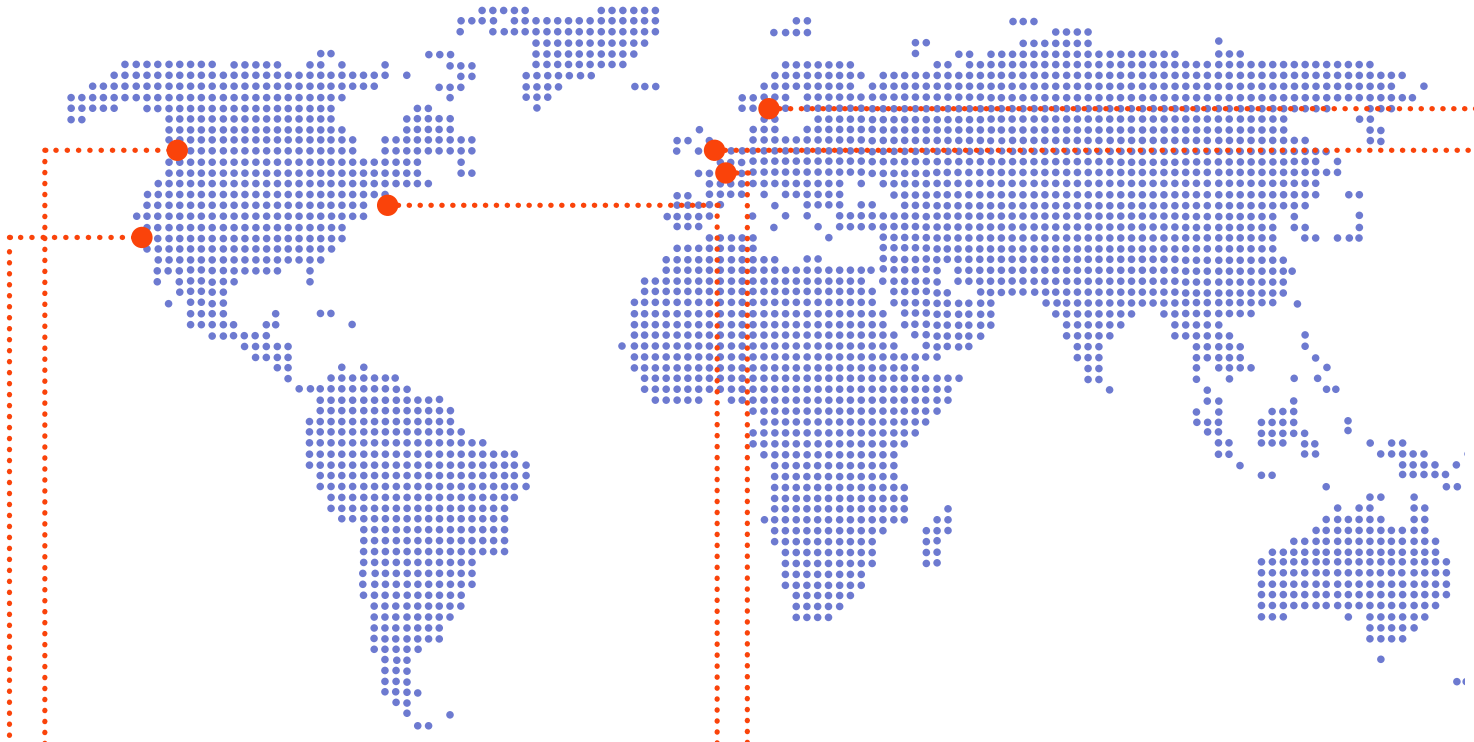
IN A NUTSHELL

Adopting the 2°C pathway means leaving behind our fossil fuel-based civilisation, an enormous task, that must be tackled by all of humanity.

The Paris Agreement, which came into force on 4 November 2016, sets a course and provides a working framework, whose robustness remains to be proven. The Agreement has been weakened by the results of the American presidential election, but has elsewhere been strengthened by the mobilisation of international institutions, States (including the biggest emitters), local authorities, investors and stakeholders in civil society, who have all reiterated their commitment to this path.

The commitment of cities is particularly crucial, as they mobilise most of the world's population. Some are showing the way in the short and medium term: abandoning fossil fuels as quickly as they can and speeding up the move towards 100% renewable energies.

THE MOBILISATION OF CITIES



According to the GPC scope (Global Protocol for Community-Scale Greenhouse Gas Emission Inventories):



VANCOUVER

600,000 inhabitants
5,200 inhab/km²

-33% in 2020
100% fossil energy free by 2050

Baseline: 2007
By 2050 Vancouver will be producing 100% of its energy for buildings and transport from renewables.
Introduction of an obligation to recycle food waste.
Launch of a programme of energy audits of SMEs.
Launch of the Transportation 2040 Plan.



PARIS

2,240,000 inhabitants
21,200 inhab/km²

-50% in 2030
-80% in 2050
Carbon neutrality by 2050

Baseline: 2004
Clean, emission-free mobility.
Better insulated, more sober buildings.
A metropolitan energy transition.



SAN FRANCISCO

860,000 inhabitants
7,100 inhab/km²

-40% in 2025
-80% in 2050

Baseline: 1990
By 2030 100% of electricity for residential buildings will be produced by renewable energies.
By 2050 San Francisco is aiming to reduce its waste-related emission by 72%.
Creation of a "Carbon Fund" for local carbon offsetting projects.



NEW YORK

8,550,000 inhabitants
10,800 inhab/km²

-30% in 2030
-80% in 2050

Baseline: 2005
Most of the drop is accounted for by buildings and carbon-free energy sources.
Zero-waste.

OVERVIEW

THE ESSENTIALS

It is at local level that the reduction of greenhouse gas emissions takes place: where people live, move about, heat their homes, eat, produce and consume.

At the Climate Summit for Local Leaders on 4 December 2015, the City of Paris signed a declaration setting out the commitments made by local governments, along with more than 700 mayors from all over the world. The latter pledged to unite with international organisations, national governments, the private sector and civil society to meet the challenge of climate change. This declaration was deposited by the Mayor of Paris at the Action Day at Le Bourget.

The goal of carbon neutrality by 2050 is a major landmark that positions Paris among the world capitals in the fight against climate change. These disparities in methodology could lead to opting for the lowest common denominator: a reference date and a calculation scope that would lead to minimising the reduction effort. Such an approach would be a failure from the point of view of the global objectives.

Ensuring the success of the carbon neutrality scenario according to the GPC scope is a necessary objective, which must be achieved without fail. Above all, it is necessary to go beyond this minimal objective and engage a strategy whose momentum will be sufficient to carry along a larger number of stakeholders and therefore have an influence on strategic sources of emission, beyond the items counted in the GPC methodology.

City of Melbourne, Kate Vinot
Director of City Strategy and Place

Achieving carbon neutrality requires structural, economic and policy change to drive an increase in energy efficiency; rapid decarbonisation of the electricity grid, transport systems and other activities using fossil fuels; and investment in carbon offsets.

HOW TO COMPARE CITIES

C40 *(Cities Climate Leadership Group)* is an organisation that aims to encourage cities to take action to tackle climate change and has been headed by Paris Mayor Anne Hidalgo since 2016. C40 connects 86 of the world's greatest cities, representing over 600 million people, 25% of global GDP and over half of the world's greenhouse gas emissions: an extremely important organisation for sharing good practices and generating virtuous emulation between its members.

C40 proposes a calculation method for assessing a city's CO_2 emissions: the GPC, which stands for Global Protocol for Community-scale Greenhouse Gas Emission Inventories. The scope of the GPC calculation is different to that of the Carbon Assessment, the «historic scope» used by City of Paris. This means that when a city states that it intends to reduce its emissions by 80%, it is important to look at what scope is concerned. To enable homogeneous comparisons, all the data presented here are based on the GPC scope.



OSLO
660,000 inhabitants
1,500 inhab/km²

-50% in 2030
100% fossil energy free by 2050

Baseline: 1991
By 2020, 100% of district heating and 100% of public transport will be fossil fuel-free.
Oslo offers very strong incentives to use electric vehicles.
Oslo is beginning to think about how to introduce a carbon neutrality strategy.



LONDON
8 540 000 habitants
5 400 hab./km²

-60% in 2025
-80% in 2050

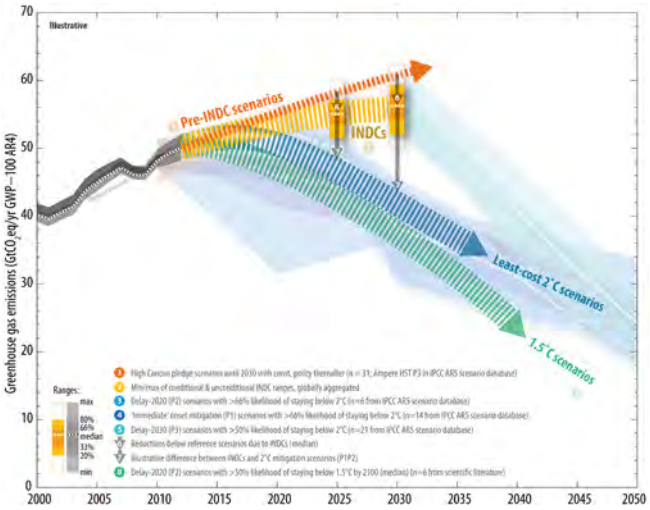
Baseline: 1990
Launch of a major renovation programme:
- RE: NEW (neighbourhoods)
- RE: FIT (houses)
- RE: CONNECT (public buildings)

1.3.1/ THE OVERALL FRAMEWORK: THE CONTRIBUTIONS OF THE PARIS AGREEMENT

The modelling of climate change and its consequences by the IPCC led to the signing and then the entry into force of the Paris Agreement, which sets the goal of a reduction of 2°C in a restricted period of time.

The objective of the Paris Agreement is to maintain an acceptable risk of not exceeding 2°C whilst aiming a maximum warming of 1.5°C ("likely" trajectory). This objective is an important step, for it creates a global dynamic, binding on the main emitting countries (China and the USA in particular).

However, the commitments made ahead of COP21, the INDCs ("Intended Nationally Determined Contributions") lead to a trajectory of +3°C, substantially higher than the 2°C threshold (itself considered not as an objective, but as a threshold not to be exceeded).



source : CCNUCC (2016), *Updated synthesis report on the aggregate effect of INDCs*, 2016

1.3.2/ THE ACTION OF NON-GOVERNMENTAL STAKEHOLDERS: CITIES AT THE FOREFRONT

It is at local level that the reduction of greenhouse gas emissions takes place: where people live, move about, heat their homes, eat, produce and consume.

The priority therefore is to reinforce and accentuate the momentum driven by governments. The Climate Chance summit held on 26-27 September in Nantes advocated a mobilisation of non-governmental stakeholders (companies, local authorities, civil society).

At the Climate Summit for Local Leaders organised on 4 December 2015 by the City of Paris and the Bloomberg Foundation, the City of Paris signed, with more than 700 mayors from all over the world, a declaration setting out the commitments made by local governments. The latter pledged to unite with international organisations, national governments, the private sector and civil society to meet the challenge of climate change. This declaration was deposited by the Mayor of Paris at the Action Day at Le Bourget.

The involvement of networks of cities, such as C40, Eurocities, EnergyCities, ICLEI, CGLU or the R20, represents a particularly promising lever to sustain this momentum between non-governmental players: actions supported and implemented by a large number of cities, and therefore a significant part of the population, will be able to weigh on the investment strategies of industry and urge States to adopt more ambitious national standards.

Similarly, the mobilisation of investors over the course of 2015 showed that the financing of the transition can be accelerated: $3,400bn were disinvested, and the development of energy-related investments shows that the energy transition is reaching critical mass.

Jean Haëntjens
Economist, urbanist, director of Urbatopie and author

« The reduction of energy demand by a factor of 4, necessary condition of all zero carbon scenarios, cannot be realised without strong support for the project from the general public and a capable government to navigate the difficult change of culture.
These conditions seem to be possible in the metropoles of Gothenberg or Copenhagen that are set to achieve the zero carbon objectives between 2025 and 2030. Copenhagen has demonstrated, in the role played by bikes in its transport system (more than 40% of journeys), the support of its people for the project and its high level of ecological conscience.»

1.3.3/ CITIES' REDUCTION STRATEGIES

An international comparison of Paris with other major cities shows that geographical boundaries, timescales, calculation scopes and percentage reductions vary from one city to another. However, their general ambitions are relatively similar, with the exception of Oslo, which has announced that its goal is carbon neutrality.

Paris's goal of carbon neutrality by 2050 is therefore a major landmark that positions the City among the world capitals in the fight against climate change. As an introduction, a brief presentation page summarises the actions of a few cities that have embarked upon extremely proactive policies to mitigate their carbon footprint.

These disparities in methodology could lead to opting for the lowest common denominator: a reference date and a calculation scope that would lead minimise the reduction effort. Such an approach would be a failure from the point of view of the global emission reduction objectives.

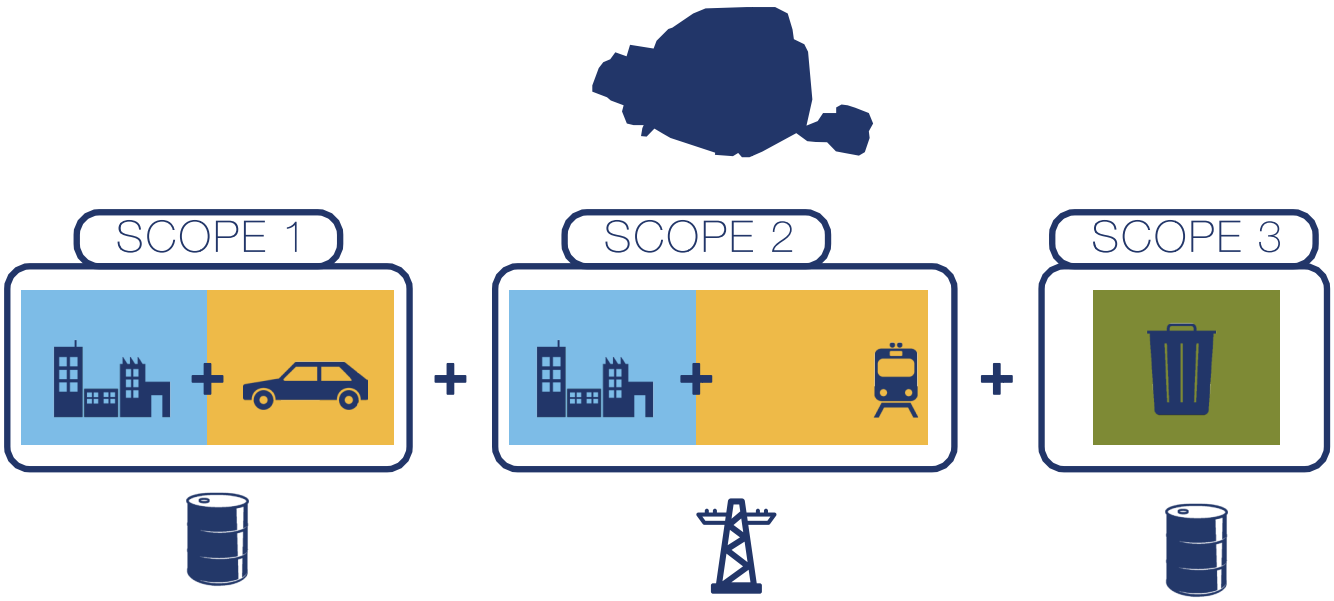
Ensuring the success of the carbon neutrality pathway according to the C40 scope (GPC scope) is a necessary objective, which must be achieved without fail, with particular emphasis being placed on the City's strategy relating to the emissions of buildings and transport.

Above all, it is necessary to go beyond this minimal objective and engage a strategy whose momentum will be sufficient to carry along a larger number of stakeholders and therefore have an influence on strategic sources of emission, beyond the items counted in the GPC methodology.



©Mairie de Paris

"Basic" GPC calculation



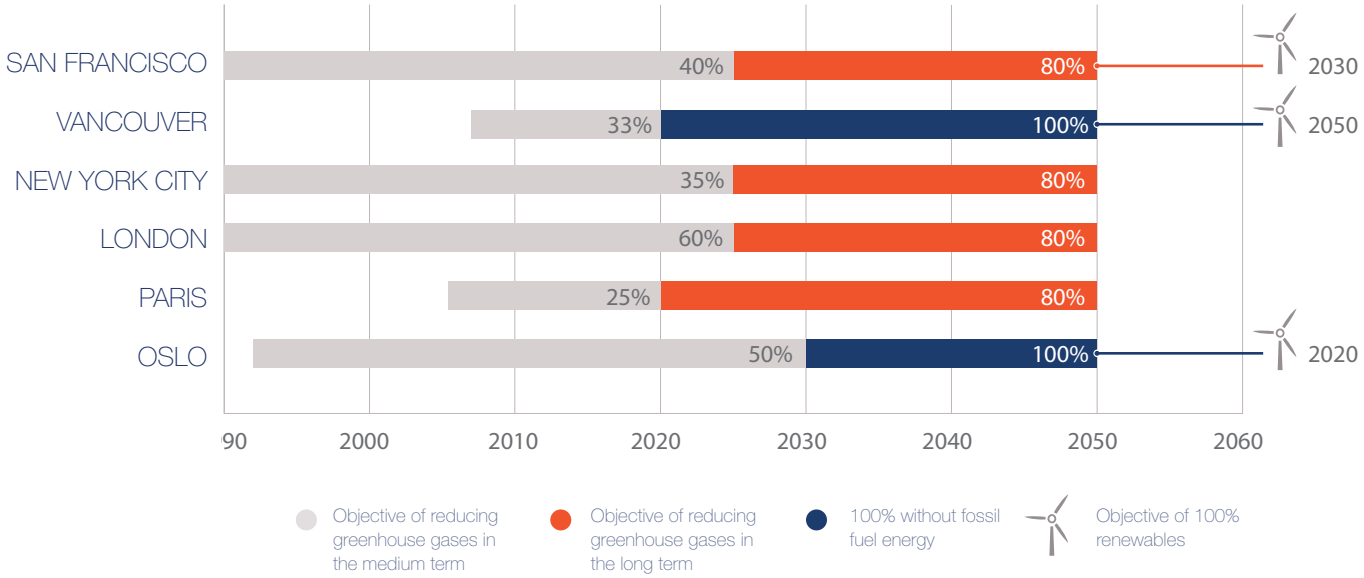
1.3.4/ SIX MAJOR CITIES

In this study we will summarise the situation of just 6 major cities, which represent quite well the different ambitions and different contexts. The first very obvious point is that each capital has its own specific geography that sometimes makes comparisons less easy.

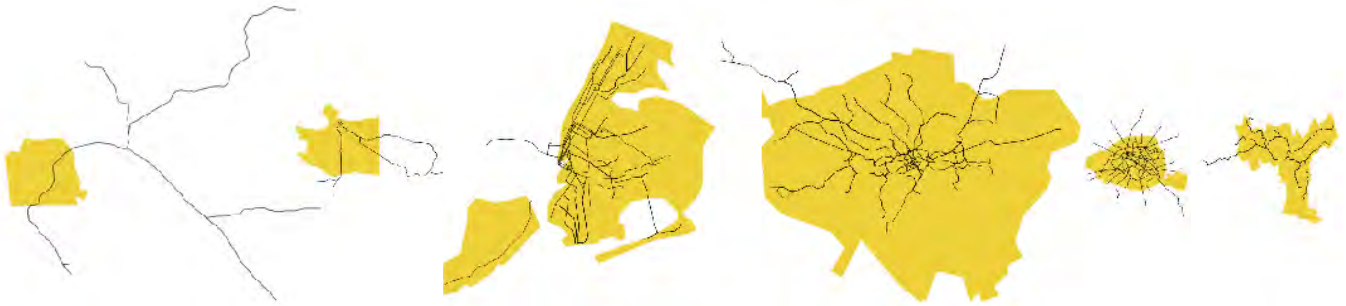
In the graphs below, the scales are respected in the diagrams. It can be seen, for example, that unlike Paris, London has taken as its boundary "Greater London" which covers an area 15 times greater than that of Paris. This also shows that the boundary used changes the density of the population, so that whereas the population density of Manhattan in New York is higher than that of Paris, in the C40 calculation it is the whole of New-York that is taken into account, which leads to a lower density.

5 "carbon neutrality" goals and strategies

- reduction goals relating to a reference level of emissions
- "milestone" -type reduction targets (2030-2050)
- strategy of adaptation to climate change
- strategy on the use of renewable energies
- scope of application of the reduction



SAN FRANCISCO	VANCOUVER	NEW YORK	LONDON	PARIS	OSLO
860 000 inhabitants	**600 000** inhabitants	**8 550 000** inhabitants	**8 540 000** inhabitants	**2 240 000** inhabitants	**660 000** inhabitants



SAN FRANCISCO	VANCOUVER	NEW YORK	LONDON	PARIS	OSLO
121 km²	**115** km²	**789** km²	**1572** km²	**105** km²	**454** km²
7 100 inhab./km²	**5 200** inhab./km²	**10 800** inhab./km²	**5 400** inhab./km²	**21 200** inhab./km²	**1 500** inhab./km²
72 390 $/inhab (2014)	**44 337** $/inhab (2014)	**69 915** $/inhab (2014)	**54 157** $/inhab (2014)	**57 241** $/inhab (2014)	**52 802** $/inhab (2014)

Methods / Scopes / Sectors

	SAN FRANCISCO	VANCOUVER	NEW YORK	LONDON	PARIS	OSLO
						
	-80% (2050)	**-80%** (2050)	**-80%** (2050)	**-80%** (2050)	**-75%** (2050)	**-95%** (2030)
METHOD	**GPC** (+ California Environmental Quality Act Guidelines)	**GPC** (+ CEEI British Columbia)	**GPC**	**LEGGI**	**CARBON ASSESSMENT METHOD**	**INPUT - OUTPUT + ACV**
SCOPES	**Scopes 1/2/3**	**Scopes 1/2/3**	**Scopes 1/2/3**	**Scopes 1/2**	**Scopes 1/2/3**	**Scopes 1/2/3**
SECTORS	Buildings: electricity Buildings: natural gas Transportation Waste	Buildings: electricity Buildings: natural gas Transportation Waste	Stationary energy Transportation Waste	Residential Commercial-Industrial Transportation	Industry Tertiary Residential Transportation Waste Food	Stationary energy Transportation Others
OTHER METHODS.	**TBIF :** GPC X2 **CBEI :** GPC X4	← «consumption» bilan →				**DSCP :** LEGGI X2 **CB :** GPC X3

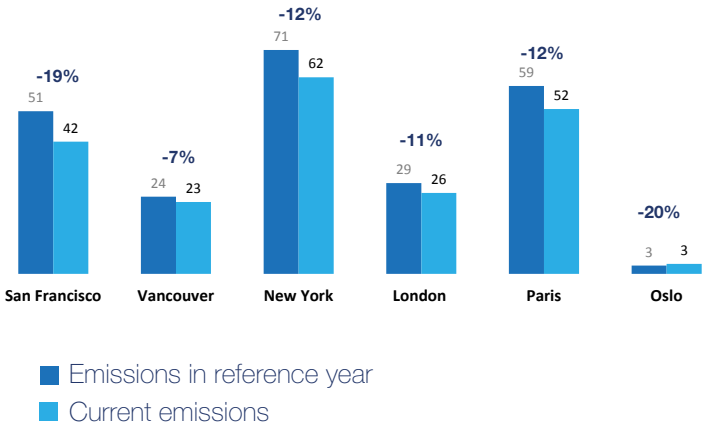
Differences/common features

As well as the GPC method of calculation, many cities use their own method of calculation (LEGGI, Carbon Assessment, etc.). These different models are interesting because they often use scopes that are wider and therefore closer to physical reality. The progressive adoption of the GPC method or its dual use with another method, on the other hand, makes it possible to compare the cities' ambitions more accurately.

The scopes and boundaries also vary. "Scope 1" is the minimum in-boundary consumption of carbon not counting embedded energy. Scope 2 takes into account the energy supplied by external grids (such as electricity). "Scope 3" is a wider scope taking into account out-of-boundary transportation for example. Scope 1 + 2 is the common denominator with actions on buildings, the changeover to less carbon-intensive energy sources, renewable energies, soft mobility in cities, etc. The reports issued by the cities show an awareness of the limits of the territorial approach and the difficulties inherent in the bottom-up approach focused on consumption.

Cities' annual emissions with respect to their land registry area

$ktCO_2eq/km^2$



1.3.5/ A MATTER OF CALCULATION SCOPE

The question of the scope is an important one since it conditions the efforts to be made. If the scope of calculation is very small - housing only, for example - then the efforts to be made to produce a relative result – for example 80% – are easier because they only concern housing. If the scope covers all the real carbon balance of a population then it is necessary to work on every aspect (food, waste, goods purchased, etc.) and sometimes without really having any real leverage over the actions to be taken – is it possible for example to make people buy mobile phones coming from China?

This question is not insignificant and must be placed in an overall context. Human beings have a carbon impact through everything that they do. Sometimes the impacts are very small or even negative (purchase of wood for the home), sometimes they are much greater, such as an aeroplane journey. Between these two extremes, we have to look at what we are taking into account.

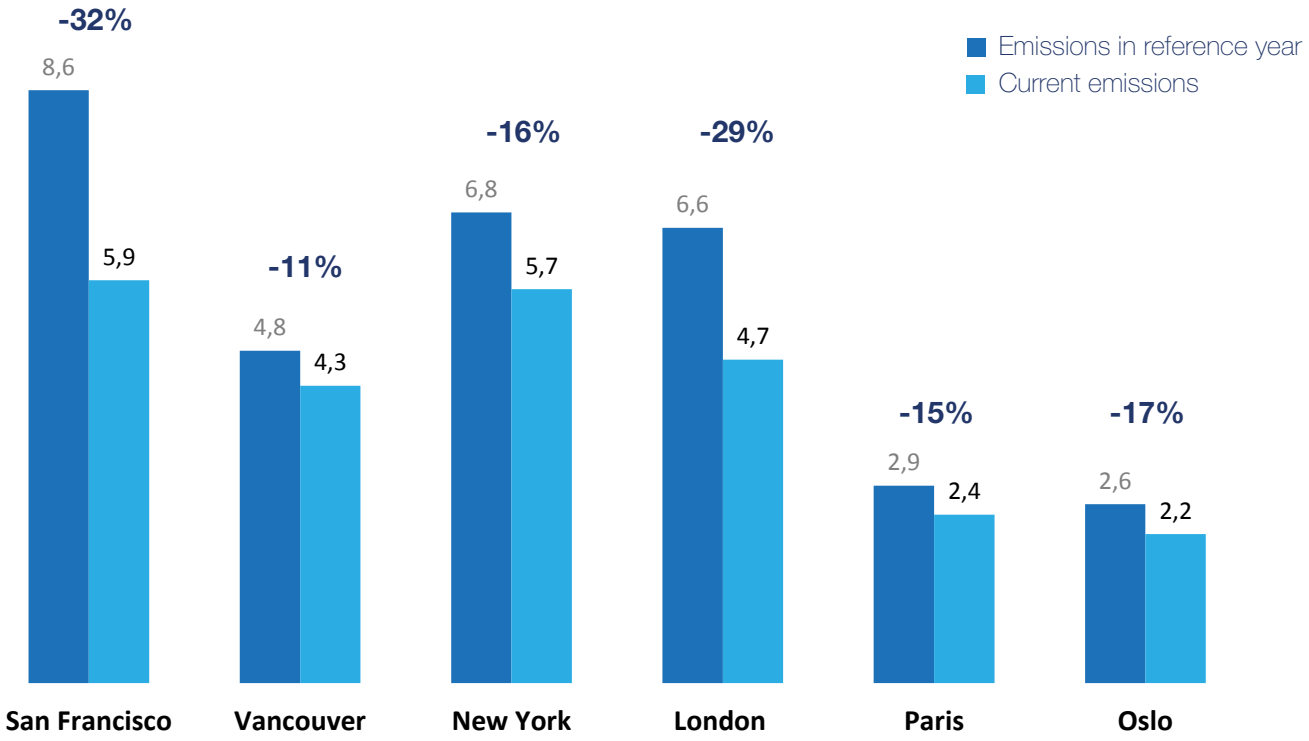
C40 (Cities Climate Leadership Group) is an organisation that aims at encouraging cities to take action to tackle climate change, and has been headed by Paris Mayor Anne Hidalgo since 2016. C40 connects 86 of the world's greatest cities, representing over 600 million people, 25% of global GDP and over half of the world's greenhouse gas emissions: an extremely important organisation for sharing good practices and generating virtuous emulation between its members.

C40 proposes a calculation method for assessing a city's CO_2 emissions: the GPC, which stands for Global Protocol for Community-scale Greenhouse Gas Emission Inventories. The scope of the GPC calculation is different to that of the Carbon Assessment, the "historic scope" used by City of Paris. This means that when a city states that it intends to reduce its emissions by 80%, it is important to look at what scope is concerned. To enable homogeneous comparisons, all the data presented here are based on the GPC scope. The usual GPC scope is the sum of GCP Scopes 1 and 2, i.e. all of: the annual energy consumption of buildings excluding renewable energies, in-boundary transport, waste, industrial processes, grid-supplied energy. It does not take into account, for example, food, long-distance travel and many other items.

The other point about the method is to know what the starting point is. If we suppose, justifiably, that the carbon footprint improves over time, it is more advantageous to take a starting point further back in time as the part "remaining to be done" is less great. On the other hand, choosing a year with a good carbon footprint is penalising.

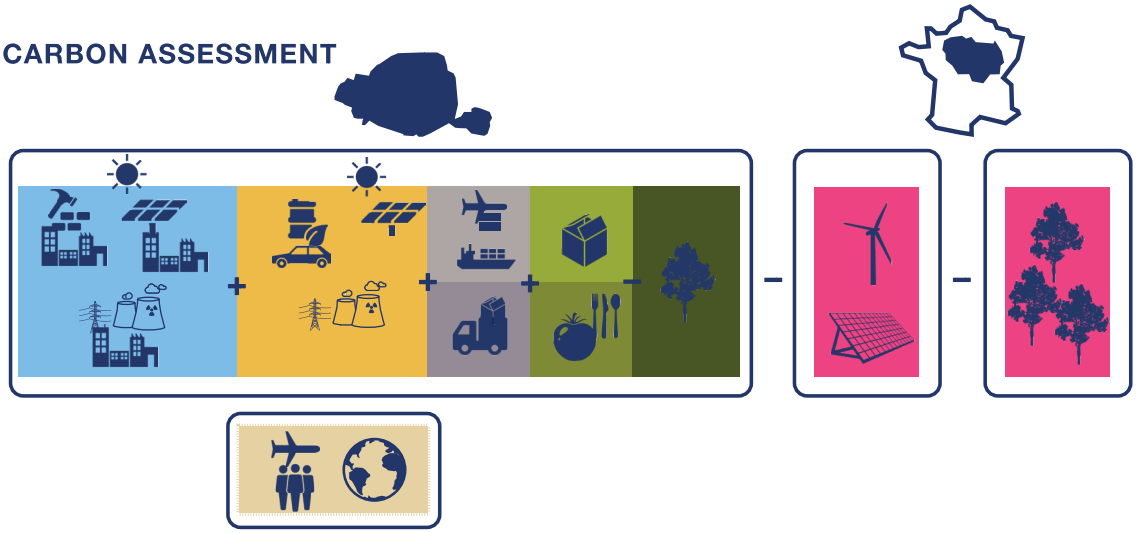
Annual emissions per inhabitant

tCO_2eq/hab



GPC inventory and City of Paris Carbon Assessment method of carbon accounting





1.3.6/ FOCUS ON SAN FRANCISCO



San Francisco, © Richard Heyes

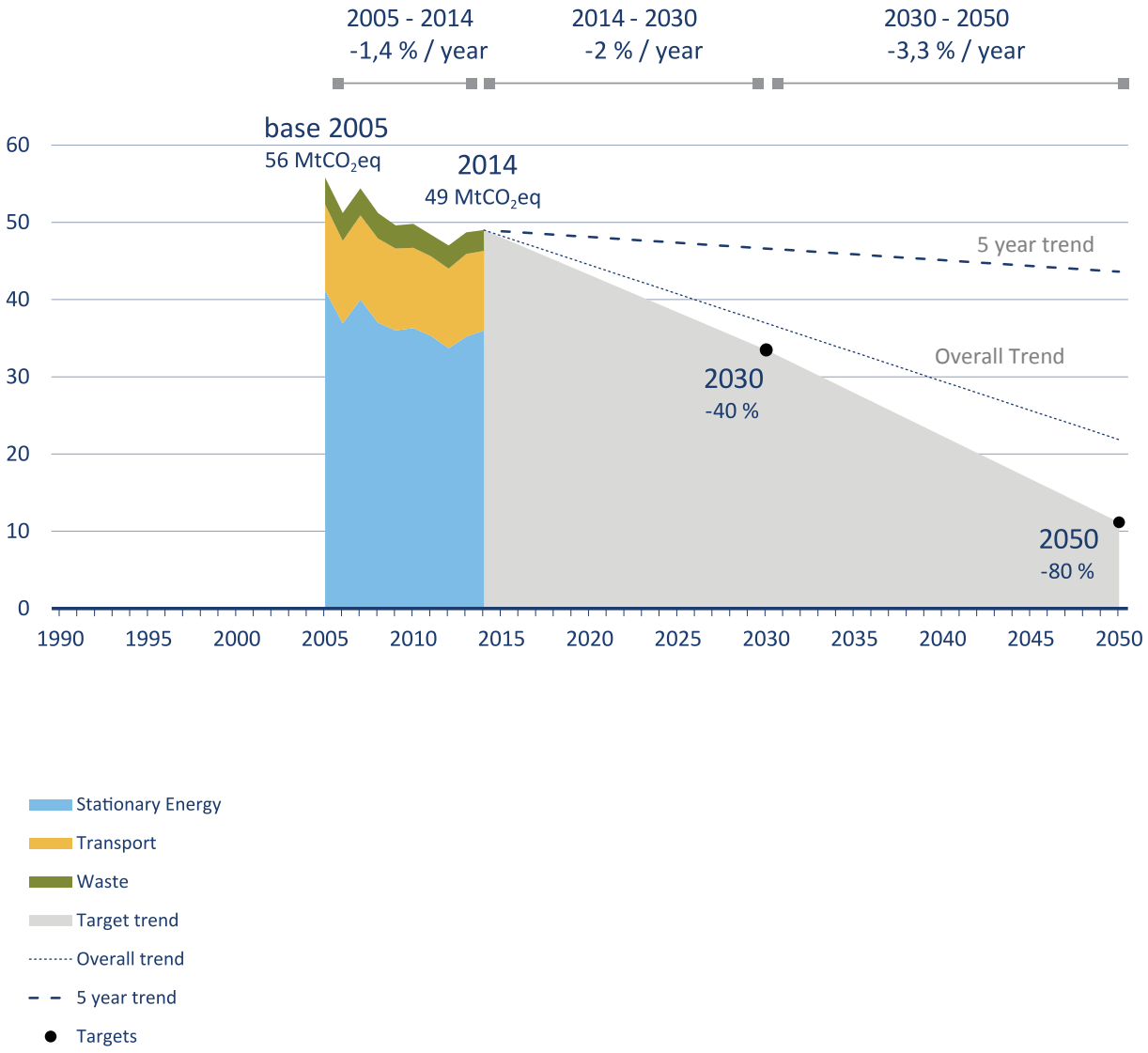
Based on the GPC scope, San Francisco's ambitions are substantially the same as those of the other cities:
-40% in 2025
-80% in 2050

Its baseline is 1990, which shows that the city has been reflecting on the issue for a long time. However, San Francisco has also set itself extra goals such as that of having 100% of the electricity for residential buildings produced by renewable energies by 2030. It should be noted that San Francisco is aiming, by 2050, for a 72% reduction in waste-related emissions (recycling and recovery) and the creation of a carbon fund for local carbon offsetting projects.

For San Francisco, we note that the mitigation efforts expected in the coming years are quite stable with a reduction of about 2.5% a year, which is a relatively low rate, possible because considerable efforts have already been made.

Rate of emissions reductions

relative % reduction at the beginning of each period



1.3.7/ FOCUS ON VANCOUVER



Vancouver, © Domo k.

According to the GPC scope, Vancouver has set its ambitions very high:
-33% in 2020
100% fossil energy free by 2050

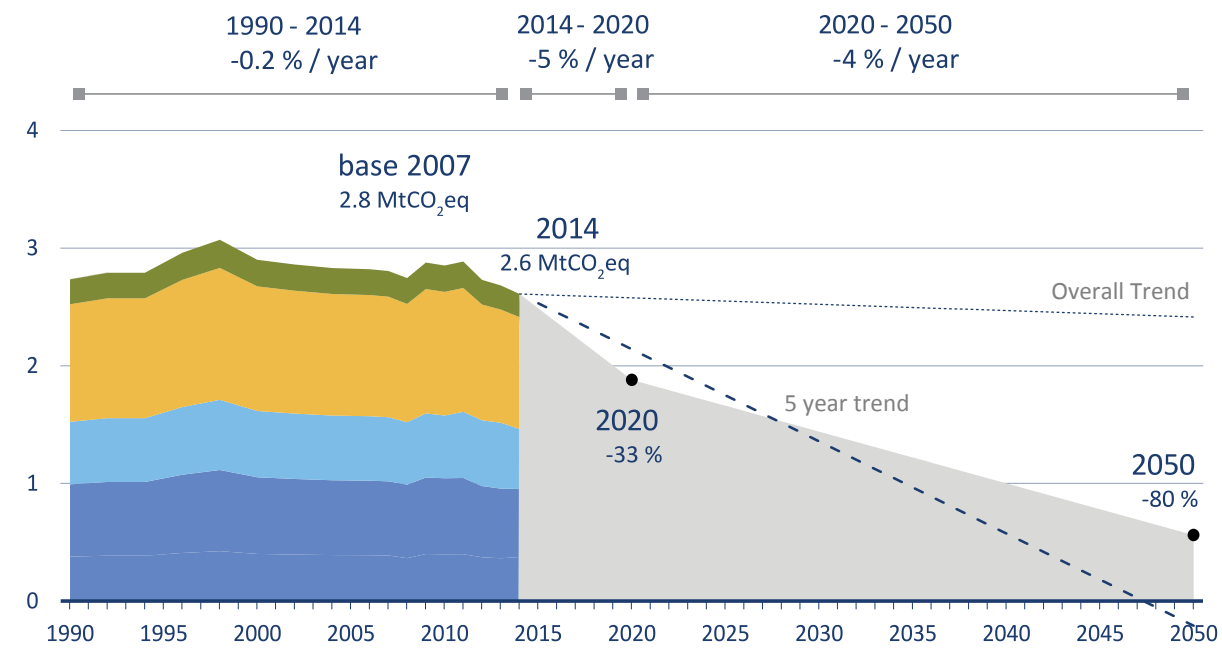
The baseline is 2007.
Its ambitious goals should be regarded in consideration of its size and population density much smaller than that of Paris.

By 2050 Vancouver aims to be producing 100% of its energy for buildings and transport from renewables. Vancouver is also looking to introduce an obligation to recycle food waste and launching a vast programme of energy audits of SMEs. Launch of the Transportation 2040 Plan, which sets goals in terms of distances covered and the share of electric vehicles.

For Vancouver, we note that very ambitious mitigation efforts are being made between 2012 and 2020 with an average reduction of almost 5% a year. Vancouver is showing the way on the dynamic implementation of short-term actions.

Rate of emissions reductions

relative % reduction at the beginning of each period



Tertiary industry

Residential

Transport

Waste

Target trend

Overall trend

5 year trend

Targets

1.3.8/ FOCUS ON NEW YORK



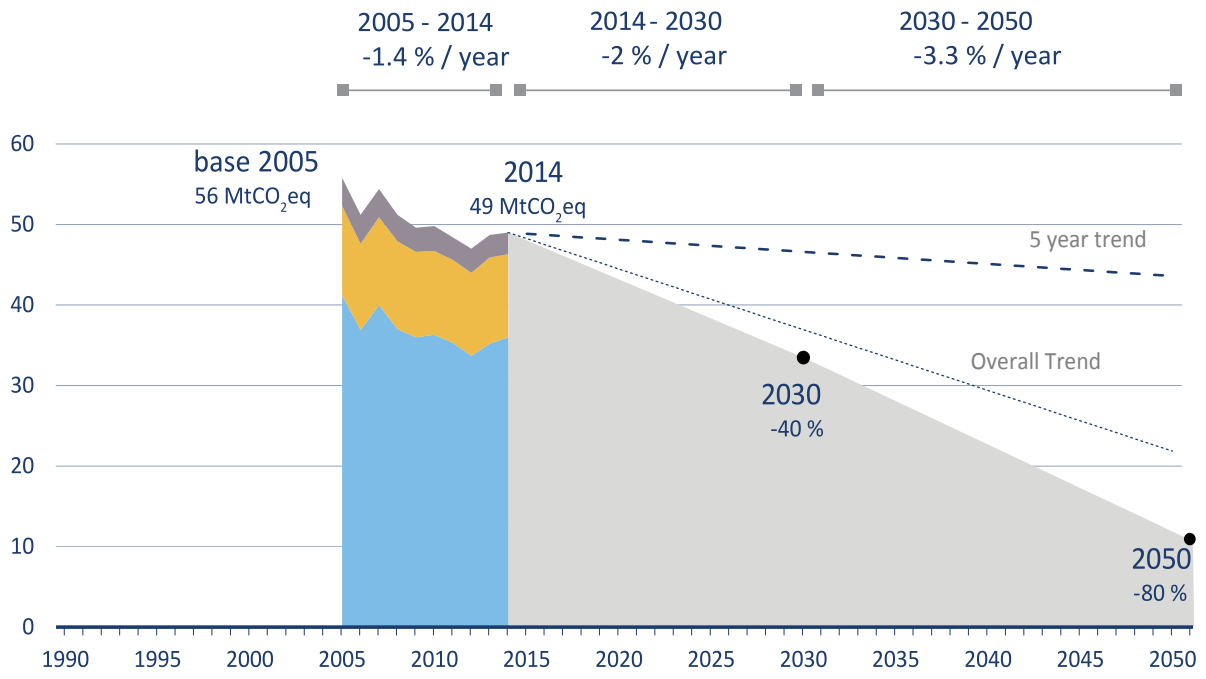
New York, © Aurelien Guichard

According to the GPC scope, New York has set itself the targets of:
-30% in 2030
-80% in 2050

The baseline is 2005. Most of the reduction is due to buildings and carbon-free energy, with an improvement in the carbon content of electricity (-30%) and heating (-33%) with a transfer from fuel oil to natural gas.
New York is already anticipating occasional increases in energy-related emissions due to colder winters.
Finally, New York is introducing a zero waste strategy and banking on a reduction in car journeys.

Rate of emissions reductions

relative % reduction at the beginning of each period



Stationary Energy
Transport
Other
Target trend
Overall trend
5 year trend
Targets

1.3.9/ FOCUS ON LONDON



London, © Mariano Mantel

According to the GPC scope, London has set itself the targets:
within the «Greater London» boundary of:
-60% in 2025
-80% in 2050

The baseline is 1990.
It should be remembered that the boundary used by London is that of «Greater London» which is an area as big as the Department of Seine-et-Marne.

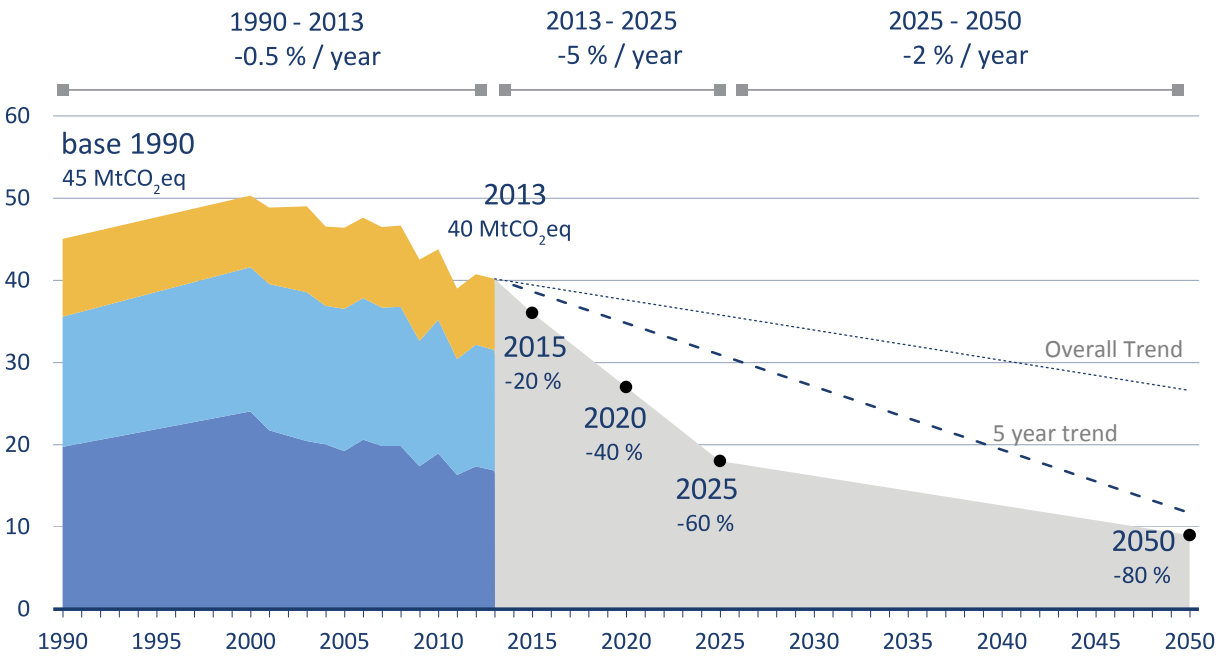
The London Authority has a very ambitious reduction strategy for the short and medium term. The goal of -60% by 2025 requires an annual reduction of over 5% a year.

According to the scope chosen by London, buildings (housing and tertiary) represent 78% of emissions and 80% of the existing building stock will still be in place in 2050. London therefore plans to implement some very large action plans to renovate the existing fabric and has very high ambitions concerning new buildings:

The RE:NEW programme for housing and RE:FIT for public buildings. London is also introducing a policy of monitoring consumption in the tertiary sector with its «Business Energy Challenge». The current trend on transport is more or less in line with the target of -48% by 2025, but a change in the method of calculation makes it difficult to examine this result in depth.

Rate of emissions reductions

relative % reduction at the beginning of each period



Tertiary industry

Résidential

Transport

Target trend

Overall trend

5 year trend

Targets

1.3.10/ FOCUS ON PARIS



Paris, © Emilie Barbier

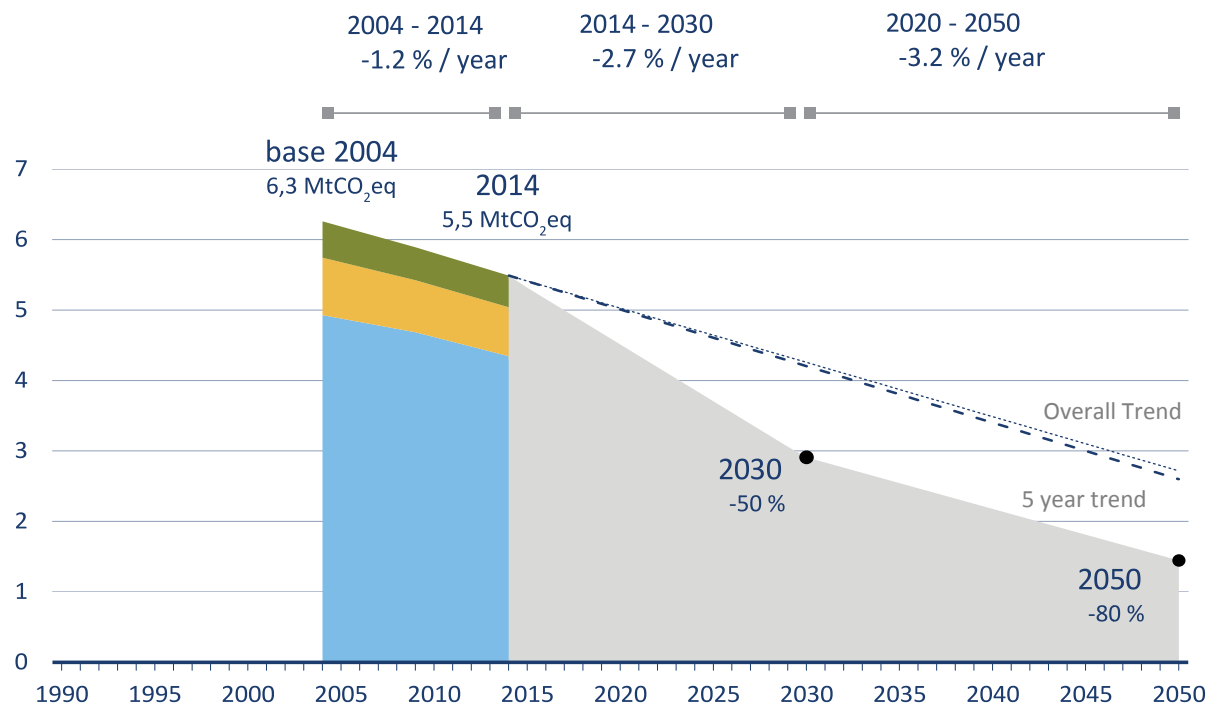
According to the GPC scope, Paris has set itself the targets of:
-50% in 2030
-80% in 2050
Carbon neutrality by 2050 whilst extending the scope and the boundary.

The baseline is 2004. Although the method of counting is different, the principles applied to strategy using the Carbon Assessment scope also work for the GPC method, apart from a few exceptions.

The graph opposite shows Paris's trajectory according to the GPC scope in order to compare it to the other cities. The pages that follow will provide more detail about this trajectory and the actions included in the carbon neutrality strategy. Nevertheless, taking the year 2004 as the starting point, we note that the annual pace of the reduction is relatively stable: a reduction of about 3% a year, which will enable the -50% target to be met in 2030 and then the -80% target in 2050.

Rate of emissions reductions

relative % reduction at the beginning of each period



Stationary Energy
Transports
Waste
Target trend
Overall trend
5 year trend
Targets

1.3.11/ FOCUS ON OSLO

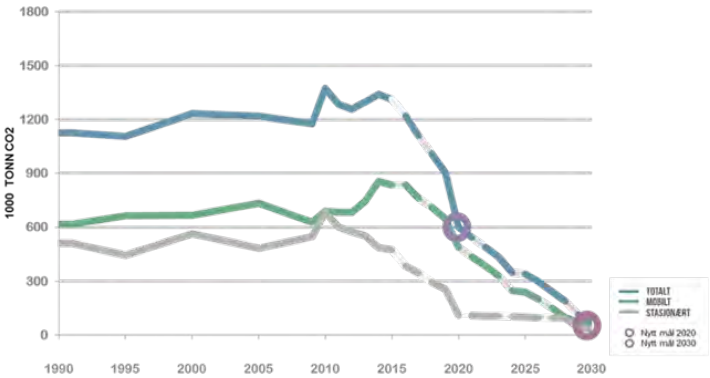


Oslo, © Alexander Ottesen

According to the GPC scope, Oslo has set its ambitions very high:
-50% in 2030
100% fossil energy free by 2050

The baseline is 1991. When considering Oslo the low density of its population should be kept in mind: almost 15 times lower than Paris. By 2020, 100% of district heating and 100% of public transport will be fossil fuel-free. This is why Oslo offers very strong incentives to use electric vehicles and its energy mix is almost 100% hydroelectricity, meaning its energy sources are easily renewable. Mid-2016 Oslo launched a reflection on a carbon neutrality strategy[1] with the aim of being carbon neutral by 2030. The idea is to set an annual reduction target, which will be included in the city's budget and which may go as far as to ban private cars in the city centre. The outcomes of the measures will be published annually.

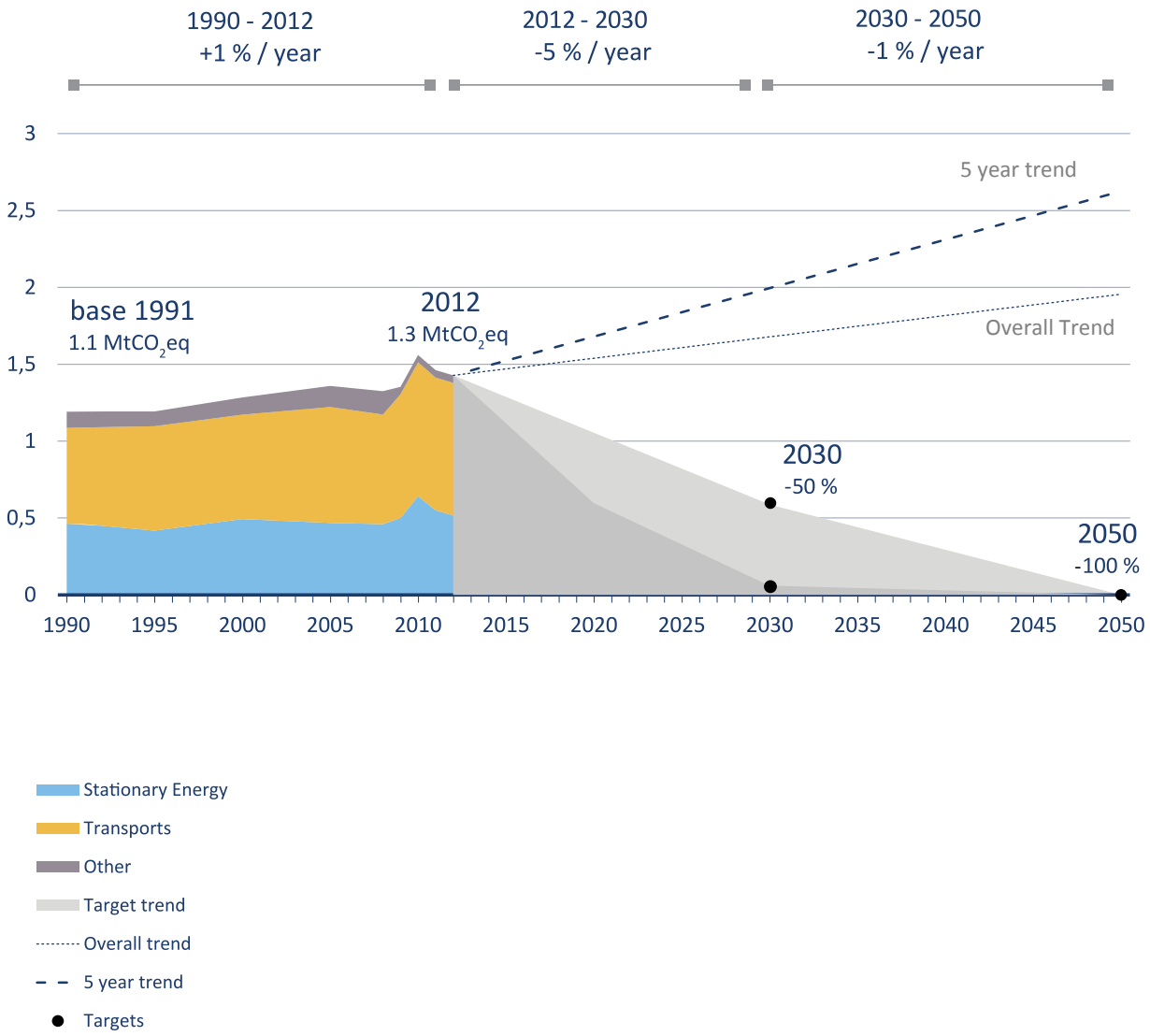
Emissions of tCO_2e (x1000) from 1990 to 2015 and forecast until 2030 (C40)



[1] Reuters, Oslo's radical «climate budget» http://www.reuters.com/article/us-climatechange-oslo-idUSKCN11Y1RK

Rate of emissions reductions

relative % reduction at the beginning of each period





2/

THE CARBON NEUTRALITY OF PARIS: THE 2050 VISION

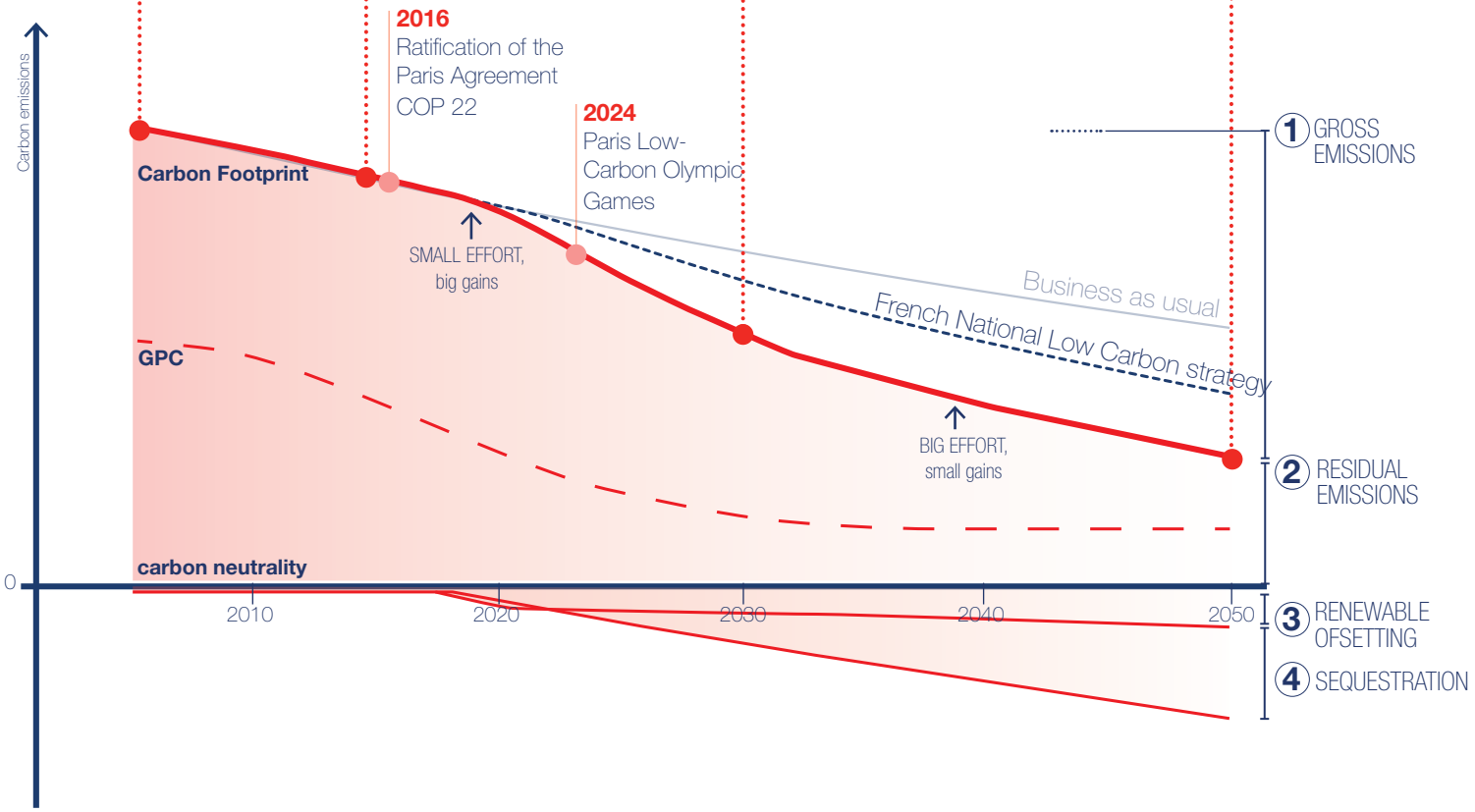
WHAT TYPE OF CARBON NEUTRALITY STRATEGY?

2004
First Paris Carbon Assess-ment

2015
Signature of the Paris Agreement. COP 21

2030
A deadline that is closer to 2017 than 21 April 2002. The priority is to reduce emissions and efforts must be intensified to attain carbon neutrality in 2050. The first offsetting measures must begin.

2050
A deadline that is closer to 2017 than 10 May 1981. The aim for 2050 is to maximise the reduction of emissions to minimise the proportion of offsetting. Renewable energy must be produced outside the territory in order to decar-bonise the electricity mix. The remaining emissions must be captured and stored.



OVERVIEW

THE ESSENTIALS

How does the carbon neutrality strategy stand in relation to the **National Low Carbon Strategy** *(Stratégie Nationale Bas Carbone)* and **Business as Usual?**
The Business as Usual strategy shows the situation if Paris makes few changes to its habits and allows its course to be dictated mainly by a changing external environment. This approach is too slow and lacks ambition: it is incapable of attaining the goals that have been set. The National Low Carbon Strategy reflects the transformations on different regional, national, continental and international scales. This is a more ambitious trajectory than the Business As Usual strategy but still remains too slow and requires Paris to implement additional measures to aim for carbon neutrality by 2050, doubtless by resorting to an over-reliance on offsetting the net emissions of Parisians. Paris has a duty to set an example by charting a very ambitious course for emission mitigation.

1 DEFINING THE CALCULATION SCOPE

We first need to decide what to count as emissions – the gross emissions that must be reduced to zero between now and 2050.
Several scopes can be envisaged. For the City of Paris, it is the broad scope of the Carbon Assessment that provides the most accurate description of the amount of emissions that can be attributed to activities in Paris.

The different scopes of the GPC (Global Protocol for Community-Scale Greenhouse Gas Emission Inventories) apply to the C40. Paris can seek to mark its presidency of the C40 by encouraging other cities to adopt broad assessment scopes for gross emissions, while harmonising the comparison of the trajectories of other metropolises according to the GPC format.

2 MITIGATING GROSS EMISSIONS

Irrespective of the scope adopted, the priority is to reduce gross emissions drastically with the reference point being 2004 – the year of the first Carbon Assessment.
The actions undertaken allowed a reduction of this first calculation by 9% in 2015 when the Paris Agreement was signed. The aim is to attain a five-fold reduction in the gross emissions that are assessed for both assessment scopes: the broad scope that traditionally applies to the City – the Carbon Assessment (over 28 $MtCO_2eq$ in 2004 and 25 $MtCO_2eq$ in 2014) – and the scope of the GPC which has been adopted by the C40 community (5 $MtCO_2eq$ according to this scope).

3 RESIDUAL EMISSIONS OFFSETTING

The residual emissions will exceed the 2050 targets, as certain items cannot be reduced. Consequently, an offsetting mechanism capable of reducing these emissions needs to be devised. The simplest way is to generate renewable energy. As the surface area of Paris city centre is insufficient to meet all of its energy needs by renewables alone, the acquisition (or financing) of renewable capacities outside Paris will be required to offset the residual emissions.

4 CAPTURING AND STORING THE REMAINDER

Capture and storage is the final measure and should only come into play after all other emission reduction and offsetting options have been exhausted. The aim here is to minimise the extent of the capture and storage capacity, and in particular, the territorial surface area that is mobilised to offset the corresponding gross emissions.
The net emissions of Paris by 2050 will be 4.4 $MtCO_2eq$ according to the Carbon Assessment format. The city will therefore be participating in territorial actions to promote the capture and storage of atmospheric carbon by encouraging afforestation.

Benoît Leguet
Director-General of I4CE

Efforts should be made to offset the residual emissions throughout the metropolitan territory, which cannot become neutral without doing so, and without transferring the problem of emission reductions elsewhere. In response to the question of scope, it is therefore important to take into account the scope of the Greater Paris Metropolitan Area, including its interactions with the region [...].

CARBON ASSESSMENT

When a territory carries out an annual assessment of its greenhouse gas emissions, it quantifies all the emissions flows from the activities that it has decided to include in the scope of its calculation: emissions from cars, heavy goods vehicles, building heating systems, waste processing, and the production of its residents' food, etc. This is a difficult exercise because these flows are only recorded in a fragmentary and aggregated manner, and may not even be measured at all! For example, nobody knows how many consumer goods enter the city each year, their points of origin, what the residents and workers actually eat, the number of journeys they make by air, rail or road, and their destinations.

The assessment is based on the available data: the managers of the Enedis (electricity) and GRdF (gas) grids provide figures for the total amount of energy consumed in Paris; Aeroports de Paris knows how many people depart from and arrive at Orly and Roissy-CDG, their origins and therefore the distances they travel; the SYCTOM knows how much waste is collected in Paris… However, emissions cannot be assessed on the basis of these data alone, and the approach must therefore be supplemented by modelling based on numerous assumptions. What are the shares of the residential and tertiary sectors in overall energy consumption? What is the proportion of Parisians travelling by air among all the travellers recorded by Aéroports de Paris? How many meals do Parisians eat and what types of diet do they have? What quantity of freight enters and leaves Paris? What types of engines power vehicles in Paris?

Data derived from national or regional studies and surveys are used to answer these questions. INSEE (French National Institute of Statistics and Economic Studies) provides estimates of the characteristics of the population and dwellings based on its surveys at the territorial level; every ten years or so, the ANSES (French Agency for Food, Environmental and Occupational Health & Safety) studies dietary habits throughout the whole of France; on a regular basis, the Ministry for the Environment, Energy and the Sea quantifies the long-distance mobility characteristics of French people, etc. These data compensate for the lack of information but skew the model in several ways, since an outline of the territory's operations is developed on the basis of data that are not specific to it and may be several years old: the map does not represent the territory.

EMISSIONS MODELLING

The modelling principle for a carbon assessment is based on a simple counting method. The number of kilometres travelled by Parisians in cars is determined and the types of vehicles used and their emission levels are estimated, which can be used to calculate Parisians' car emissions. To take another example, building heating requirements are evaluated, the heating systems used are established and the levels of emissions from the different energy sources of these systems are calculated, which allows for the calculation of heating-related emissions.
In each of these cases, this involves estimating a quantity of use and using different technical methods to apportion it and associate it with a quantity of unit emissions, according to the method used for **Kaya's famous equation**, shown opposite.

Using this modelling principle to make forward assessments constitutes a simplification of how systems actually operate, and does not reflect the fact that the terms of the equation are often interdependent. For example, energy consumption – a quantity of use – sometimes increases following an improvement in the energy efficiency of systems, which is a technological criterion (referred to as the "rebound effect"). In another example, the number of kilometres travelled for holidays – a quantity of use – is increasing due to the availability of low-cost-flights, which is a technological and economic criterion. Therefore, this type of phenomenon is ignored, on the assumption that its effects are of lesser importance in relation to the quantities calculated by the model.

To calculate the carbon footprint, hundreds of equations of this type are then populated using the data available for the territory, in order to determine the emissions for each business sector.

A model of this carbon accounting framework was implemented to tackle its complexity and combine hundreds of inputs coming from numerous sources at different dates as well as intermediary results, at six different time horizons for two scenarios.

This algorithmic implementation keeps a low enough level of description of the carbon flows, in order to quantify carbon footprints both at the **individual and city levels** : the objective was to provide results for the usual sector approach (buildings, transport, food consumption…) and for the families' transition narratives, which are two faces of the same coin but often disconnected in the models.

The bottom-up approach adopted requires a good understanding of the links between the population diverse characteristics and its individual needs (housing, transportation, food consumption...). Socio-demographic inputs were therefore central in the modelling scheme, and we took particular care to account for their evolution and impacts when sufficient prospective data was available (size and aging of the population in particular).

Cities rarely have access to the same quantity nor quality of data about their population and emission sectors, which makes model customization inevitable and requires extensive data search and harmonization. However, the implementation method that was experimented here is **reproductible and scalable** and could be applied to any city willing to get detailed insights on transition paths to carbon neutrality.

DIFFERENT VARIATIONS OF THE KAYA EQUATION

$$CO_2 = POP \times \frac{PIB}{POP} \times \frac{E}{PIB} \times \frac{CO_2}{E}$$

$$CO_2 = POP \times \frac{km}{POP} \times \frac{kWh}{km} \times \frac{CO_2}{kWh}$$

$$CO_2 = POP \times \frac{m^2}{POP} \times \frac{kWh}{m^2} \times \frac{CO_2}{kWh}$$

CO_2 : world anthropogenic emissions
POP : worldwide population
PIB : gross domestic product
E : global consumption of primary energy



Different climate plans for the city of Paris



© Elioth - Résilis, montage, Paris

Jean Haëntjens, Economist, Town Planner, Director of Urbatopie and author

«By analysing these data, we can propose several desirable principles for a zero-carbon metropolis.

Its urbanised areas must reconcile minimal density (allowing economic mobility) with the possibility of easy solar energy collection and prioritising the place of vegetation. The figure of 30 to 50 dwellings per hectare, corresponding to 7,000 to 10,000 inhabitants per km², which is frequently used by designers of eco-neighbourhoods, gives a good indication of this medium density.

In these urbanised areas, the metropolis can meet a proportion of its own energy needs via solar collectors incorporated into buildings (10% of the floor space).

It must rely on its close hinterland to meet its additional energy requirements (wind and biomass), in addition to the agricultural products required for its basic food needs.»

2.1 / STARTING POINT

IN A NUTSHELL

The baseline of the Carbon Neutrality Strategy is now known and measured via the carbon assessments and the Climate Plan conducted by the city. While the thematic breakdown identifies each major area of action in the Climate Policy, a systemic approach is required to highlight the interactions and interdependency among the different components of the carbon footprint.

2.1.1/ TRANSPORTS



Every day, Parisians travel to work or school, to go shopping or for recreational purposes, and sometimes venture outside the Ile-de-France region for their holidays, professional journeys, or to visit their families, etc.

They are not the only mobile actors in Paris; some one million inhabitants of the inner and outer suburbs travel to work in Paris[1], and 220,000 tourists visit the capital on average![2] Should they be taken into consideration? The question of geographical scope also arises: after crossing the main Paris ring road *(boulevard périphérique)*, should Parisians' emissions be counted by Paris or by the town or city of destination, or divided among the municipalities along their route? The method adopted for this study is consistent with the approach used for the City of Paris's carbon assessments in 2004, 2009 and 2014: it includes all journeys with at least one foot in Paris (origin and/or destination) that are carried out by Parisians or by Ile-de-France residents.

Unfortunately, there is no way of precisely quantifying the number and geography of the journeys made by these populations, nor of identifying which modes of transport they use precisely. For its assessments, the city relies on the statistics provided by transport operators such as the RATP, SNCF and Aéroports de Paris, which carry out their own surveys and possess their own customer data, or by bodies such as AirParif, which monitors air quality and therefore road traffic in Ile-de-France. To estimate the effect of the transformations planned by the Carbon Neutrality Strategy between now and 2050, from the ageing of the population to the ban on car traffic in Paris at the weekend, and including the development of teleworking and telepresence, the study starts with the initial need for travel and asks why, where and how people travel in Paris.

Publicly accessible surveys allow the calculation of detailed estimates of daily mobility[3] and long-distance mobility[4]: what is the proportion of short journeys carried out on foot or by bicycle? How many managerial staff go on holiday by air? What is the vehicle occupancy rate for professional journeys?

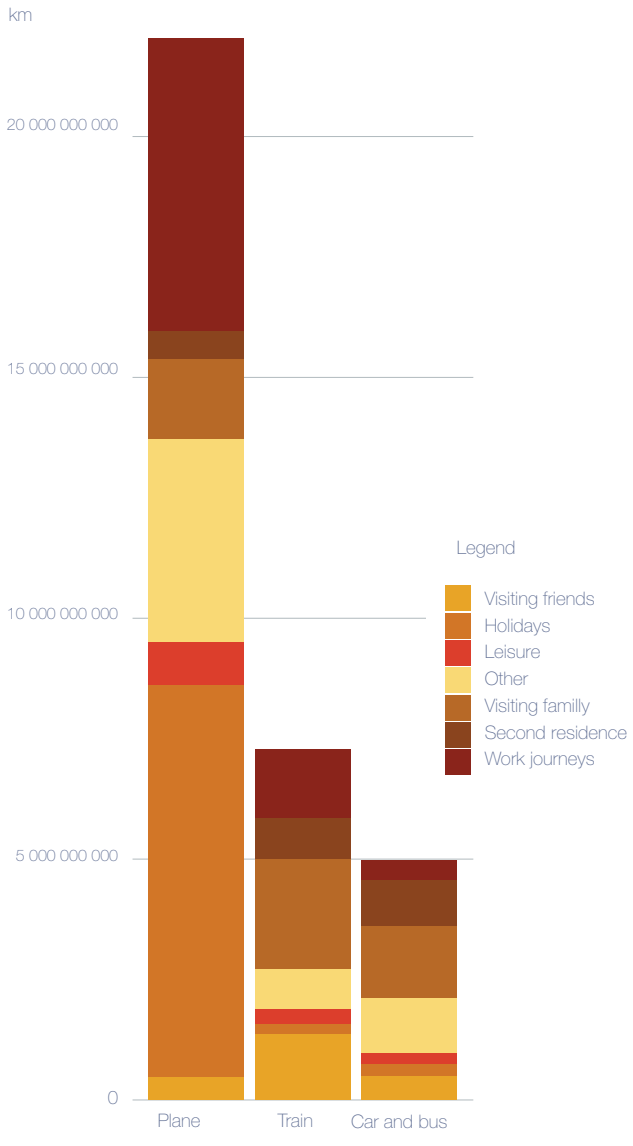
In this way, the results of the modelling indicate that approximately 40 million journeys are carried out by Ile-de-France residents every day of the week – 9 million of them by Parisians! If we confine the scope of the calculation to that of the study (therefore excluding journeys not connected with Paris), this still leaves 13 million journeys, 70% of which are carried out by Parisians. Reasoning in terms of distance rather than the number of journeys, this makes Ile-de-France residents the biggest travellers with 65% of the distances travelled. These are mainly journeys between Paris and the inner suburbs and Paris and the outer suburbs, amounting to 7 and 25 kilometres on average, whereas journeys within central Paris cover about one kilometre. These distances may be relatively short, but they still add up to 8 billion kilometres travelled by Parisians each year, corresponding to an average of nearly 4,000 km per person per year.

Half of all journeys and 80% of the distances are travelled in this way by people going to work, travelling for professional reasons, and going to school or university, followed by shopping, recreation, visits, helping people, etc. Public transport, walking and cycling represent 75% of all journeys and 60% of the distances travelled, with the remainder carried out by car or motorcycle, mainly for professional reasons. The fact of moving people closer to their workplaces (or the opposite), and of reducing or indeed eliminating a proportion of the journeys by teleworking or telepresence, will therefore have a major impact on the number of kilometres travelled and the emissions from the transport sector.

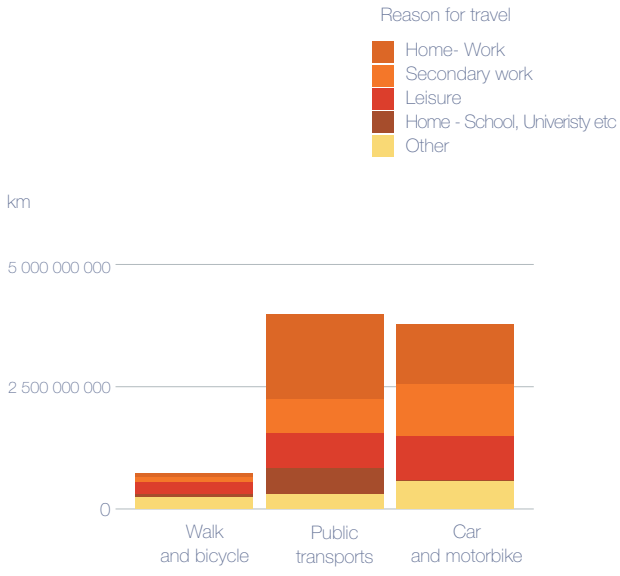
As far as long-distance mobility is concerned, the study counts the journeys made by Parisians between Paris and other French regions or foreign countries: their holidays, professional journeys, visits to second homes or to see their families, etc. At first sight, the 20 million annual journeys calculated seem to be much less than the three billion annual journeys within Paris or the Ile-de-France region described above, but the distances travelled are such that long-distance mobility has a much greater impact in the final analysis: an average of 15,000 kilometres per person and per year, travelled primarily by air (64%), by train (21%) and then by car (14%). However, there is no such thing as the "average" Parisian, and there are enormous differences between managerial staff who travel extensively – on average 26,000 km per person, 19,000 km of which are by air for their holidays and professional journeys – and retired people who only cover 6,000 km per person, mainly for holidays or when travelling to their holiday homes.

Different types of greenhouse gas emissions are associated with these journeys: direct emissions from vehicles generated by fuel combustion and indirect emissions related to the manufacture of vehicles or to the production of

[1] In permanent inhabitant equivalents (inh.eq.), i.e. the number of annual tourist overnight stays divided by 365. *Mobilité touristique et population présente*, 2006, Ministry for Transport and Ministry for Tourism.
[2] Population, logement, emploi dans la métropole du Grand Paris, 2015, APUR.
[3] Enquête Globale Transports, 2012, Omnil.
[4] Enquête Nationale des Déplacements et des Transports 2008, 2010, Ministry for Transport and INSEE.



Distance travelled annually by Parisians for long distance journeys

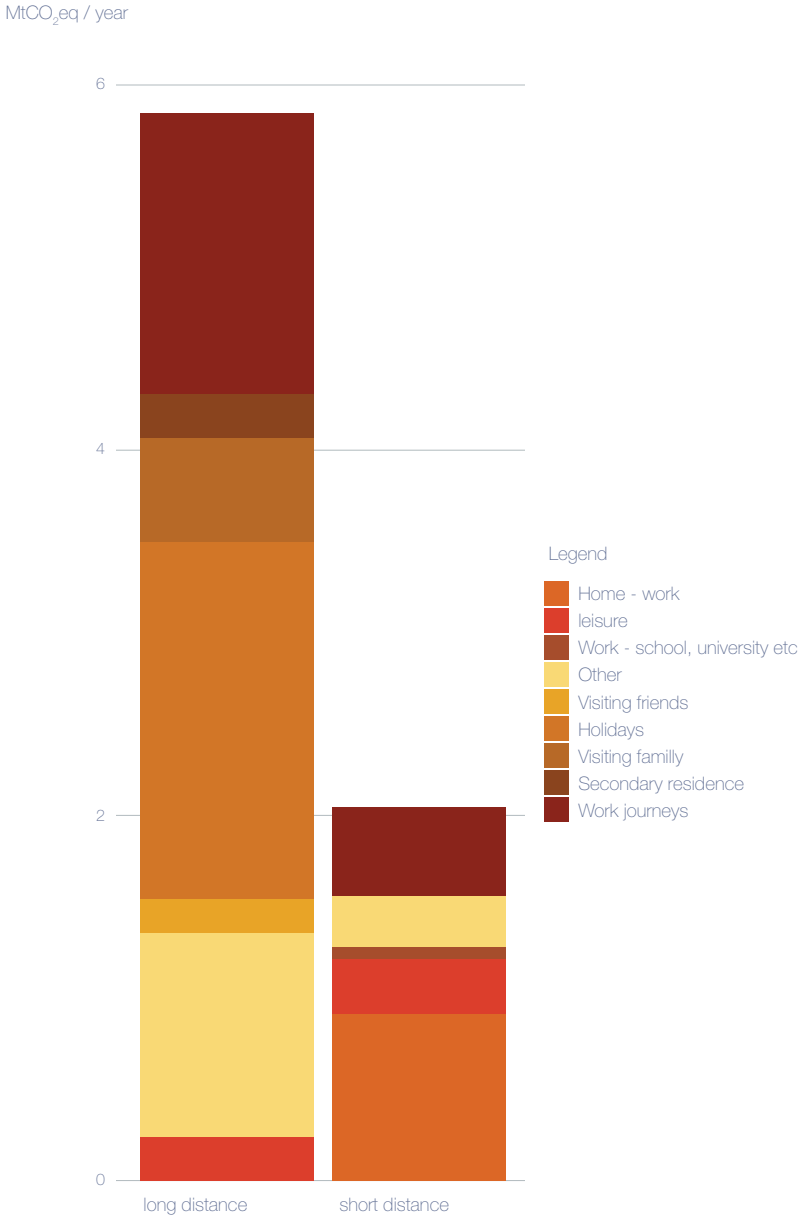


Distance travelled by Parisians annually for daily commuting

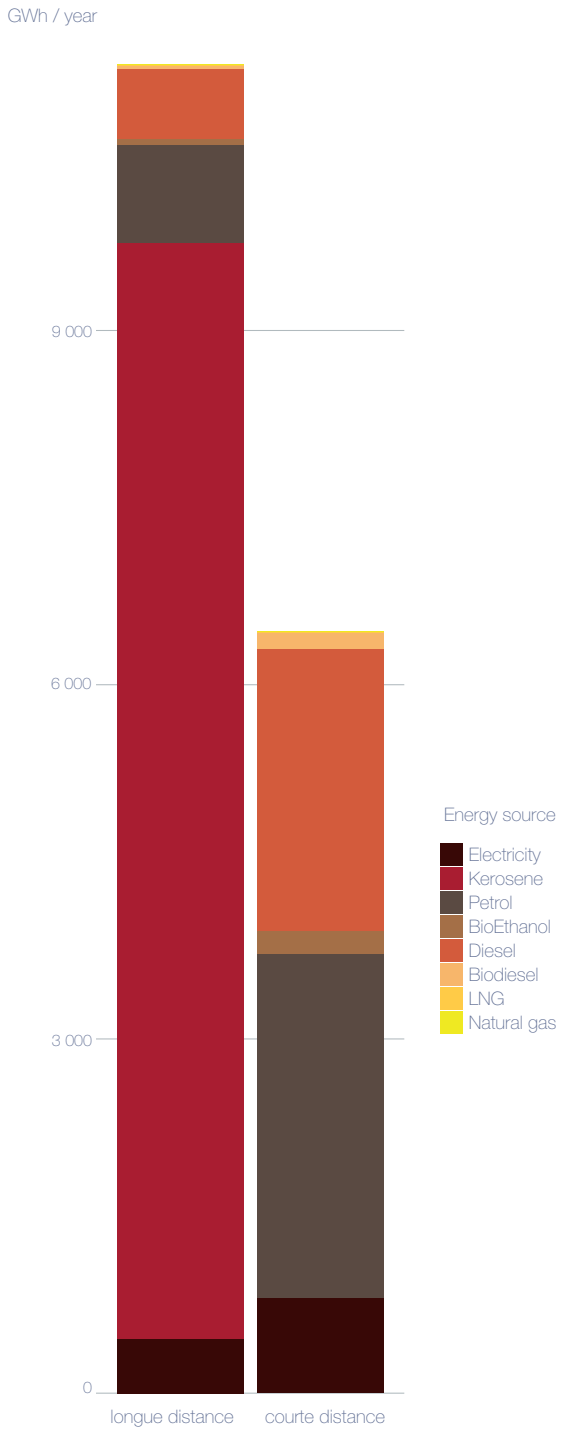
the energy used. Approximately 4 tCO_2eq must be emitted to manufacture a petrol-powered car and 7 tCO_2eq for an electric car,[5] and then approximately 200 gCO_2eq/km and 80 gCO_2eq/km are required to run them, respectively. To avoid counting the emissions from a single vehicle that is used by several people simultaneously several times, the occupancy rate is also taken into account: an underground railway train emits 200 gCO_2eq/km, but with an average occupancy rate of 40 people the emissions per passenger carried are close to 5 gCO_2eq/km. Conversely, this occupancy figure is currently 1.06 persons per car for home-work journeys in the Ile-de-France region, which gives emissions of approximately 190 gCO_2eq/km per person. This clearly shows the benefit of filling vacant seats in vehicles and the potential of public transport use and car sharing to reduce emissions.

All in all, the emissions generated by the transportation of people within the calculation area may amount to 7.9 $MtCO_2eq$ per year[6] and consume 16,600 GWh of final energy per year. Short-distance mobility accounts for one quarter of these emissions – especially due to home-work and professional journeys (68%) – and one third of the energy consumption, consisting of 82% petrol and diesel and 13% electricity (with the remainder being mainly biodiesel and bioethanol incorporated into fuels at the pump). The three-quarters of emissions that are generated by long-distance mobility can be mainly attributed to holiday journeys (33%) and professional mobility (26%), and the associated energy consumption is primarily derived from aircraft kerosene (82%) and car fuel (13%).

[5] Production, according to life-cycle analysis principles, of energy assessments, greenhouse gas emissions and other environmental impacts induced by all electric and internal combustion-engine-powered vehicle sectors, sector b passenger cars (multipurpose town cars) and light commercial vehicles for the 2012 and 2020 horizons, 2011, ADEME.
[6] The City of Paris's 2014 Carbon assessment estimates this figure at 8.4 $MtCO_2eq$ per year; the difference may be explained by methodological differences in the production of the assessment, as described previously.



Mobility emissions



Mobility energy consumption by source

2.1.2/ BUILDINGS

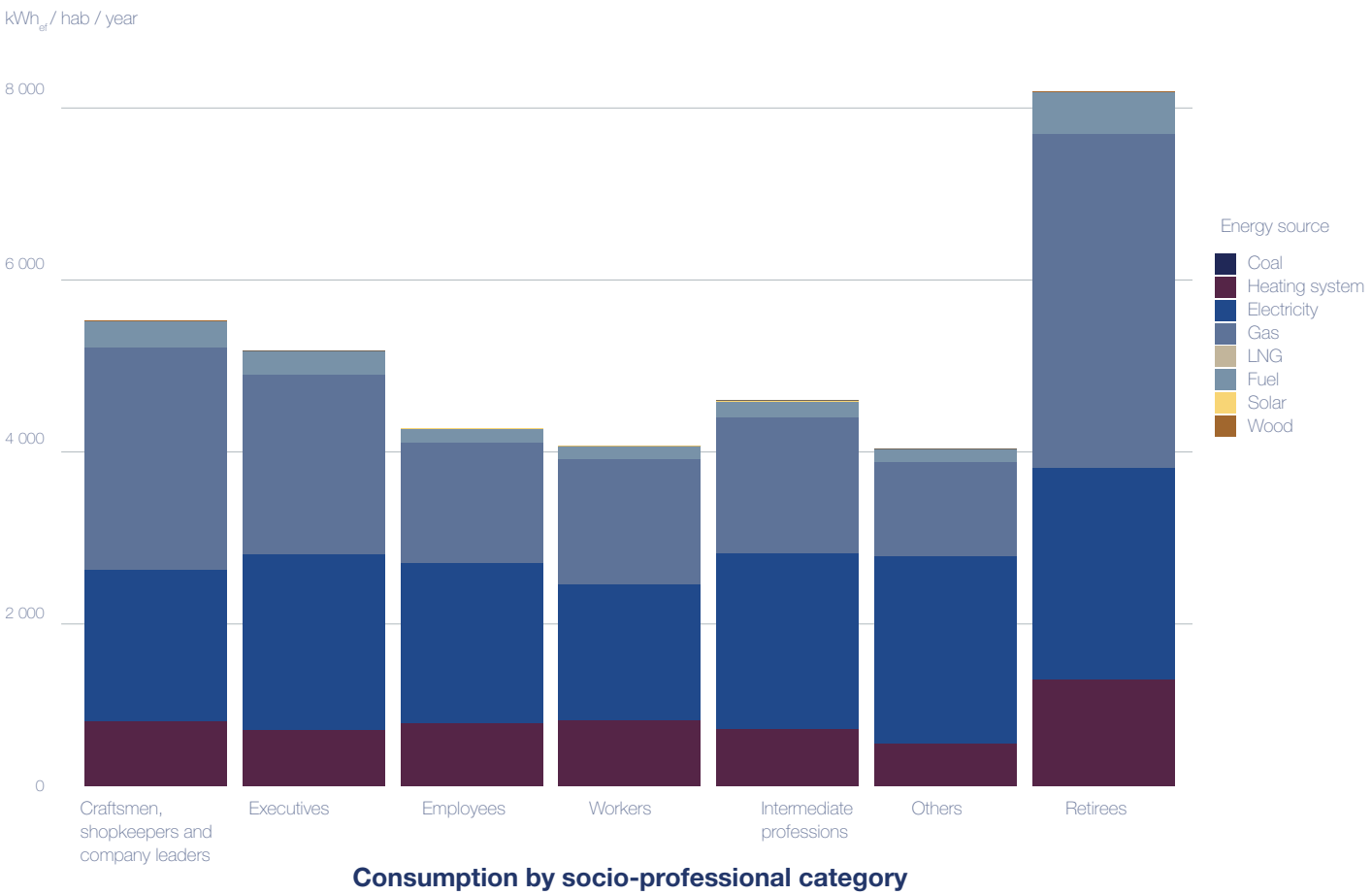
Parisians constantly consume energy in their homes or in their workplaces: for heating, air conditioning, lighting or ventilation of buildings, powering or recharging different appliances, heating water, and storing or cooking food. Multiple energy sources and vectors are mobilised to meet these needs: electricity, gas, steam, etc.

This brings us to the usual questions of scope: should we count the consumption of Parisians who work in office blocks outside Paris? And the consumption of Ile-de-France-resident employees who travel to Paris? The scope chosen by the City of Paris for its carbon assessments and this study is purely geographical, and includes all square metres of space built in Paris, irrespective of whether they are used by residents (dwellings, offices, shops, restaurants, hospitals, etc.). On this scale, grid managers provide the statistics for the quantities of energy injected into the grid to cover consumption: Enedis for electricity, GRdF for gas, and CPCU for vapour in the heating network. However, as we do not know who consumes this energy or for what uses, the detailed aspects of the energy assessment are modelled according to the consumption ratios supplied by the CEREN to create the energy assessment for the City of Paris.[7] INSEE survey data[8] are used to associate consumption with people and not only with square metres of space: what types of households in what types of dwellings? What surface area per person according to the age of the inhabitants or their socio-professional category?

The results show that Parisians consume approximately 12,100 GWh of final energy per year in their dwellings (corresponding to an average of 5,400 kWh per inhabitant), especially for heating (53%) and domestic hot water production (16%), above all from gas and electricity (40%) and electricity (38%). An analysis per socio-professional category reveals contrasts in household consumption, with retired people consuming 8,200 kWh/inhab., managerial staff 5,200 kWh/inhab., and employees 4,300 kWh/inhab.

An initial explanation resides in the size of apartments, averaging 55 m² in Paris and 73 m² for retired people, 57 m² for managerial staff and 42 m² for employees: heating consumptions are proportional to the surface area, consequently the overall consumption of dwellings rises as their size increases. A second explanation relates to the size of households, currently averaging 1.9 persons per household in Paris, 1.5 pers./household for retired people, 2.1 pers./household for managerial staff and 1.9 pers./household for employees. One household of several people shares its square metres of space, household electrical appliances and lighting among its different members, but one person living alone does not have the opportunity to pool these consumptions, which further increases his or her personal consumption. There is a relatively even distribution of the construction dates of dwellings throughout the different populations which does not, therefore, contribute to differences in consumption, but there is a greater variety in the types of heating systems which are also an extremely important factor. Retired people are above (+11%) the average of 35% of households equipped with inefficient gas heating systems, whereas employees are below this average (-7%), for example.

[7] Bilan énergétique de Paris 2009, 2011, Mairie de Paris.
[8] 2013, 2016 surveys, INSEE.



Consumption by socio-professional category

In the tertiary sector, 15,800 GWh of final energy per year are consumed by the 1.8 million employees working in Paris and the 59 million square metres of buildings that accommodate them (i.e. 8,800 kWh/job and 266 kWh/m² on average), especially for heating and air conditioning the buildings (37% and 19%), primarily by electricity (57%) and gas (21%). In Paris, buildings are mainly used as offices or business premises in terms of surface area (38% and 18% respectively), and are primarily occupied by private operators (70%), with the remainder shared between the City of Paris (6%) and the other public and parapublic territorial stakeholders (24 %).

Many of the variations in energy consumption can be explained by the different activities carried out in buildings used for different purposes: cafés, hotels and restaurants consume above-average amounts of energy for cooking, recreational facilities and businesses consume more energy for lighting, offices use more energy for office computing applications, etc. This is reflected by the unit energy consumptions per m², with a difference of 235 kWh/m² between the most energy-hungry category of cafés, hotels and restaurants at 385 kWh/m², and the least energy-hungry category – education and research – at 150 kWh/m². In absolute values, offices consume the most energy (5,000 GWh, or 32% of the total), followed by cultural facilities (1,300 GWh, or 8% of the total) and restaurants (1,200 GWh, or 8% of the total).



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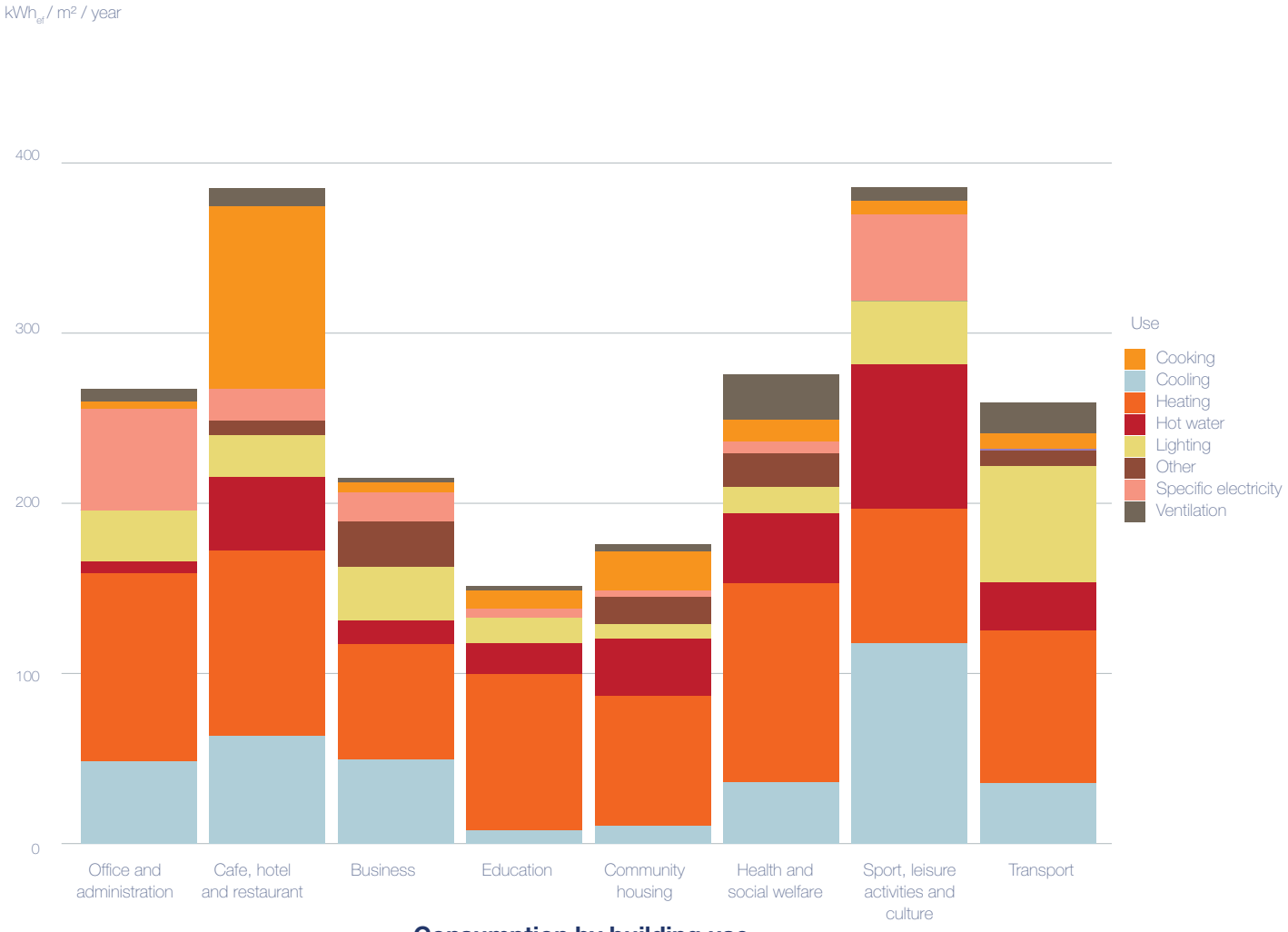
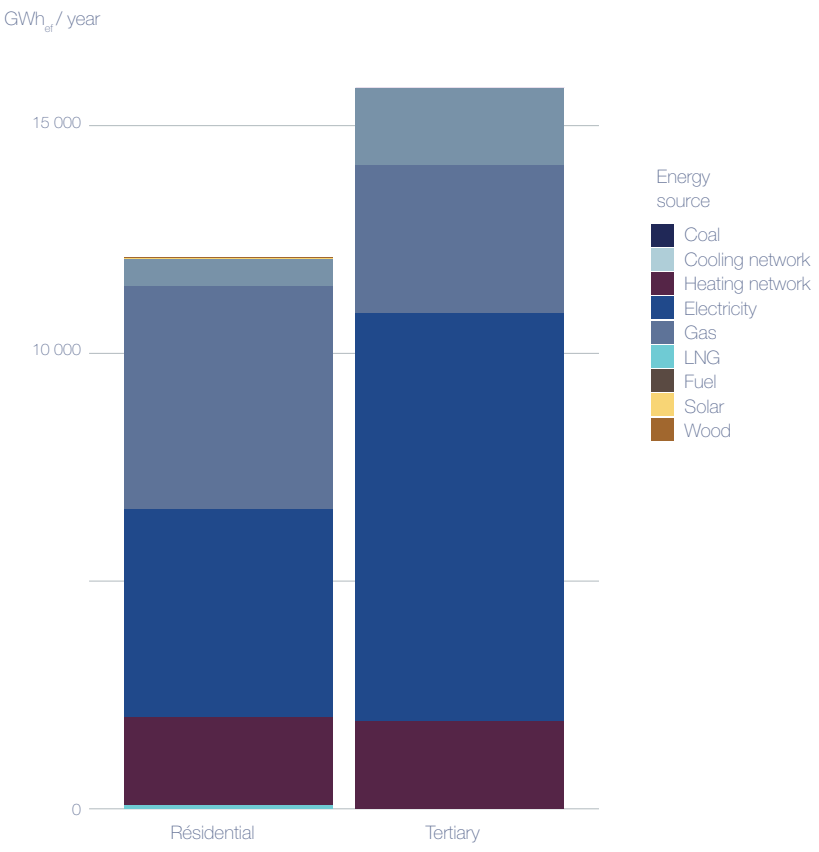


Consumption by building use

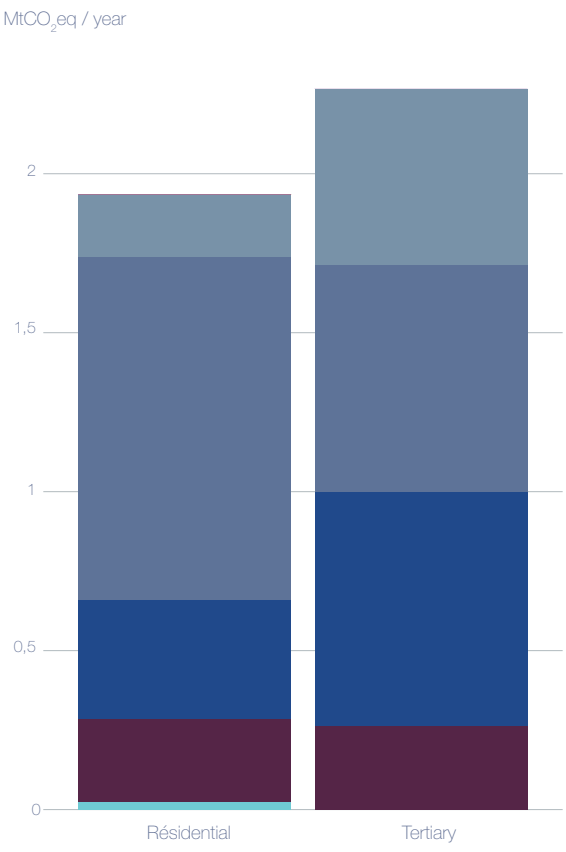
These energy consumptions generate direct greenhouse gas emissions, during gas combustion for example, or indirect emissions related to the production of electricity or steam, or the supply of fuels (referred to as "upstream emissions"). In this way, each kWh of gas emits approximately 200 gCO_2eq/kWh on combustion and 4 gCO-eq/kWh upstream. Conversely, there are no combustion emissions for each kWh of electricity, but there are approximately 80 gCO_2eq/kWh of upstream emissions. The key issue for national energy transition consists firstly of reducing energy consumption by improving uses, by renovating buildings or by increasing the energy efficiency of installations and equipment, before reducing the total carbon intensity of these energy vectors (electricity, gas, steam or water in heating and cooling networks, etc.), i.e. the unit emissions for a kWh consumed.

For all uses and all types of energy, 1 kWh consumed in the tertiary sector emits 140 gCO_2eq on average, rising to 160 gCO_2eq in the residential sector due to the greater use of gas in housing and electricity in tertiary buildings. All in all, this leads to an annual energy consumption of 28,000 GWh and to corresponding emissions of 4.2 $MtCO_2eq$. Three quarters of this energy are used for thermal applications (heating, air conditioning, domestic hot water and cooking), which represent 85% of the emissions. Fossil energy sources with high carbon intensity have a detrimental impact on the overall emissions, with gas representing just 8% of overall consumption but 25% of the emissions, and fuel oil representing just 6% of overall consumption but 13% of the emissions!

The energy consumption emissions mentioned previously correspond to those generated during the operation of buildings, but their construction, renovation and demolition must also be taken into consideration. Between 2009 and 2014, approximately 410,000 m^2 of tertiary premises and 280,000 m^2 of dwellings were built per year, which generated emissions of 330,000 tCO_2eq, corresponding to an average of 490 $kgCO_2eq/m^2$. Depending on the performance and uses of the buildings, this may correspond to several decades of operating emissions, which increases the need to reduce this embedded carbon, while also improving their energy performance.



Energy consumption of building by type



Building emissions

2.1.3/ FREIGHT

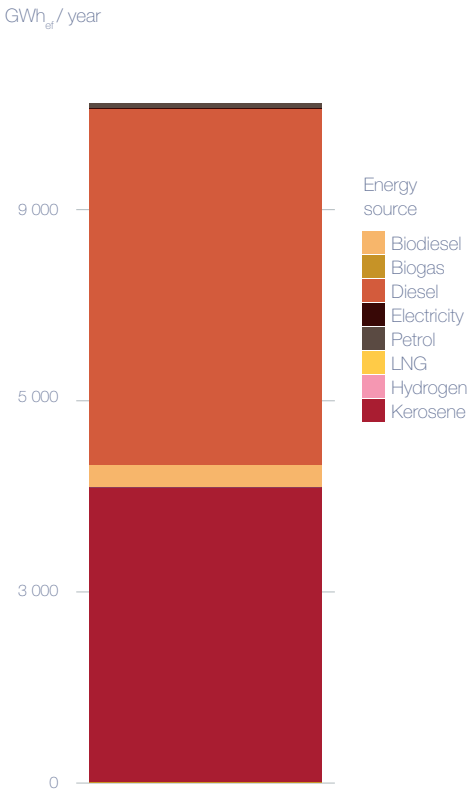
The activities taking place in the territory of the City of Paris set in motion vast flows of materials – raw materials, foodstuffs, capital goods, construction materials, etc. – to and from other regions of France and foreign countries, by road, air, rail and inland waterways.

The standard unit used to describe these flows is the tonne-kilometre (tkm), which corresponds to the transportation of one tonne of goods over a distance of one kilometre and combines information about quantity and distance. Consequently, it is impossible to differentiate between 10 tonnes of vegetables that have travelled 1,000 km and 1 tonne of fruit that has travelled 10,000 km (both will be counted as 10,000 tkm). The available data do not reveal what is transported and do not identify the senders or recipients of these flows. Insufficient data also means that the recording method does not take entire logistics chains into account – only their final links that enter the Paris area (extended to Roissy-CDG and Orly airports). Therefore, goods produced in Asia, shipped to the port of Rotterdam by container ship and then transported to Paris by lorry will only be counted for this final journey.

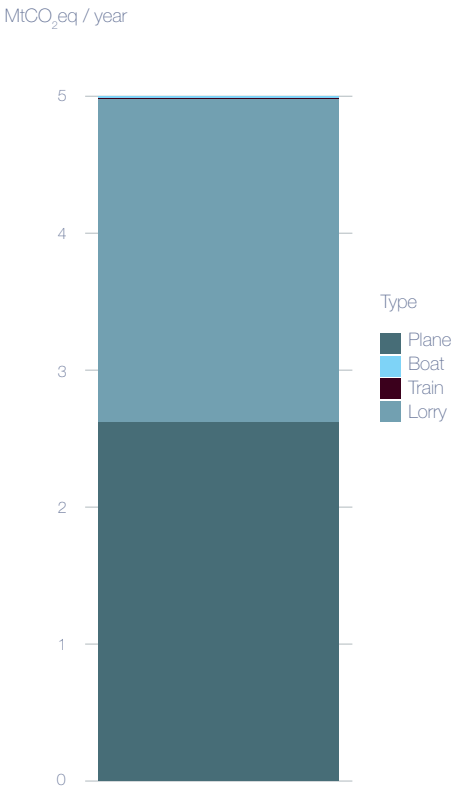
Overall, the aggregated flows recorded in this way amount to 6.5 billion tkm on an annual basis, corresponding to approximately 1,600 tkm per inhabitant and job, or 4 kilogrammes transported for a distance of 1,000 kilometres each day per inhabitant and per job. Two thirds of these journeys are imports and the almost all of the remainder are exports, with Paris's internal flows being small in terms of tkm (3%) as the distances travelled are short. 80% of the flows are domestic within France and the remainder may travel great distances, e.g. from Asia (10% of the total tkm) or from the American continent (6% of the total). Three quarters of the flows are transported by road (73%), followed by air (18%), inland waterways (5%) and rail (4%).

Therefore, tonne-kilometres reflect the intensity of goods flows, to which must be added the emissions from the vehicles that make them possible, which are very variable: from 2.5 $kgCO_2eq$/(tkm) for small vehicles (small van-type) to 0.1 $kgCO_2eq$/(tkm) for semi-trailers, and 2.2 $kgCO_2eq$/(tkm) for aircraft (for distances of 9,000 to 10,000 km). Rail and inland waterway transport emit fewer emissions by a factor of 100 to 1,000: 4 gCO_2eq/(tkm) for trains and 30 gCO_2eq/ (tkm) for barges! Switching to these modes will therefore be highly beneficial, but how can we manage the "last-mile logistics" that are difficult to transfer to bulk modes?

All in all, freight transportation emits 5 $MtCO_2eq$ per year, corresponding to approximately 0.8 $kgCO_2eq$ per tonne-kilometre transported. Air freight accounts for a disproportionately high share – 52% of total emissions – due to its poor carbon performance, although it only accounts for 18% of the flows. Conversely, rail and inland waterways represent 9% of the flows but only generate 0.2% of total emissions. The energy consumption of the vehicles used is 10,800 GWh, especially diesel at 55% (+2% for petrol) and kerosene at 43%.



Freight energy consumption by type



Annual equivalent emissions related to freight transportation, for Parisians

2.1.4/ CONSUMPTION, MATERIALS AND WASTE



Food

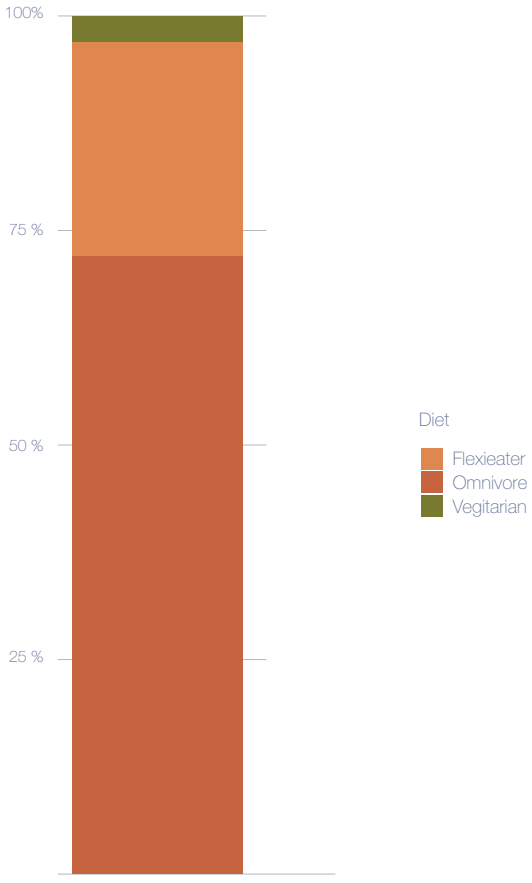
Food is the most basic and immediate need of inhabitants and workers, and the choice of diet, agricultural methods and sources of supply have a decisive impact on the balance of greenhouse gas emissions.

Approximately 2.5 $kgCO_2eq$ are emitted in order to supply 100 g of meat to the consumer, dropping to 1.4 $kgCO_2eq$ for 100 g of cheese, and 0.4 $kgCO_2eq$ for 100 g of vegetables, etc. In this way, 2.27 $kgCO_2eq$ of emissions may be generated for the production of the average French meal, corresponding to nearly $2tCO_2eq$ for an "average" person, i.e. the same order of magnitude as the typical electricity consumption of ten Parisians – approximately 20,000 kWh. As the emissions per type of food vary greatly, diet also leads to very different emission factors per meal: vegetarian meals are likely to emit around 0.4 $kgCO_2eq$ per meal, while meat-based meals may emit five to 10 times more according to the types of meat used, at around 3 $kgCO_2eq$/meal. The study is based on the initial assumption that around three quarters of Parisians have a meat diet (72%), a small proportion of the population is vegetarian (3%) and the remaining quarter falls somewhere between these two types of diet, adopting a position sometimes referred to as "flexitarianism".

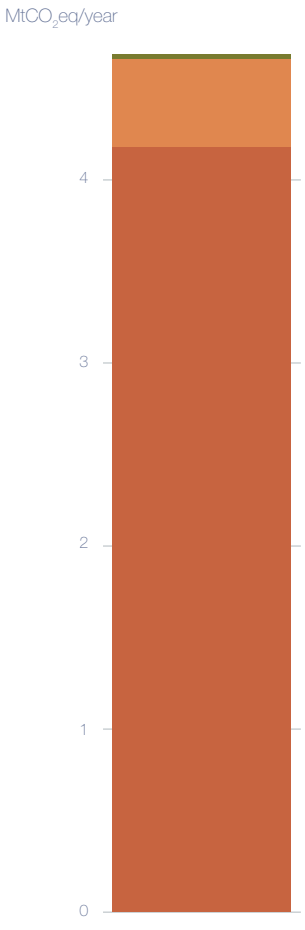
The emissions of foodstuffs at the consumer level combine the emissions generated by the production of raw foods (65%), their processing (15%), their packaging (5%), their long-distance transportation (8%) and finally from their last-mile delivery (7%).[1] The local food supply system is already relatively well developed given that 60% of foodstuffs (based on their nitrogen – i.e. protein – content) travel less than 250 km from their production site to Paris.[2] Diets followed by agricultural production methods are therefore the biggest potential sources of reduction.

The food consumed by Parisians and workers from Ile-de-France in Paris therefore emits 4.7 $MtCO_2eq$/year, i.e. almost matching the emissions from tertiary buildings and housing.

[9] Average distribution of emission factors derived from the FoodGES database, 2015, ADEME.
[10] L'empreinte alimentaire de Paris en 2030, 2011, Billen.



Division of different diets of the population of Paris

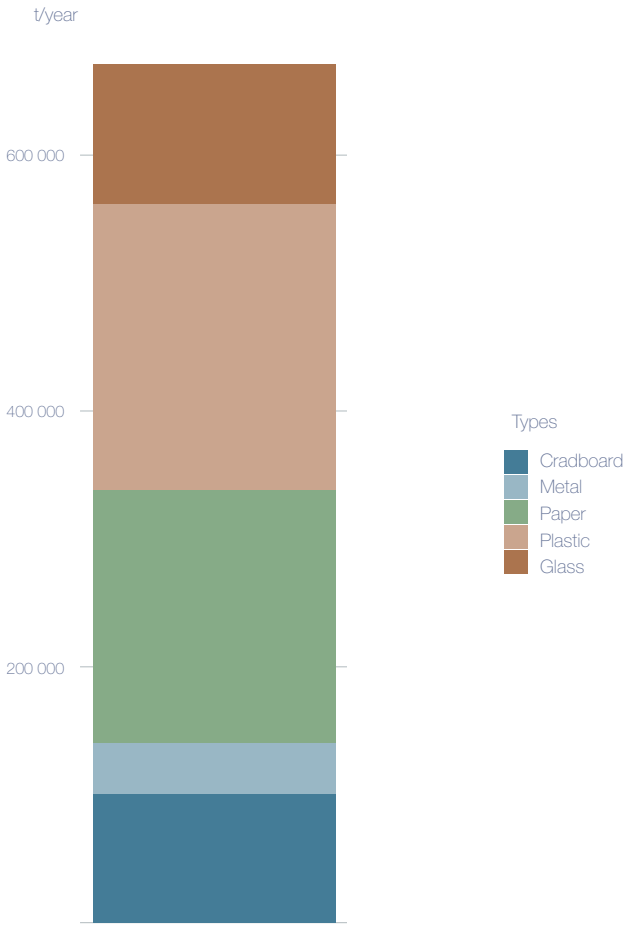


Annual equivalent emissions for food consumption in Paris

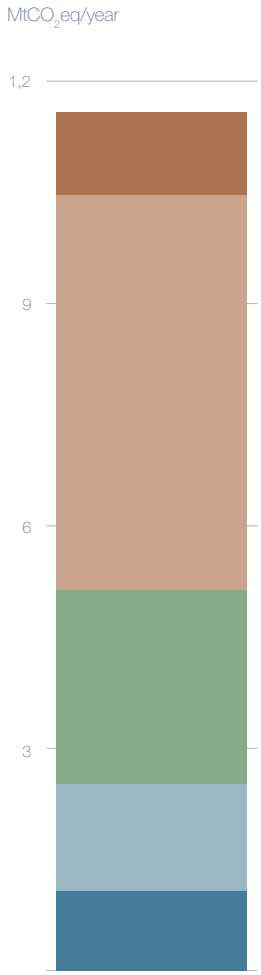
Consumer goods

In addition to food, Parisians purchase equipment, clothing and furniture, etc. How can we determine the emissions associated with the production of these consumer goods? Their constituent materials and production techniques are specific to each item, but it is impossible to measure the flows at this level of accuracy because we do not know exactly what enters Paris. The transportation of these products is taken into account by the freight sector, but without differentiating between them according to their type, with one kilogramme of electronic goods being treated in exactly the same way as one kilogramme of clothing. As we do not know how to quantify what enters the Paris area, we will therefore partly count what leaves the area during waste collections, and the estimation of the quantities of products consumed per major family of materials (paper, cardboard, plastics, metals and glass) will be derived from these measurements.

The flow of materials consumed by Parisians and workers that is calculated in this way is estimated at 670,000 tonnes of goods, whose production generates the emission of 1.1 $MtCO_2eq$, or 1.7 $kgCO_2eq/kg$ of imported material. By weight, nearly half (45%) of this flow consists of paper and cardboard, and one third consists of plastics (33%), but in terms of emissions, this ranking is reversed with plastics accounting for 46% of the total and paper and cardboard 32%.



Annual flow of consumed goods to Parisians (mass)



Equivalent Annual Emissions of Parisians due to consumption of goods

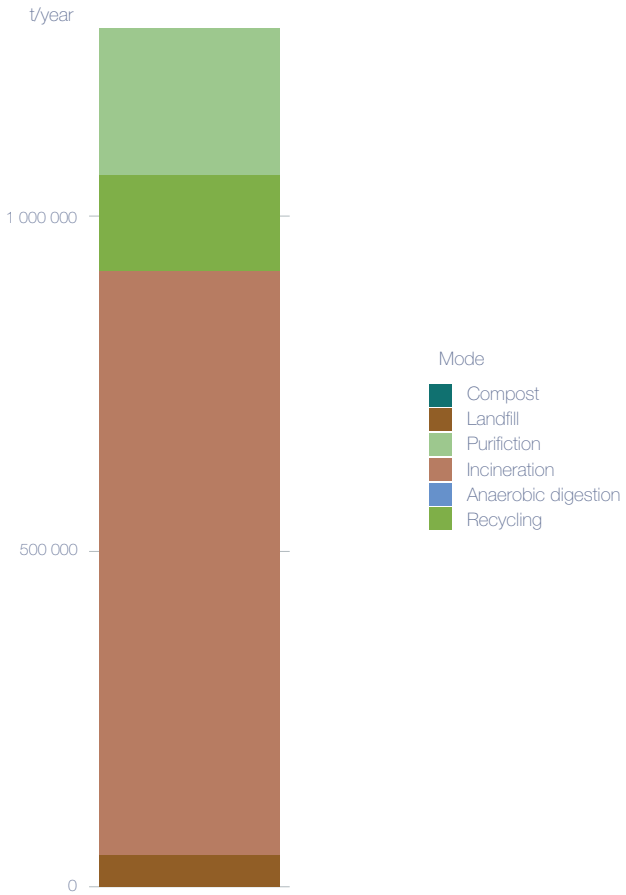
Waste

According to the measurements associated with the collection and processing of waste in Paris, it is estimated that approximately 1.1 million tonnes of solid waste are generated by Parisians and workers annually, or 263 kg per person and per year. 220 million cubic metres of wastewater are also generated each year, or 54 cubic metres per person.

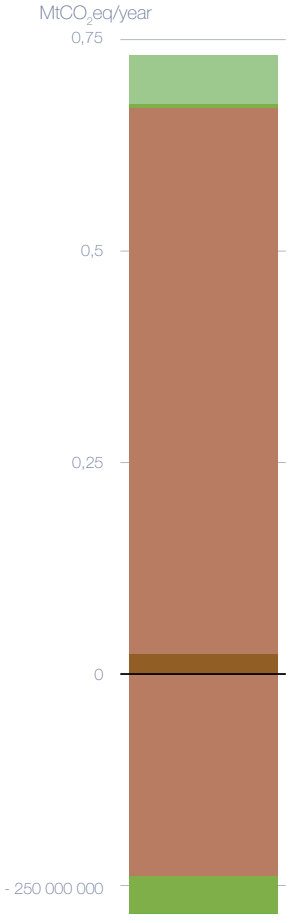
Depending on the situation, these flows may be recycled, composted, methanised, incinerated, landfilled or depolluted, and the choice of processing method has a significant impact on emissions: the landfilling of household waste generates 440 $kgCO_2eq$ per tonne, incineration 362 $kgCO_2eq$ per tonne, recycling 33 $kgCO_2eq$ per tonne, etc. Waste may also generate "negative emissions" due to the substitution effect in a circular-economy-type mode of operation.

Considering the fact that one kilogramme of recycled paper contributes to reducing the use of new raw materials and their processing, the action of recycling does indeed reduce the territory's emissions. The same reasoning explains how the incineration of waste can eliminate the need for fuel oil or coal to generate steam for the Paris heating network.

The vast majority (88%) of the 0.7 $MtCO_2eq$ of annual solid and liquid waste emissions relate to incineration, with purification accounting for 8% and landfilling 3% (95% of solid non-recycled waste is indeed incinerated). Waste processing should prevent the emission of 0.3 $MtCO_2eq$ per year, especially due to the substitution effect concerning incineration and secondly recycling (15%).



Annual waste of Parisians (mass)



Annual equivalent emissions linked to waste for Parisians

2.1.5/ 2016 ASSESSMENT

The total emissions for the City of Paris are obtained by adding together the emissions from the different sectors, which amounts to 25.6 $MtCO_2eq$ per year?[1] corresponding to just over 10 tCO_2eq per inhabitant: one third for the mobility of people, one quarter for the consumption and waste sector, one fifth for the transportation of goods and one fifth for the building sector.

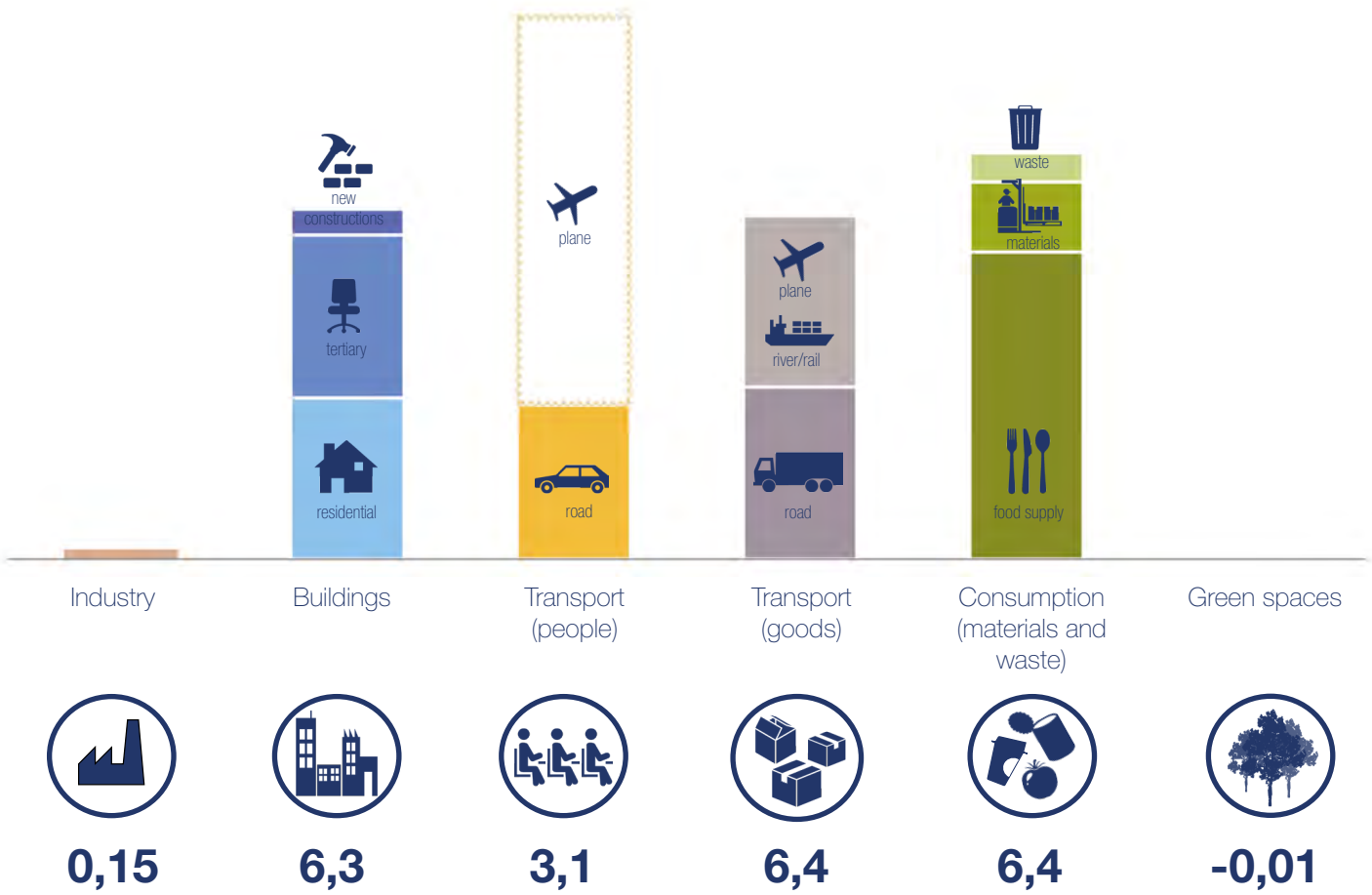
These figures are helpful in guiding the actions of different stakeholders in the transition towards carbon neutrality, but an overall assessment glosses over the individual differences in emission levels and creates an image of the average person that does not correspond to any real Parisian lifestyle. This is why the study proposes to replicate the work carried out at the territorial level for a set of families, in order to describe these contrasting uses and the equally contrasting associated emissions.

The construction of the assessment also reveals the importance of the inhabitants' consumer habits and lifestyles in the City of Paris's emissions: choices of holiday destinations and the practice of car-sharing have a decisive impact on passenger transport emissions; purchasing products transported for long distances by air or by road has an enormous impact on emissions generated by freight transportation; dietary choices impact emissions in the consumption sector; the sizes of households and the available housing surface area per person affect building sector emissions, etc.

Therefore, the main way to reduce greenhouse gas emissions without delay is to change people's practices. Then comes the improvement of technical systems, which is a more difficult and complex process: replacing heating systems powered by fossil fuels, renovating all the buildings in Paris, replacing highly inefficient internal combustion-engine-powered vehicles with fuel-efficient hybrid or electric vehicles, increasing the share of renewables in the mix for electricity grids, heating and gas networks, etc.

[11] The emissions from each sector are adjusted to coincide with the emission levels obtained by the City of Paris in its 2014 Carbon Assessment..

2016 PARIS CARBON ASSESSMENT



19,6 $MtCO_2eq$

25.6 $MtCO_2eq$ (with air transport)



Exposition +2°C… Paris s'invente ! © Collectif et alors Y. Gourvil et C. Leroux, 2010

City of Melbourne, Kate Vinot
Director of Urban Strategy

« The carbon neutrality of the city is technically achievable because the technologies required to reduce energy demand, supply renewable sources of energy and replace fossil energy sources are available on the market today. […] By committing to the zero emission objective, the City of Melbourne is attracting attention from regions and the State, which is encouraging other Australian cities to share the same ambitions. »

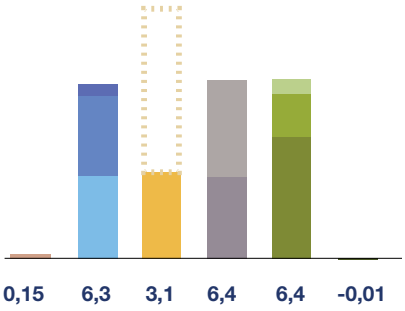
2.2 / THE EMISSION REDUCTION TRAJECTORY

IN A NUTSHELL

The Carbon Neutrality Strategy sets the course for transition between 2016 and 2050. In addition, the cumulative emissions over this period must be minimised. Therefore, not only must the target be attained, a reduction trajectory must also be defined that allows for a massive reduction in emissions from the initial stages of the strategy. A trajectory in the form of a "long plateau before jumping off the cliff" would be… suicidal.

80% REDUCTION COMPARED TO 2004

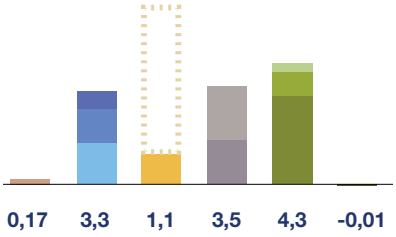
2004



22,3 $MtCO_2eq$

Transport (people), not including by plane

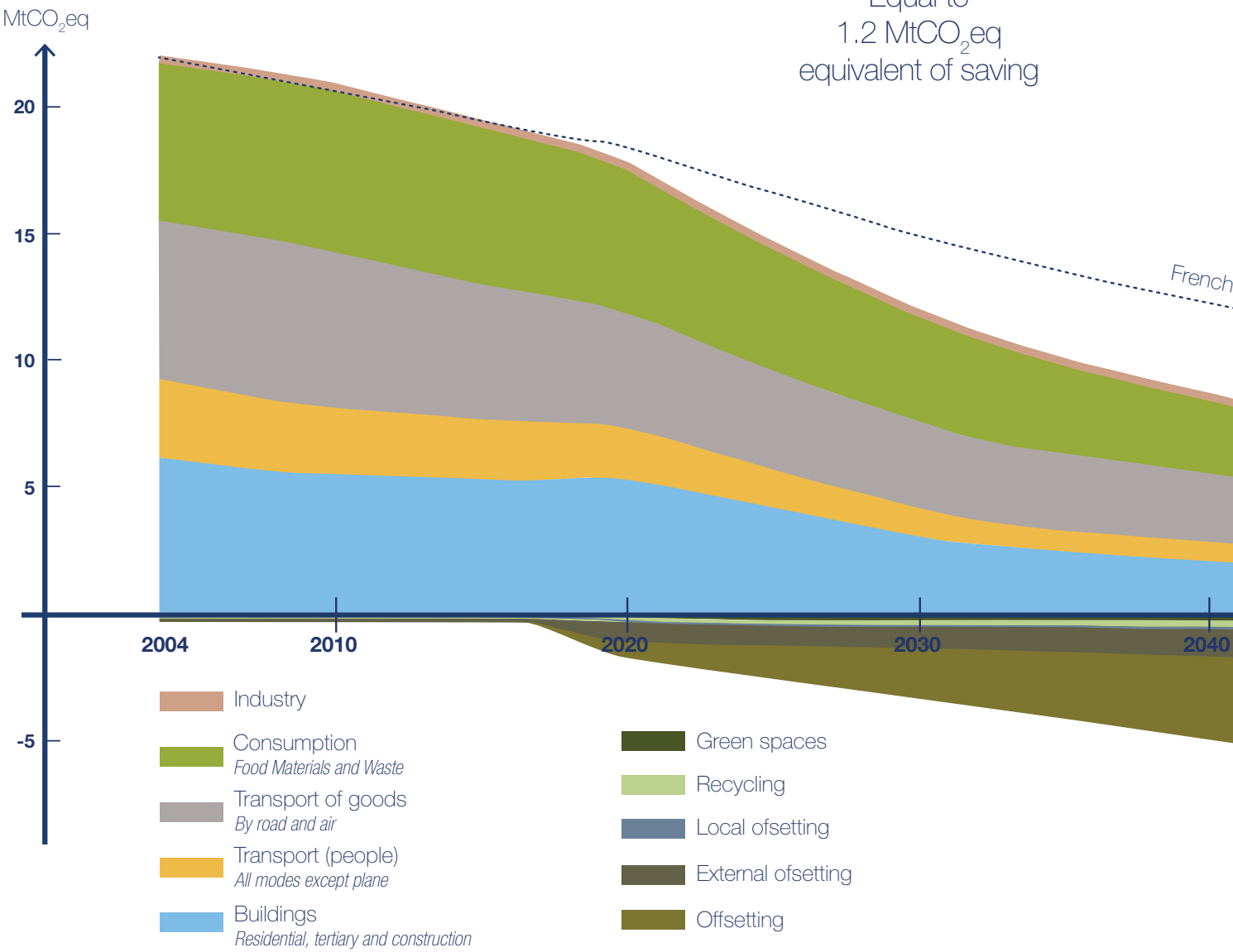
2030



12,4 $MtCO_2eq$

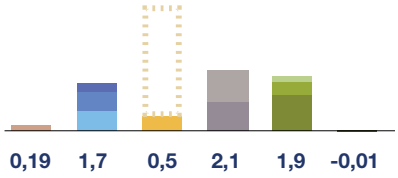
-50%

Equal to
1.2 $MtCO_2eq$
equivalent of saving



OVERVIEW

2050

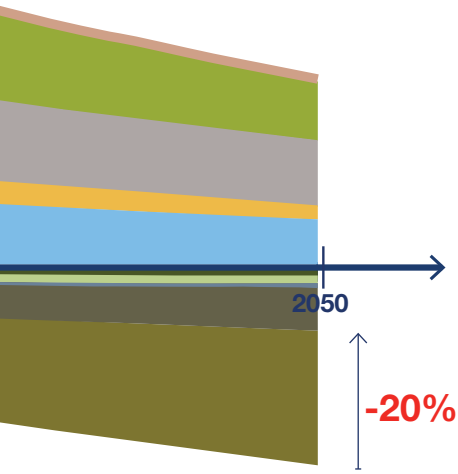


6,4 $MtCO_2eq$

-80%

Equal to
2 $MtCO_2eq$
equivalent of saving

National Low Carbon strategy



-20%

Neutrality

Equal to
4.4 $MtCO_2$
equivalent of
saving

THE ESSENTIALS

Updated in 2012, the Paris Climate Plan sets ambitious targets in terms of reducing the carbon footprint by 2020. Carbon neutrality by 2050 extends the intensity of these efforts. This trajectory could be considered ambitious, but above all, it is **reasonable**: undertaking key structural actions in the first 15 years rather than waiting until the last minute is more sensible and responsible than passing on a disproportionate risk and responsibility to future generations and therefore to the children of today. It is also rational: we can calculate the maximum amount of carbon that we can emit between now and 2050 to maintain a 2-in-3 chance of keeping global warming below 1.5°C. By managing this carbon budget sparingly, and therefore by reducing our emissions rapidly and significantly, we will give ourselves room for manoeuvre in the years to come.

Paris is seeking to play an exemplary role in this movement: tending towards neutrality while counting the majority of emissions related to its citizens' lifestyles. This is the scenario and the fundamental ambition.

This goal will be a marathon endeavour, a race against the clock towards neutrality. It is an immense challenge that will require a determined, long-term commitment over six consecutive political terms of office. The next few years will be decisive in building the momentum required for this process, by reassuring and motivating all of the inhabitants and all of the city's stakeholders to join the movement with **the goal of an 80% reduction relative to 2004 by incorporating renewable energy sources.**

Eric Vidalenc
Responsable Pôle Transition Energétique,
Direction Régionale Hauts de France, ADEME

A carbon neutral city is possible in the medium term, in 2050 at the earliest, but it cannot be achieved within one or two elective terms. It is thus necessary to integrate structural actions in infrastructure projects and to reach a consensus with the territory stakeholders to adopt more behavioural or «soft» measures..

2.2.1/ CARBON FORECASTING

Assessing the recent past is already a daunting task, but the forecasting exercise established for the Paris Carbon Neutrality Study is even more complex, involving the quantification of seven carbon assessments: one in 2016 followed by another every six years from 2020 to 2050, according to several scenarios.

Many influencing factors will change during this period: the population of Paris, the construction dynamics in housing and the tertiary sector, changes in the national energy mix, changing mobility practices, new transport technologies, etc. The model used to describe the territory must therefore be extended to represent the wide variety of possible changes in the different sectors, which may relate to uses (number of long-distance journeys per person, and whether or not they are made by air) or to technology (reduced kerosene consumption). For each scenario and for each of the seven projected balances, all of the information describing these influencing factors must be evaluated precisely.

Since we are dealing with the future, there are no surveys or measurements to be used for modelling purposes, only other forward studies by different stakeholders attempting to set the scene for the next 35 years: changes in the Paris population according to INSEE, the rise of biofuels in road transport according to the IEA, changes in the French electricity production mix according to ADEME, etc. To these factors can be added political or regulatory objectives such as those contained in the French Energy Transition Act.

Rather than being used to create a forecast, these sequences of carbon assessments are used to develop possible scenarios describing desirable futures that are compatible with limiting the temperature rise to 2°C by 2100. The aim of this study is to develop these possible carbon neutrality trajectories at the City of Paris level, and to describe this transition as seen from the Parisians' perspective and in light of the diversity of their practices, while avoiding references to the "average" Parisian. Therefore, the modelling strategy consists of representing, as closely as possible, the population's needs and practices, which are the biggest drivers of change, having an even bigger impact than the technological responses.

2.2.2/ POPULATION, PRACTICES, TECHNOLOGIES AND EMISSIONS

The study is based on different surveys which segment the population according to age, socio-professional category and type of household, in order to understand, model and then map out the characteristics of the Paris population and its practices related to daily mobility, long-distance mobility and housing, etc. Managerial staff travel by air much more often than manual workers and employees; company directors, shopkeepers and craftspeople travel by car more frequently than managerial staff, retired people live in homes with more dwelling space than the Paris average... The Paris population will change between 2016 and 2050: the population should rise by approximately 200,000 people, the number of retired people is expected to rise by 35%, and the average number of people per household is likely to drop from 1.9 to 1.8… This reconfiguration will lead to a "natural" change in emissions, even if practices remain unchanged.

We can then consider how these needs and practices can be transformed: to what extent will teleworking reduce the need for commuting journeys? How many Parisians will become "flexitarians" or vegetarians?



Paul Hawken
environmentalist, entrepreneur, author and activist

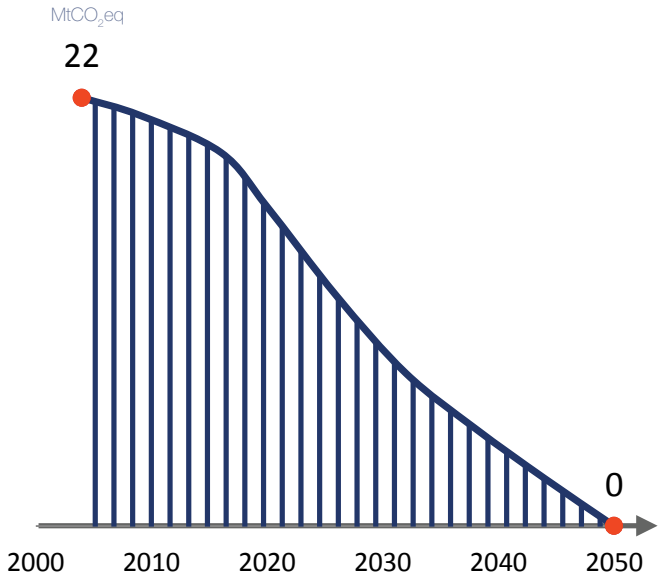
« When people ask me whether I'm optimistic about the future, my answer is always the same: if you look at the science about what is happening on Earth and aren't pessimistic, you don't understand the data. But if you meet the people who are working to restore this Earth and the lives of the poor, and you aren't optimistic, you haven't got a pulse. »

Speech at the University of Portland in 2009

WHAT IS THE CARBON BUDGET?

Greenhouse gas reduction targets are often set for the very specific future deadline of 2050, such as the fourfold (or "Factor 4") reduction in emissions, 80% (or "80x50") reduction, and the carbon neutrality goal… They are also formulated in relation to a baseline, such as 1990 for the IPCC and 2004 for the City of Paris. It is often forgotten that these two reference points relate to an emissions trajectory, and that to attain the target of limiting the temperature rise to 2°C by 2100, it is the aggregate emissions until the end of the century that matter rather than the interim check points which are chosen arbitrarily.

The "carbon budget" concept was created to provide a concrete illustration of this constraint. At the end of 2016, this budget of the emissions that humanity can still release while retaining a 2-in-3 chance of attaining the 2°C target, amounted to 800 $GtCO_2$, which corresponds to approximately 20 years of emissions at the current rate. Therefore, the commonly used year of 2050 is misleading, given that drastic reduction efforts must be undertaken right now if we are to have a chance of succeeding! The only possible way to increase this budget by virtual means would be to store more atmospheric carbon that we emit, but implementing the solutions identified to do this would be a long and complex process.



The budget is equal to the area underneath the reduction curve

Reduction curve

2.2.3/ WHERE DOES THE CARBON-NEUTRALITY STRATEGY STAND IN RELATION TO THE NATIONAL LOW-CARBON STRATEGY AND BUSINESS AS USUAL?

The **Business as Usual strategy** is mainly driven by changes in the external environment. According to this trend, Parisians' lifestyles are changing at the rate observed at the national or indeed continental level. This is neither a revolution nor a contextual strategy but first and foremost the application of trend changes that are exogenous to the city. This approach is too slow and lacking in ambition: it is incapable of attaining the targets in question. It can also be considered a passive response to the climate emergency. Finally, it is, by definition, *acontextual*, whereas each metropolis – and therefore Paris – needs to describe the actions that are adapted to its particular situation, with particular regard to the urban fabric and mobility.

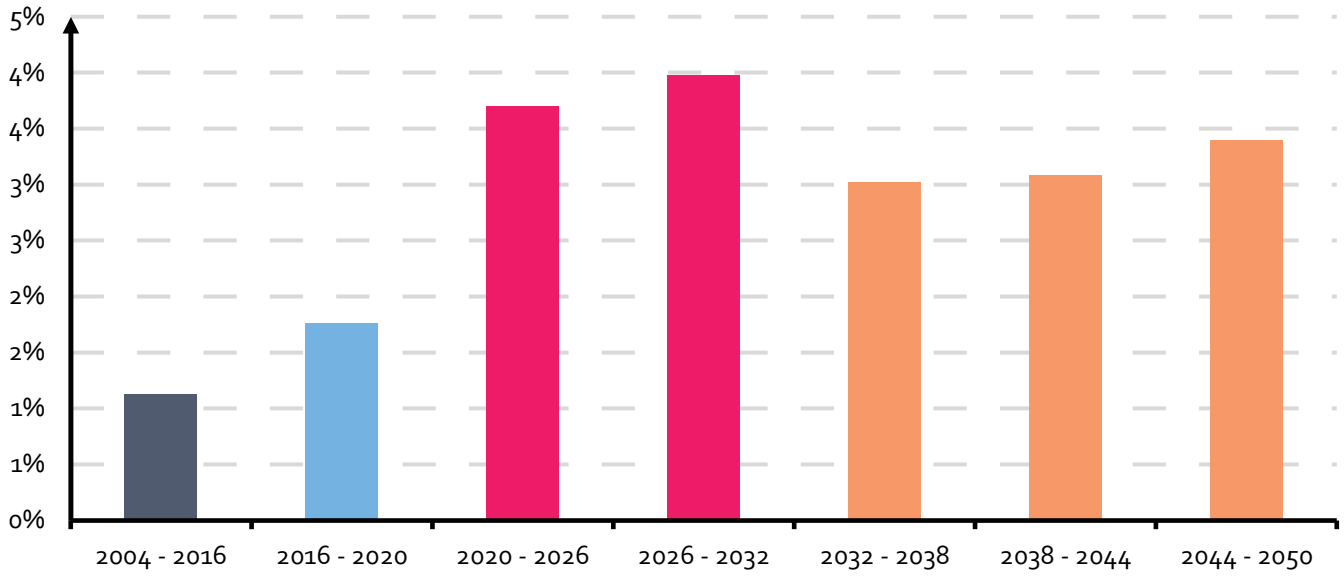
The **French National Low-Carbon Strategy** reflects the transformations that affect items over which Paris has no direct influence, such as the changes in the electricity mix and the global changes in mobility fuels and uses. This trajectory is more ambitious than the **Business as Usual** strategy but it remains too slow. In this scenario, the balance of residual emissions would be so high that it would require Paris to implement offsetting measures on an unsustainable scale with a view to attaining carbon neutrality by 2050. Paris must set an example by establishing a very ambitious emission mitigation trajectory.

2.2.4/ THE PARIS CARBON-NEUTRALITY STRATEGY

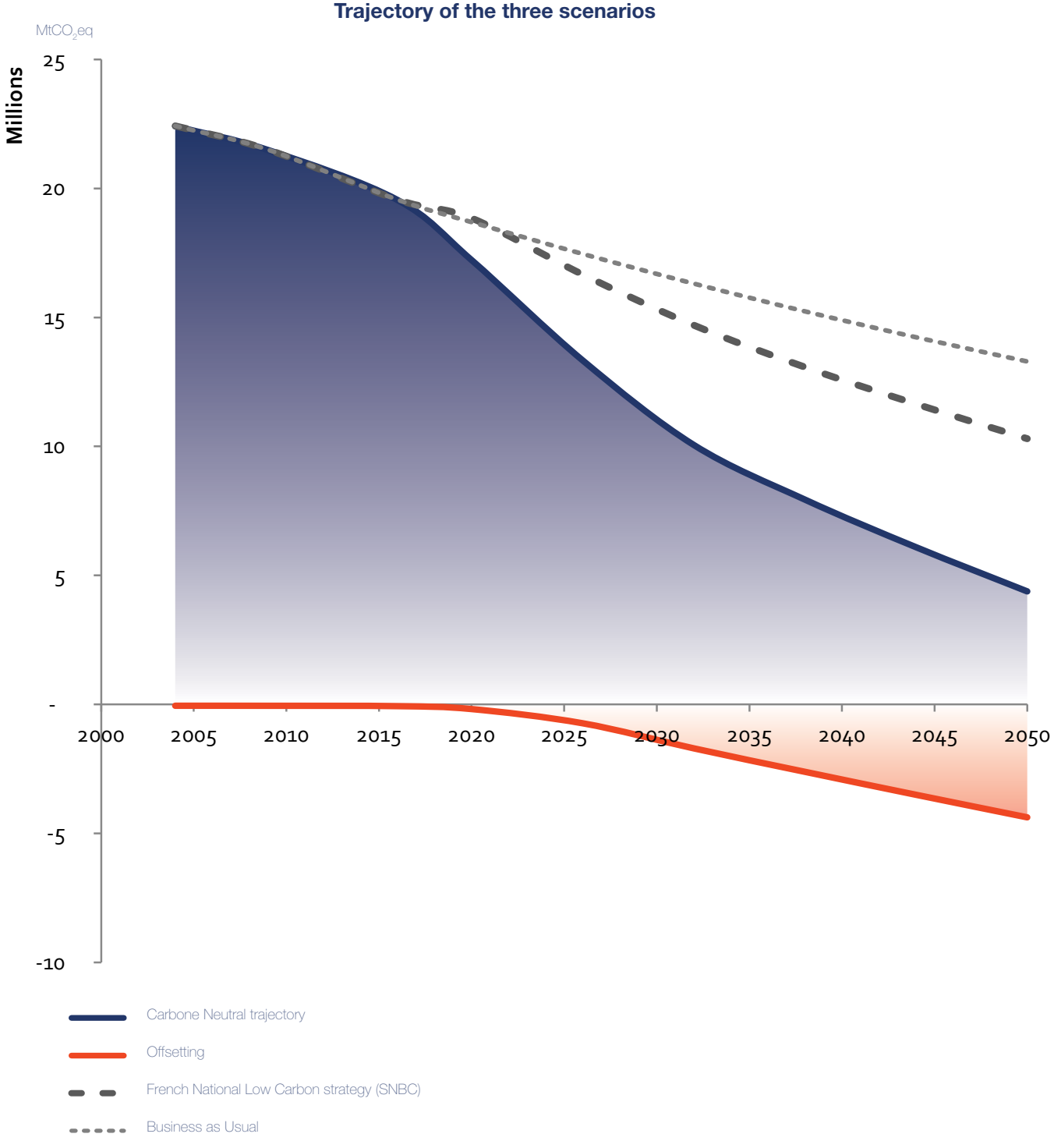
Reducing emissions by 80% is a reasonable and rational objective, but it will require sustained efforts on a massive scale. It forms a total strategy in which all issues relating to the city's metabolism must be oriented towards a massive reduction in carbon. At first sight, the carbon-neutrality trajectory may appear similar to the Business as Usual and Carbon Neutrality Strategy trajectories. In reality, it reflects a major intensification of efforts as shown by the sharp drop in the trajectory from 2016-2020 and the acceleration of the reduction between 2020 and 2030. Therefore, the neutrality trajectory raises the question of the strategy to be implemented rather than the shape of a curve.

This trajectory covers six terms of office, the first of which is already at the mid-term point.

Annual efforts by mandate, period 2016 -2020 being the implementation of next mandate actions



Trajectory of the three scenarios





Halles Pajols ©APUR

Maxime de Rostolan
Permaculture farmer, founder of Farms for the Future and BlueBees

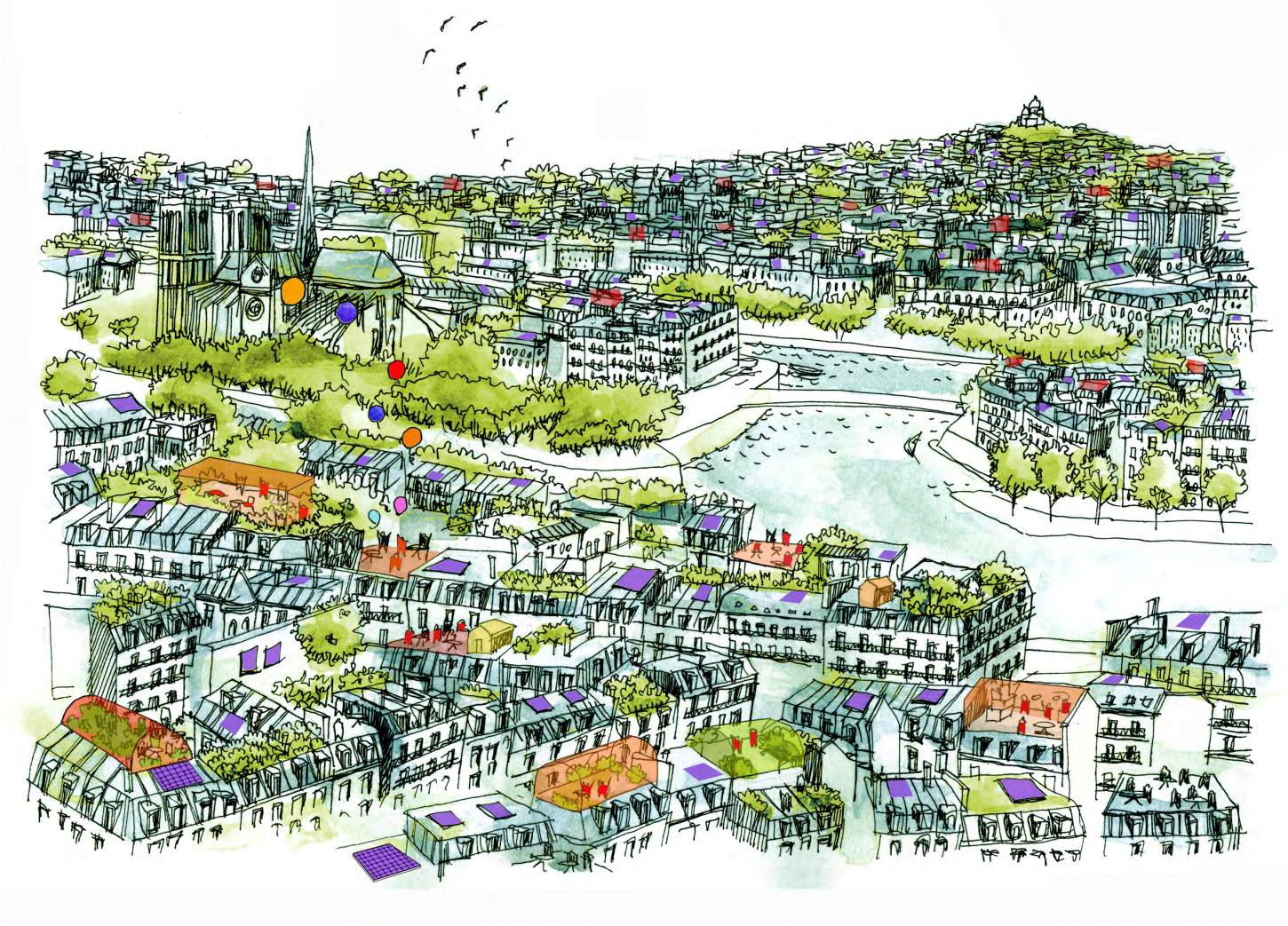
« The problem for future cities will be to produce clean energy, whilst regenerating the environment and creating desirable employment. It is a vast program, of general interest, that must settle in something concrete and must be put on a long-term footing. »

2.3 / OVERVIEW OF PROJECTS TO BE CARRIED OUT

IN A NUTSHELL

The carbon neutral strategy projects illustrate the full extent of the transition to which Paris is committed, involving a thorough renewal not only of its energy infrastructure, but also of the uses behind the emissions. We highlight here the importance to be given to uses, and therefore to the appropriation and adoption of the objectives by Parisians: these drivers are often the least costly to finance, the quickest to implement and have the biggest impact on emissions.

FOCUS ON ENERGY



PARIS ROOFTOPS

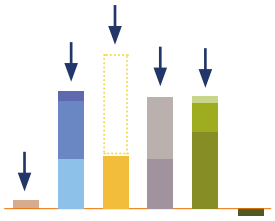
During the Greater Paris International Consultation in 2008 (towards a post-Kyoto metropolis), one of the teams, headed by Rogers Stirk Harbour & Partners, emphasised the necessity to **occupy the rooftops**. In a manifesto, the architects of 169-architecture stated:

"From now on, the city must be resilient in order to provide all or part of its energy needs. If it only produces one tenth of requirements, it still guarantees that vital services can continue should energy distribution fail. Self-production and micro-networks are our essential safeguards. Due to the density of its human population, stable or increasing individual requirements and the increasing scarcity of external fuels, the city must produce a part of its energy locally […] In the future, only flow energy sources (the sun and its derivatives, and to a lesser extent geothermal energy) will be able to provide a permanent supply. The city must therefore bring energy down directly from its rooftops […]"

By 2050, regulatory barriers will have changed and almost **20% of Paris rooftops will have solar panels.**

These adaptations will be carried out, for example, as part of energy renovation work on the existing housing stock, by combining work on the superinsulation (or even extension) of rooftops with the "geometric adjustment" of certain protrusions (dormers, chimney gables) in order to **promote solar energy production on a large scale**.

By 2050, average output of the photovoltaic installations will exceed 20% and the annual electricity production of Paris rooftops will reach about 1,400 GWh.



THE CHOICE OF THE URBAN NETWORK

Although the trend towards a reduction in heating requirements from the existing housing stock and the continued improvement in the performance of new buildings may lead to an individualisation of energy production, Paris has decided to retain and develop its heating networks. Two reasons have led to this choice: energy network greening strategies are particularly effective in massively reversing the carbon footprint of end consumers. In addition, in new neighbourhoods, these networks act as "thermal balance hubs" which recycle waste energy and develop more ethical local production, coupled with renewable energy production. The network operators are collaborating and will eventually merge in order to come up with large scale systemic solutions.



Heating network temperature.

TOWARDS 0% FOSSIL FUELS

Between 2016 and 2050, consumption of fossil fuel energy will drop by 70%, and its share in consumption by buildings, transport of goods and passenger transport will drop from 90% to 45% (excluding air travel by Parisians).

Electricity, heating, cooling and gas grids will increasingly make use of solar, wind, biomass and biomethane power to reduce their reliance on fossil and fissile energy.

Biofuels are being developed for mobility and will partially replace kerosene for aeroplanes, and petrol and diesel for road vehicles.

What is left? Gas in buildings, above all, but also petrol, diesel and kerosene for some everyday journeys by Parisians and for long distance freight (air and road). We should emphasise that by 2050, half of the motorised travel by Parisians will be driven by renewable final energy, representing an immense transition!

OVERVIEW

THE ESSENTIALS

Paris' energy destiny is intrinsically linked to local and national trajectories.

Among the action scheduled for Inner Paris, the City is committed to the **large-scale solarisation** of its rooftops. **Smart grids** and electricity storage will support this development, thus making for a more robust energy supply.

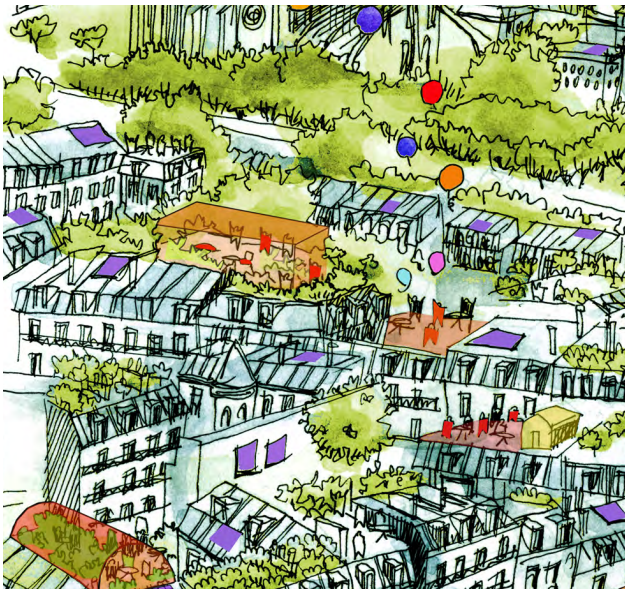
The reduction of the proportion of gas in the mix and total elimination of fuel oil and coal make it essential to reboot a strategy based on heating networks. The CPCU network, designed in an industrial era, will be densified and extended into the North and East of the capital, while also becoming greener. Its key arteries will serve lower-temperature local circuits supplied by multiple sources. Energy balance service providers will develop in every neighbourhood.

To offset its residual greenhouse gas emissions, Paris will participate in the funding and operation of renewable capacities outside its territory. Through their contribution to local investment funds and their enlightened consumption choices, Parisians will become the central players in the Paris low-carbon strategy.

Matthieu Auzanneau
Director of the Shift Project, author of "Black Gold, the Great History of Oil" and guest blogger on the editorial staff of Le Monde

Less than two centuries ago, Paris experienced the birth of the first industrial revolution, driven by coal and hydrocarbons. Since then, humanity has consumed almost half of the oil which nature has taken millions of years to produce.
Achieving zero net greenhouse gas emissions during the second half of the 21st century will literally require the emergence of a new world, and a new industrial and societal revolution

FOCUS ON BUILDINGS



COWORKING

+

SHARED LIVING

+

TELEWORKING

+

PARTICIPATORY HOUSING

2016

MAJOR RENOVATION:
10% OF TERTIARY BUILDINGS
12% OF SOCIAL HOUSING
2% OF PRIVATE HOUSING

0.05 MILLION M² OF SOLAR ROOFS

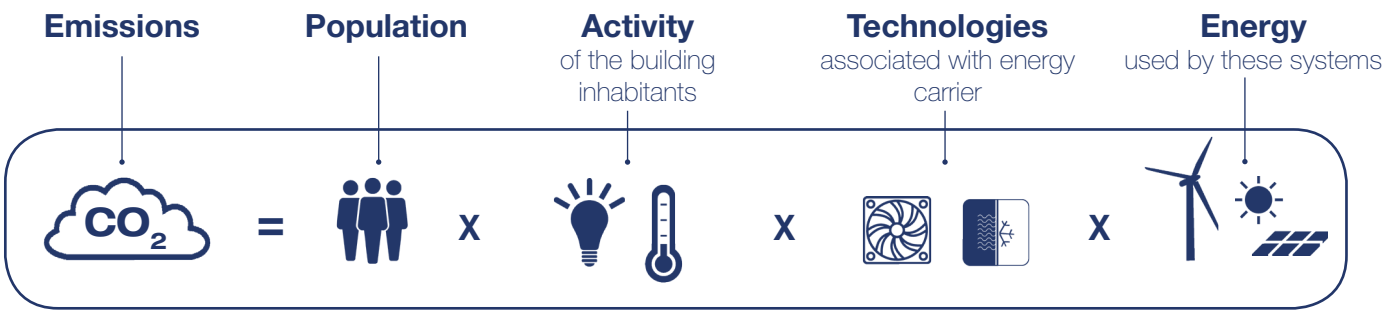
LAUNCH OF FIRST "LOW-CARBON BUILDING" LABEL

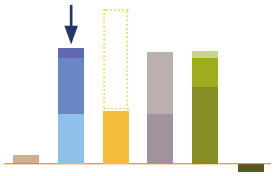
2050

MAJOR RENOVATION:
70% OF TERTIARY BUILDINGS
75% OF SOCIAL HOUSING
55% OF PRIVATE HOUSING

6 MILLION M² OF SOLAR ROOFS

THE CITY WILL TRIPLE ITS CARBON CAPTURE AND STORAGE THROUGH WOOD CONSTRUCTION





MANAGEMENT OF USES

Shared living practices are becoming widespread. Some buildings are designed for temporary or reversible uses, to respond to changes in visitor numbers to Paris. Local, connected, flexible and protean professional spaces are multiplying,

RENOVATION OF HOUSING

The renovation of social and private housing is about to be upscaled, thanks to public and citizen-based funding, and the development of new comprehensive and innovative offers from the building industry.

RENOVATION OF TERTIARY BUILDINGS

The professionalisation of the energy-related businesses has allowed tertiary sector consumption to be reduced rapidly by around 25%. Almost the entire tertiary building stock will be renovated by 2050 via EPC and third-party funding mechanisms.

OVERVIEW

THE ESSENTIALS

Only a comprehensive building strategy based on restraint and flexibility will be able to meet the requirements created by Paris' demographic and economic growth, while remedying inequalities.

Built-up area per person is a key point. The new ways of living and working in the city will embrace the new ways of life being shaped by Parisians, while allowing built-up areas to be limited.

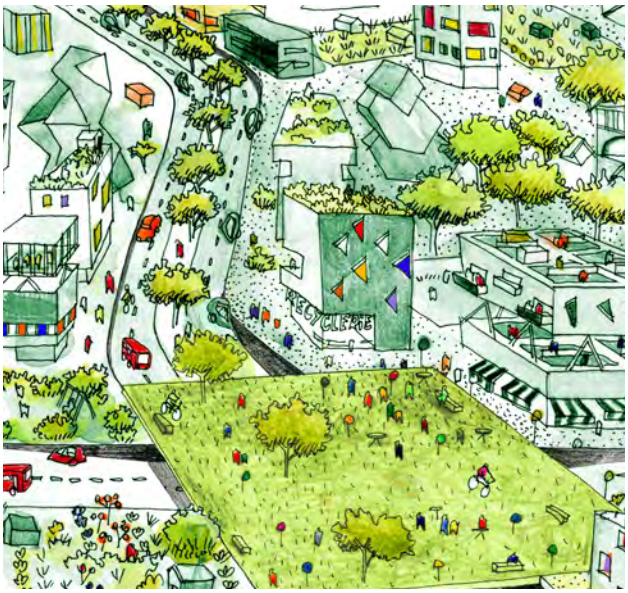
The energy renovation of existing buildings is a priority project. The work carried out by the APUR (Paris Urbanism Agency) and APC (Paris Climate Agency) will allow us to propose a selection of effective and contextual solutions. On this solid basis, Paris will support the renovation of tertiary and residential building stock on an extended scale, while making sure to preserve the city's architectural heritage. This major project will be backed up by multiple comprehensive and innovative offers from local authorities and the banking sector to fund the works and guarantee energy performance.

The construction sector will enter the low-carbon, positive-energy building era. New supply channels in Ile-de-France for secondary raw materials and bio-sourced materials will be established and contribute to the boom in the local circular economy. Buildings will be considered carefully taking account of the very long period of time from construction through to demolition, along with all the aspects of energy consumption. Buildings will become energy producers and "smart", active components in local and national energy systems.

Anne Girault
Director of the Paris Climate Agency

Building in general will find its way by the end of the first half of this century. A more difficult question which remains is that of transport and mobility in general. It's also an issue which affects Ile-de-France.
We need to learn to count differently: euros will no longer be enough, nor will KWh; it will be important to count carbon and have a more accurate view of our footprint and impacts.

FOCUS ON TRANSPORT



CARPOOLING

+

CARSHARING

+

TELEWORKING

+

MODAL SHIFTL

2016

600,000 CARS
PERS/CAR
1 CAR-FREE DAY/YEAR

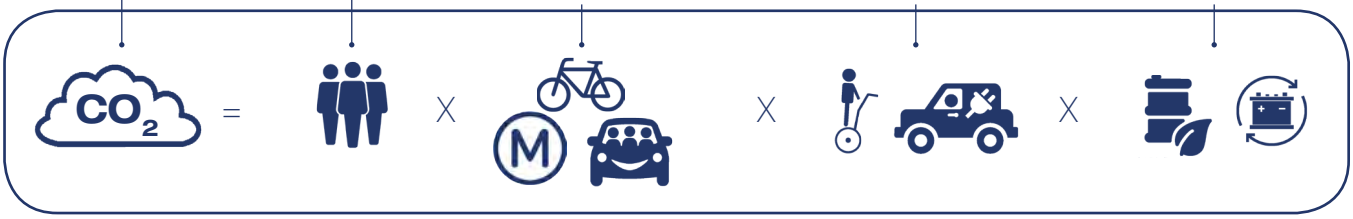


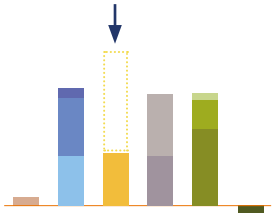
2050

300,000 CARS
2 PEOPLE/CAR
52 CAR-FREE WEEKENDS/YEAR



Emissions | **Population** | **Population Activity** | **Technology** associated with these activities | **Energy** used by these technologies





NEW USES

Many solutions already exist for reducing the number of kilometres travelled by car in Paris without changing the city: increasing the occupancy of each vehicle, working nearer home, travelling differently…

CHANGING THE FLEET

The carbon impact of vehicles needs to be considered from an overall point of view. It depends on their manufacture (weight, materials…), use (fuel, speed…) and end of life (recycling….). Carsharing and transformations of vehicles will limit the impact of each automobile.

URBANISM

In order to encourage a modal shift, public spaces must adapt to new forms of mobility, and the space dedicated to cars (roads, parking) reclaimed by users.
The transformation of the ring road into an urban boulevard will mark the beginning of a new era. Green spaces, urban farming and housing will rub shoulders with other activities necessary for the transition and the development of the circular economy (recycling centres, logistics).

OVERVIEW

THE ESSENTIALS

Despite their relatively small share of the overall number of journeys (less than 15%), **journeys by car worsen the city's Carbon Footprint** and increase local atmospheric pollution.

Increasing the occupancy rate of vehicles and promoting teleworking will limit these impacts in the short term, without having to alter infrastructures.

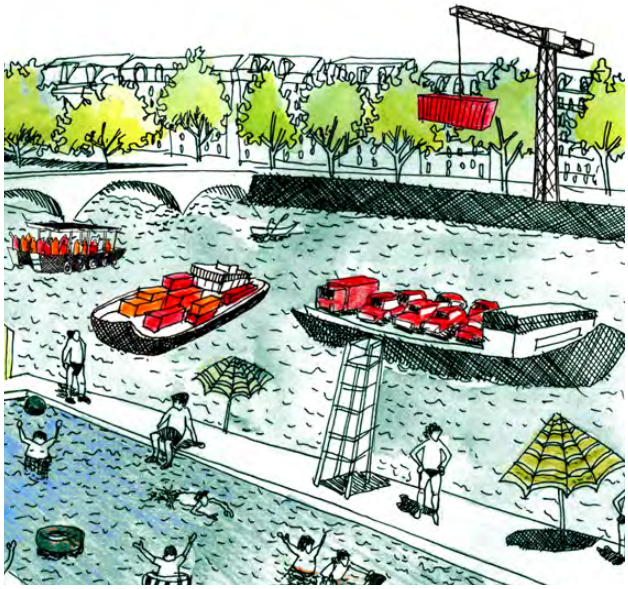
The 21st century will see a profound change in our relationship with the car: the move away from car ownership to the purchasing of mobility services. Vehicles on the roads will have lower emissions, and be lighter and less powerful thanks to the technical and regulatory measures taken by the City to speed up the process already underway.

Public spaces will be transformed: pleasanter, quieter, greener and safer. The transformation of the ring road is the most striking example of this. Car-free days will become more frequent to **allow Parisians to reclaim their streets, which will be places of renewed activity and citizenship**.

Jean Robert MAZAUD
Urbanist and Architect - CEO of S'PACE & S'IAMA

Imagining that a new tourist cannot be environmentally ethical (CO_2 emissions rate, excessive consumption of resources, a factor in pollution, noise and urban congestion) is just as outdated as thinking that Airbnb and Blablacar do not meet a real need.

FOCUS ON FREIGHT



RIVER AND RAIL FREIGHT

+

ACTIVE MODES

+

ILE DE FRANCE LOGISTICS PLAN

+

LAND FOR LOGISTICS

2016

3% RIVER FREIGHT
7% RAIL FREIGHT
(in tkm*)

98% DIESEL LCV & HGV

LC for light commercial vehicles and HGC for heavy goods commercial vehicles

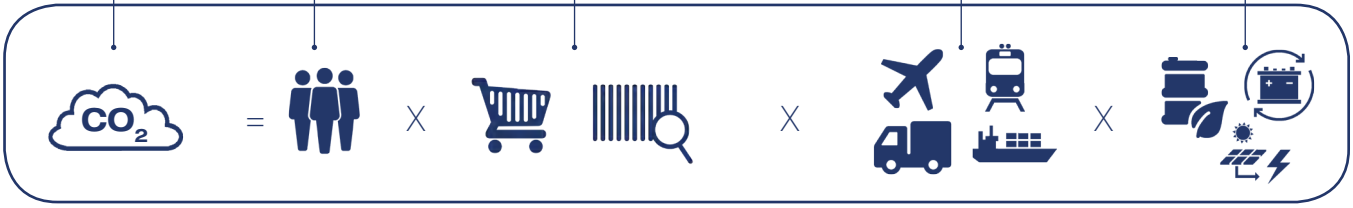
2050

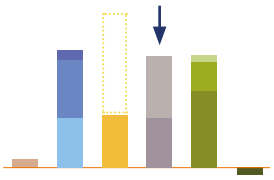
7% RIVER FREIGHT
34% RAIL FREIGHT
(in tkm*)

100% CLEAN VEHICLES

* The tonne-kilometre (tkm) is the unit of measure corresponding to the transportation of one tonne of goods over a distance of 1 km

Emissions **Population** **Products** associated to different types of consumption **Modes of transport** associated with product transport **Energy** used by these modes of transport





OVERVIEW

THE ESSENTIALS

The reduction in the carbon impact of goods transport will be achieved both through modes of transport and logistics organisation.

In terms of modes, Paris has room to manoeuvre **via the massification of river and rail freight, and also the development of last-mile delivery by active modes of transport**. Paris will not be able to do entirely without road freight by 2050, but the latter will be able to reduce its impact significantly with zero-emission vehicles, load optimisation and better management of delivery rounds.

A genuine Low-Carbon Logistics Plan throughout Ile-de-France will be essential in order to have a sustainable and positive effect on the carbon footprint of freight. The City's actions will be particularly focused on making use of land within Paris and supporting technical and social innovation. This transition must be supported in such a way that it does not take place at the expense of workers or consumers.

THE RISE OF THE MODAL SHIFT

Rail freight and river freight have low carbon and particle emission rates. They do not contribute to the phenomenon of urban congestion. Their development helps to establish more sustainable urban logistics.

MODIFICATION OF THE FLEET

Short-distance transportation of goods is perfectly suited to electrification and delivery by active modes. In the same way as for private cars, the City will support the transition of road freight to zero-emission vehicles.

REGIONAL GOVERNANCE

In order to facilitate intermodality and avoid load transfers the entire logistics chain will have to be adapted. An Ile de France freight governance system will have to be created.

Régine BREHIER
CEO of HAROPA – Port de Paris

85% of goods transportation is still done by road. In Paris, it is estimated that 20% of vehicles on the roads are goods vehicles, which represents 1.5 million journeys (deliveries and collections) per week. The development of "mass" modes of transport, such as water or rail, will generate significantly fewer greenhouse gas emissions than road haulage and is particularly strategic in a region where the roads are heavily saturated.

FOCUS ON CONSUMPTION



CIRCULAR ECONOMY

+

LOCAL PRODUCTION

+

PRICE INCENTIVES

2016

500 kg /inhabitant of WASTE

2 ha of URBAN FARMING

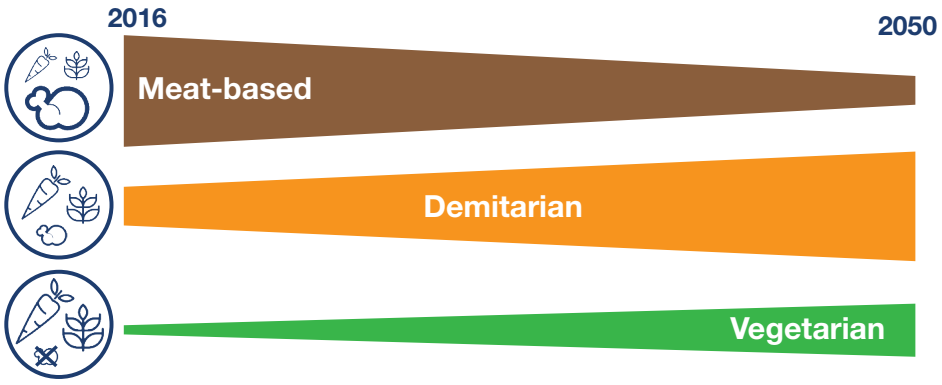
0 MEAT-FREE days/week

2050

220 kg/hab OF WASTE

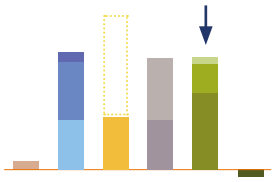
150 ha OF URBAN FARMING

2 MEET-FREE days/week



Emissions = **Population** X **Use** associated with modes of consumption X **Use** associated with the production and destruction of these products X **Energy** used





OVERVIEW

SUSTAINABLE FOOD

The theme of the carbon impact of food seems to be the least well-known to the Parisian public. Public awareness of health and ecological issues, and the support of professionals will change the situation completely.

ZERO WASTE

The issue is threefold when it comes to reducing emissions: reducing the quantity of waste generated by everyone, optimising waste sorting and finally encouraging more responsible recycling solutions. Amongst the solutions: support for the circular economy and the introduction of price incentives.

RESPONSIBLE PURCHASING

Generally speaking, it is the "embedded" energy from all consumer products which has to be reduced. Via improvements in quality (purchase of eco-designed or local goods, use of collaborative services, etc.) or self-limitation of the quantities consumed ("voluntary simplicity", frugality) everyone can act on their own level to reduce the environmental impact of their way of life.

THE ESSENTIALS

Consumption is often the poor relation in cities' analyses of their carbon impact. The City of Paris has taken a courageous stance by deciding to include it and act to reduce this component. It is the second item in the footprint as a whole, with food being the biggest contributor.

Action by the City of Paris will focus on supply and demand. Targeted campaigns will make Parisians aware of the carbon and health-related impacts of their consumer choices, food-related in particular. Vegetarianism and the economy of functionality (renting instead of buying, pooling goods used only occasionally, etc..) are all consumer decisions which support a more sustainable development of the metropolis.

To support and facilitate this transition, the city must nevertheless also support transition on the production side. This consists for example in continuing to develop urban farming in Paris and sustainable farming in Ile-de-France.

Flore Berlingen
Director of ZERO WASTE FRANCE

Our region is way behind in waste sorting and reduction. Have those who are resisting even been informed that the waste they send to the incinerator contributes directly to the pollution of their living environment? How ready would they be to finally take the step (reduce, sort) if they were aware that it's worth the effort, both for the sake of their health and their purse?



Building site in the district of Batignolles ©Guillaume Meunier

Nicolas Imbert
Directeur exécutif Green Cross France et Territoires

« The challenge is immense - Paris knew, before and around the CoP21, it must play a percursory role, engaged, substantial and operational during the low-carbon transition. The low-carbon strategy 2050 is its moment to transform this attempt, both in its definition and its implementation.»

2.4 / KEY DATES: 2030 AND 2050

IN A NUTSHELL

2030 and 2050 are set to become two key dates in this first half of the century, like those which Paris experienced when celebrating the bicentenary of the French Revolution in 1989 and the Millennium in 2000. These dates must become milestones for the people, the ambitions and objectives of both must be explained, and the planning of public and industrial investment and climate regulations and policies must be synchronised around these two major events.

2.4.1/ PARIS IN 2030: -50% ALREADY

Population

The arrival of new Parisians is dictated by three independent phenomena which are cumulative. The first is the birth rate and normal migrations published in INSEE data. The second is the city's housing policy which automatically attracts a new population by offering housing. Finally, the last phenomenon is linked to ways of life and the number of people per dwelling. Predicting the number of inhabitants of Paris in 2050 is complex, and we have made the hypothesis that the construction of housing is the variable which will allow the population to be adjusted in order to limit the increase to 200,000 people.

According to these hypotheses, the population of Paris in 2030 will be **160,000 more than in 2016**. This large increase is linked to the significant amount of housing construction that will be taking place following the "Reinventing Paris" call for projects.

Mitigation

2016 marks a turning point in the trajectory begun in 2005. After this date, the pace of emissions reductions will become three times higher than during the previous period. **Maximum effort will be concentrated on the 2020-2026 and 2026-2032 terms of office**, in order to limit any danger of overshooting the target. Reductions in emissions made during this period will be the easiest to achieve.

2030 will be a critical point which will validate the first 14 years of the strategy. Even though a carbon strategy can only be viewed in the long-term as it also depends on the climate, the symbolic aspect of this fast-approaching date should not be neglected nor its importance with regard to the efforts that must be made.

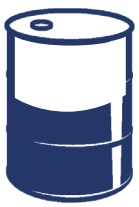
The increase of carbon in construction is related to a very high level of renovation work, which will increase sourcing of materials sharply.

Buildings	**-50%**
Residential buildings	-50%
Tertiary buildings	-60%
Carbon in construction	+65%
Mobility	**-50%**
Mobility of people	-65%
Mobility of goods	-45%
Consumption	**-35%**
Food	-30%
Goods	-45%
Waste	-40%
Industry	**+10%**

↗ + 160 000 INHABITANTS



↘ -45% GROSS EMISSIONS

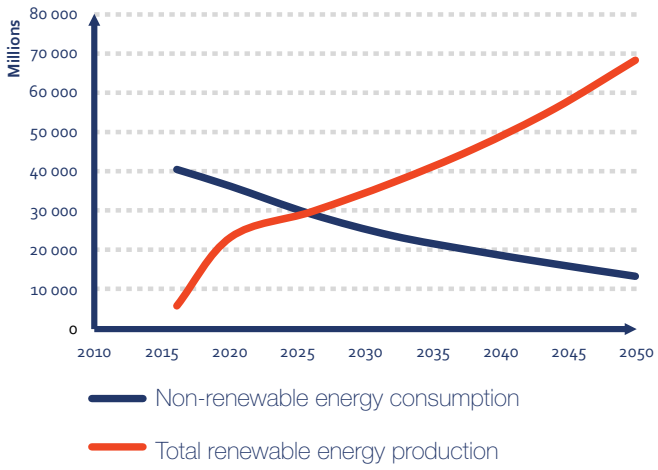


Renewable energies in Paris

In terms of energy 2030 is a crucial stage as it marks a major swing in the role of renewable energies.

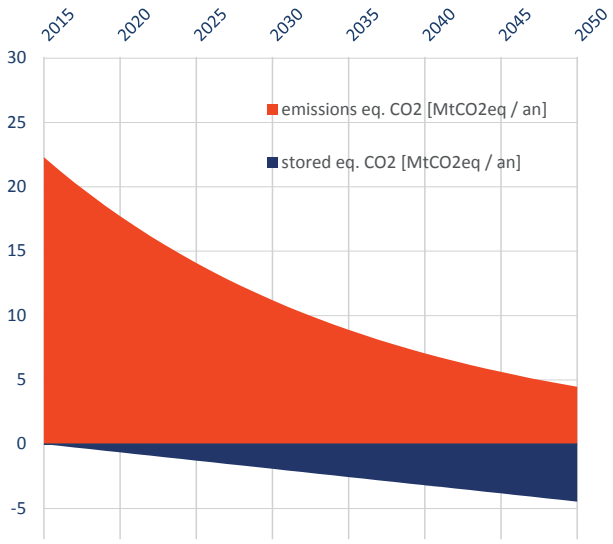
The objective to be achieved is to have installed a local production capacity of 360,000 MWh of renewable energies via solar panels in Inner Paris. Offsetting excluded, renewable energies will account for 30% of consumption by buildings and transport.

Once production for offsetting purposes is included, **total production of renewable energies exceeds fossil and fissile consumption.** This represents an enormous paradigm shift!



Capture and storage through carbon sinks

How can we be carbon neutral by 2050? The city will need to have captured and stored 2 $MtCO_2eq$ by 2030.



↘ **A FURTHER -5 %**



↘ **- 8 % ALREADY CAPTURED AND STORED**

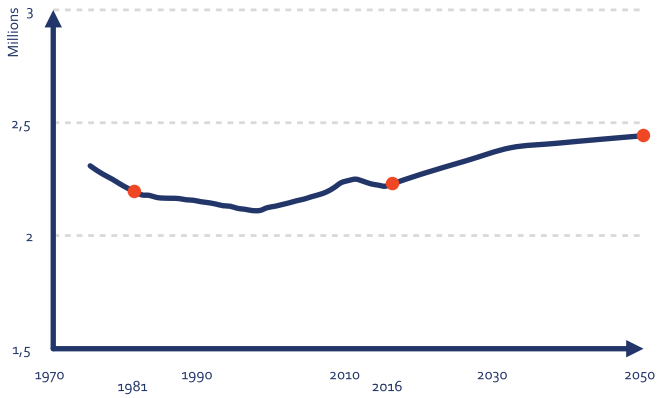


2.4.2/ PARIS IN 2050: ZERO EMISSIONS

Population

According to our main hypothesis, the **population in 2050 will be 13% higher than in 2004**. Firstly, this demographic growth should imply an increase in the city's emissions. By introducing a very ambitious strategy, **Paris will grow by being more welcoming, but will massively reduce its climate footprint!**

We should also note that Paris will have **280,000 inhabitants more over the age of 65** than in 2004. The City will have anticipated the provision of services for its elderly, notably in preparation for the **impacts of climate change on its buildings and the comfort of outside spaces.**



Mitigation

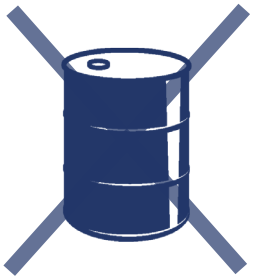
The carbon neutrality strategy aims firstly to massively reduce gross emissions by **banishing hydrocarbons** from the energy mix of Parisians. The figures presented below summarise the **reductions in gross emissions** per emission item, in particular through the drivers of restraint and efficiency. Concerning energy production, these figures take into account the large-scale installation of renewable capacities in the Paris area.

Buildings	**-75%**
Residential buildings	-80%
Tertiary buildings	-75%
Carbon in construction	-25%
Mobility	**-85%**
Mobility of people	-85%
Mobility of goods	-65%
Consumption	**-70%**
Food	-70%
Goods	-65%
Waste	-65%
Industry	**+30%**

↗ **+ 200 000 INHABITANTS**



↘ **-70% GROSS EMISSIONS**



Renewable energies outside Paris

The City of Paris is a pioneer in participating in financing and operating renewable capacities outside its territory. Paris is thus organising and speeding up changes in energy production infrastructures to move towards 100% renewable energies or do even better depending on the switchover necessary to more quickly towards emission neutrality.

These stakes in infrastructures allow the city to count the offsetting generated by the marginal difference with the carbon intensity of the national mix. With regard to the trends between now and 2050, Paris has begun this trajectory on a strong note with these investments in renewable energies and offsetting. These are rapid measures undertaken by the city which will produce their effects over the long term.

To offset almost 2 million tCO_2eq in 2050, Paris is developing the equivalent of **20 GWp of photovoltaic parks** (one third of the solar capacities planned nationally as part of the 100% renewable scenario by 2050 proposed by the ADEME) and is participating in the installation of **15 GW of wind power capacity** on French territory (one sixth of the capacity planned in the same scenario in 2050). Through these virtuous territorial partnerships, **Paris will reduce its carbon footprint by 80% thanks to this extra 10%**.

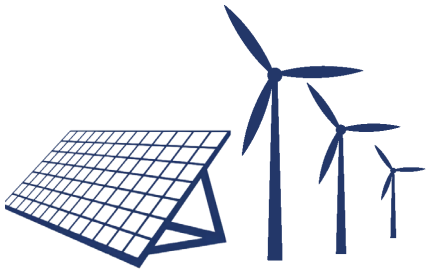
Capture and storage through carbon sinks

How can we be carbon neutral by 2050? The City will also take part in regional measures promoting the capture and storage of atmospheric carbon by encouraging afforestation: this **will be the key to targeting zero net emissions**. Capture and storage by afforestation is without doubt one of the most effective carbon sinks. On a national level, forests occupy around 30% of the territory of Metropolitan France, representing around 16 million hectares. The ADEME reminds us that “forests help to mitigate climate change though two levers: a capture and storage effect and a substitution effect”. For capture and storage, French forests act as a “net sink” of carbon of 59 $MtCO_2eq$/year (or 3.7 tCO_2eq/ha/year). Afforestation can also lead to a change in the use of certain soils. Finally, afforestation also allows timber to be produced, which is particularly useful as a very low-cost construction material!

Maxime de Rostolan
Permaculture
farmer, founder of Farms for the Future and BlueBees

« To take back land at the edge of average size cities, to ensure a relaunching of prodution of agriculture rather than of concrete or industrial zones, create outer-urban jobs, propose systems inspired by culture of supermarkets, these are the routes to follow in order to ensure the self-production of food and maintain the dynamics of our territories. »

↘ **A FURTHER -10 %**



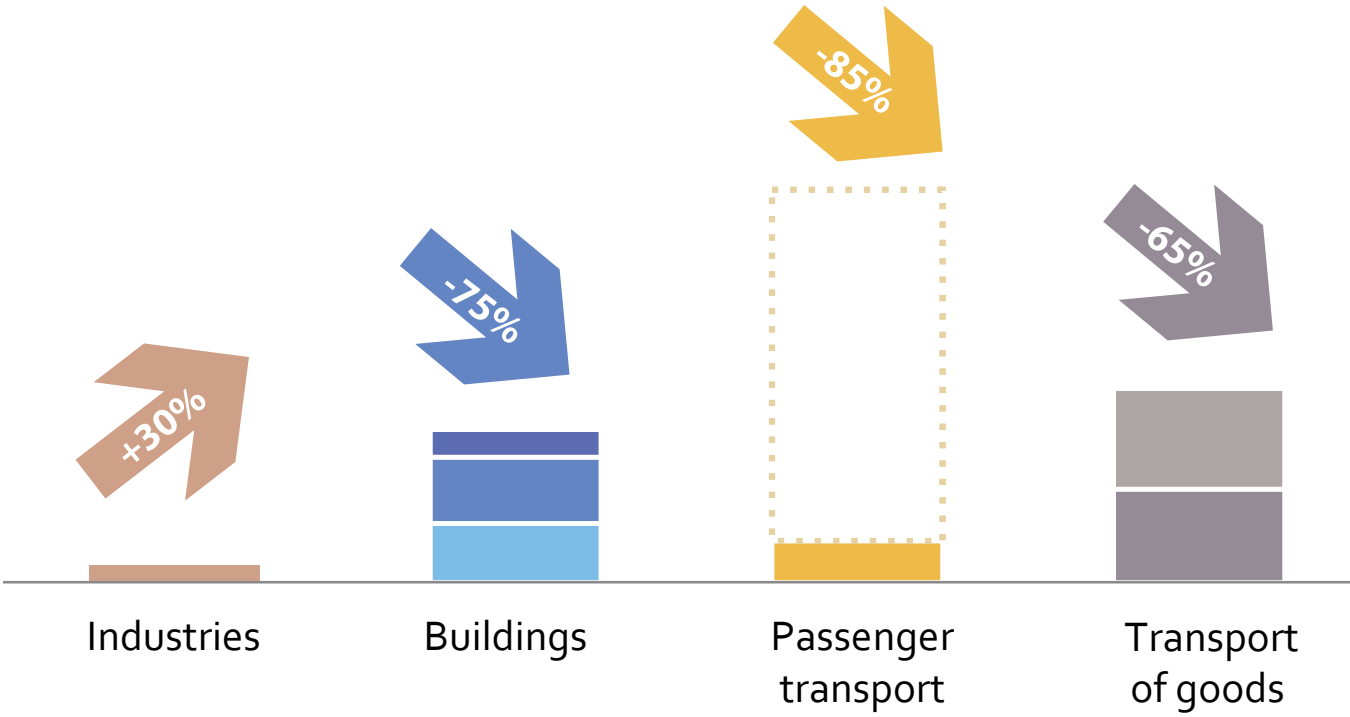
↘ **- 20 % TO ACHIEVE CARBON NEUTRALITY**

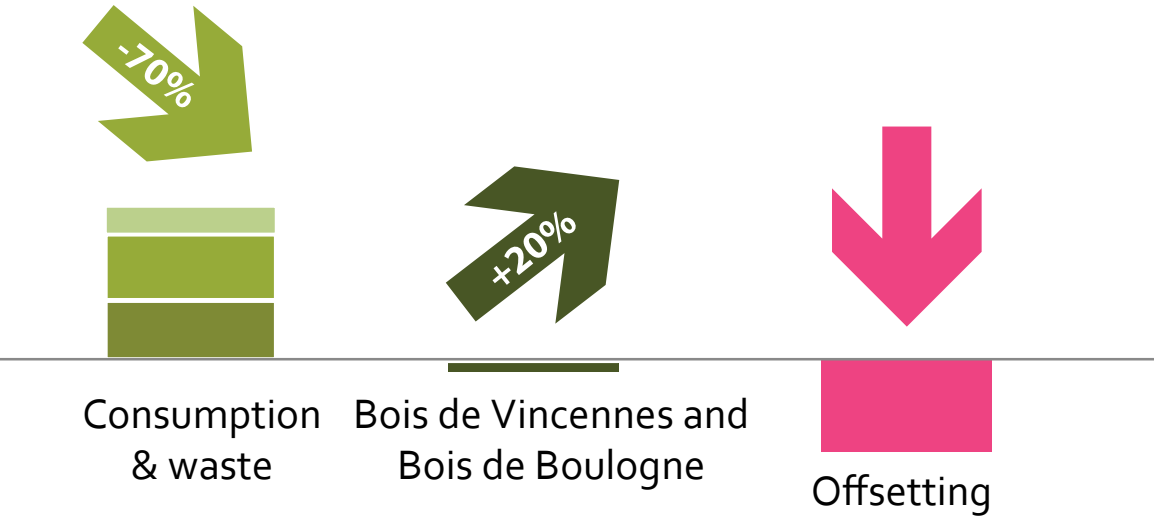


Paris Carbon Assessment – 2050 edition

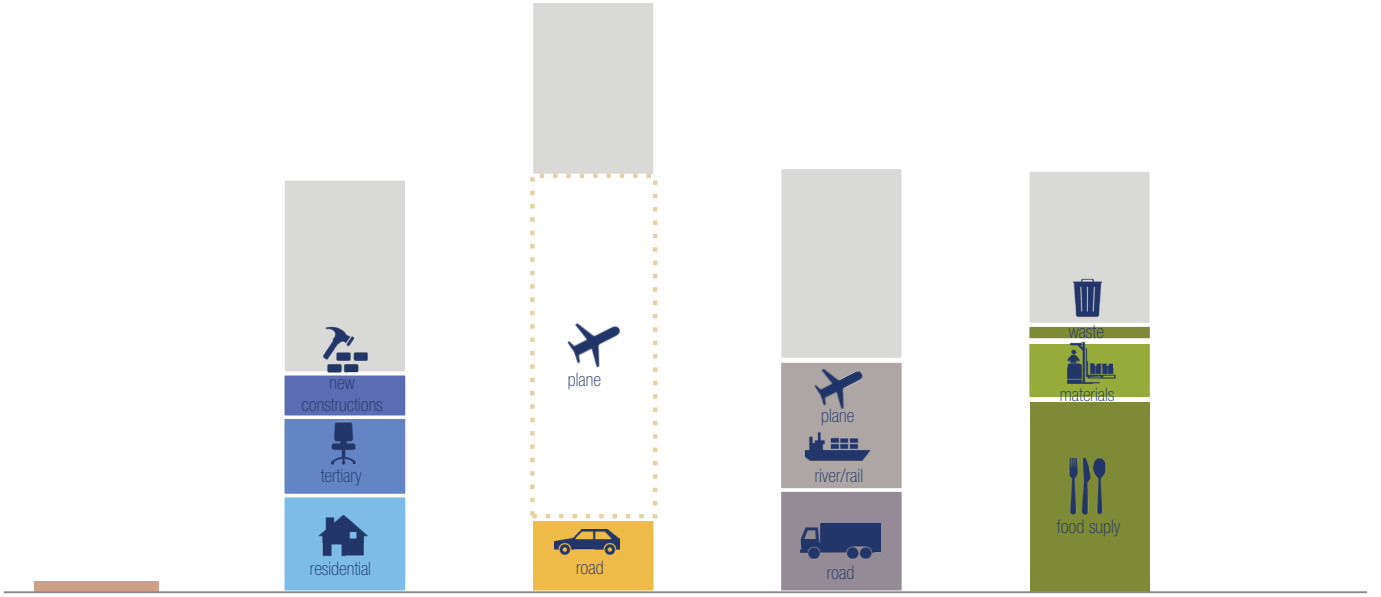
6,4 $MtCO_2eq$

10,3 $MtCO_2eq$ with air travel



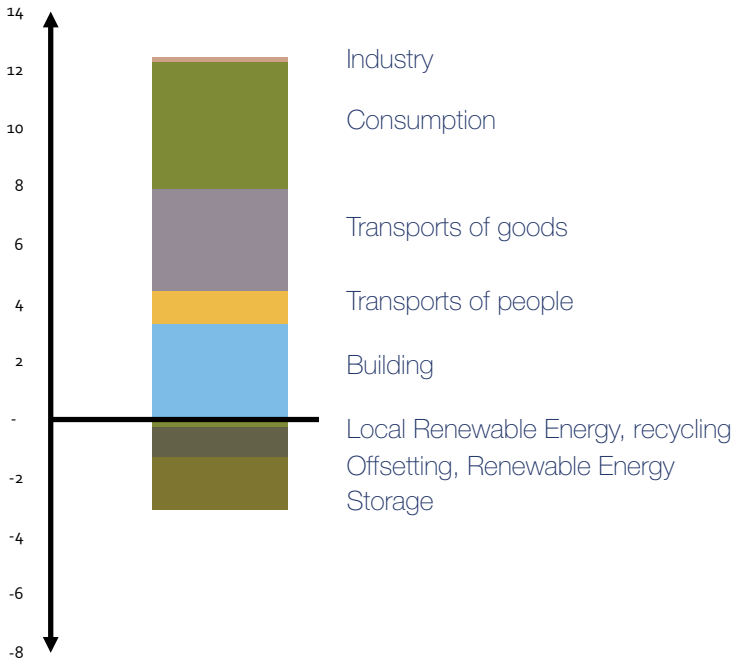

-70%
+20%
Consumption & waste
Bois de Vincennes and Bois de Boulogne
Offsetting

PARIS CARBON ASSESSMENT IN 2030

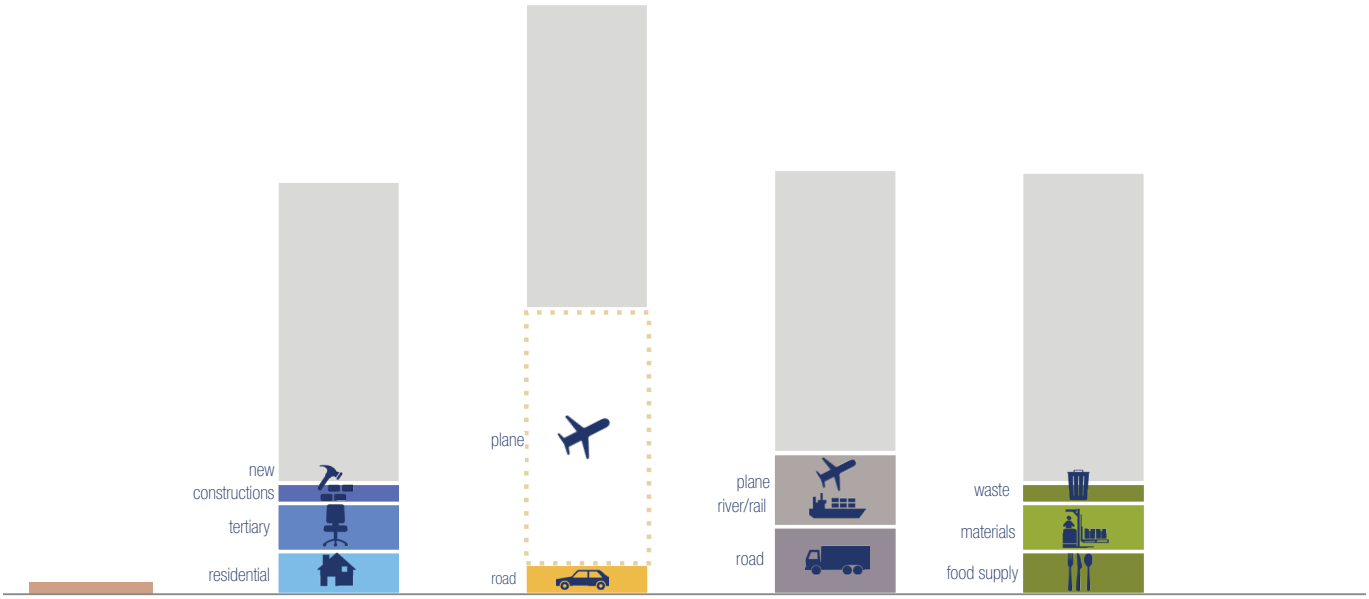


12,4 $MtCO_2eq$

17,6 $MtCO_2eq$ with the plane



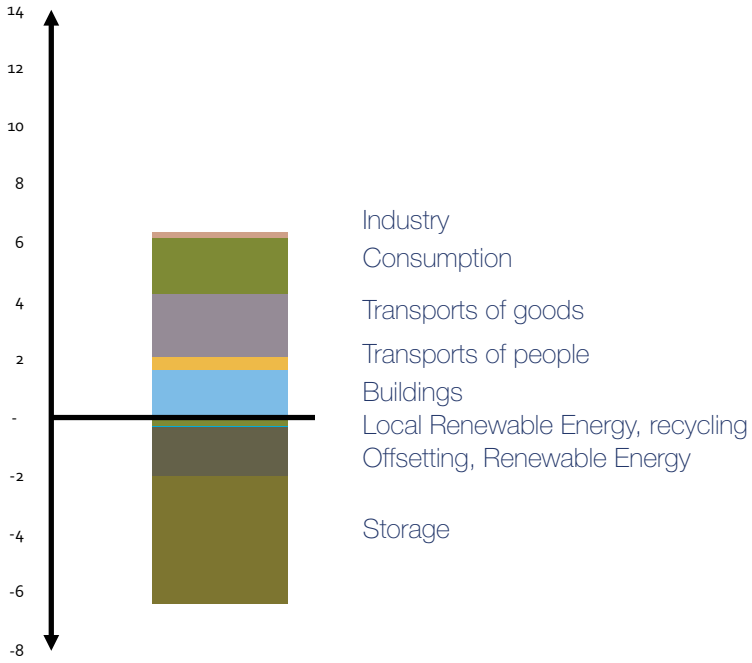
PARIS CARBON ASSESSMENT IN 2050



Industry	Buildings	Transports (people)	Transports (goods)	Consumption	Green space
0,19	1,7	0,5	2,1	1,9	-0,01

6,4 $MtCO_2eq$

10,3 $MtCO_2eq$ with the plane





©malgosia smigielska

Eric Vidalenc
Team leader for the energy transition, Regional Management (Hauts de France), ADEME

« […]The first idea is to do locally ... all that can be done locally. And then to find out where outside to do "everything else". [...] To go further, one must contractually rely on his Hinterland through a contractualization that has to be invented yet, in order to build a real territorial project with the more rural «margins» or «peripheries». This is an opportunity to make these margins find a place in the territory.»

2.5 / OFFSETTING FOR FURTHER PROGRESS

IN A NUTSHELL

Reducing greenhouse gas emissions will not be enough to achieve carbon neutrality. A proportion of the residual emissions will be offset, as Paris will be able to count the carbon savings induced by its investments in renewable energies. The city is therefore destined to become one of the major players in the energy transition by investing massively in renewable energy production capacities outside the territory of Paris.

Offsetting residual emissions via the production of renewable energy outside Paris

Residual emissions are the result of the direct reduction of gross emissions.

Paris does not have sufficient surface area to produce all its renewable energy. The acquisition (or funding) of renewable energy production capacities outside Paris is necessary in order to decrease the carbon content of energy consumed by Paris.

Carbon capture and storage through afforestation is definitely one of the most effective types of carbon sink[1]. At national level[2], the forests of Metropolitan France occupy about 30% of French territory, representing around 16 million hectares. The ADEME reminds us that "*forests help to mitigate climate change though two levers: a capture and storage effect and a substitution effect*."

For capture and storage, French forests act as a "net sink" of carbon[3] of 59 $MtCO_2eq$ per year (or around 3.7 tCO_2eq per hectare per year). Other sources mention a capture and storage flow of around 5 tCO_2eq per year.[4]

"*Firstly, the "no regret" NETs – which are characterised by low initial capital costs, co-benefits (such as an improvement in soil fertility), an absence of dependence on carbon storage and capture, economic and environmental co-benefits and fewer uncertainties - include afforestation, and improvements using soil carbon and biochar. Even considering the potential for the limited release of carbon stored in the future, they are the most promising NETs between now and 2050.*"[5]

Afforestation can also allow a change of use for certain soils. As an illustration, if nutritional habits evolve more towards a less meat-based diet, the conversion of certain cereal fields, intended solely for feeding livestock, into forests, could have a higher carbon impact than the capture and storage generated by afforestation alone.

[1] Stranded Carbon Assets and Negative Emissions Technologies – February 2015, Ben Caldecott, Guy Lomax & Mark Workman, SSEE, University of Oxford, p. 15. *http://bit.ly/1ESZYzT* quoted by *http://adrastia.org/technologies-emissions-negatives-racicot/*

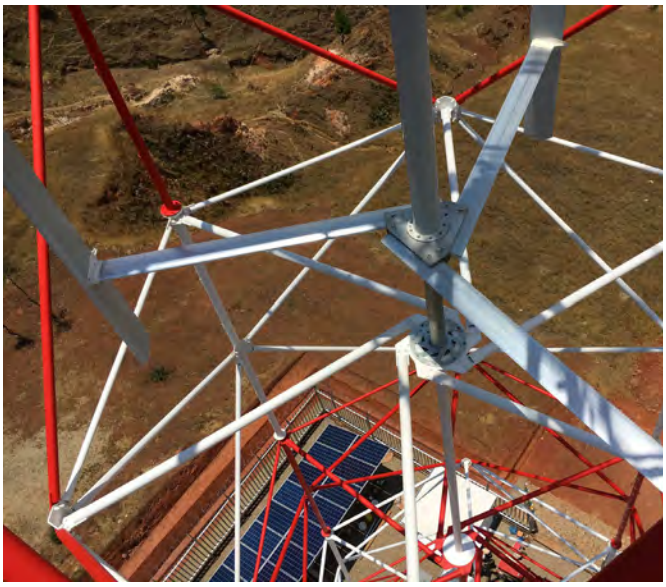
[2] *Forests and the mitigation of climate change*, Ademe, juin 2015 *https://www.ofme.org/documents/actualite/2015507/avis_ademe_foret attenuation-cght-clim_vdef.pdf*

[3] *National Inventory Report for France for the United Nations Framework Agreement on Climate Change and the Kyoto Protocol,* 2014, CITEPA, quoted in Forests and the mitigation of climate change

[4] see online *http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=28* ainsi que *http://www.treehugger.com/natural-sciences/how-much-carbon-do-different-forests-store-what-size-offsets-your-driving-for-a-year.html*

[5] Ben Caldecott, Guy Lomax & Mark Workman, SSEE, University of Oxford, February 2015, quoted by Racicot

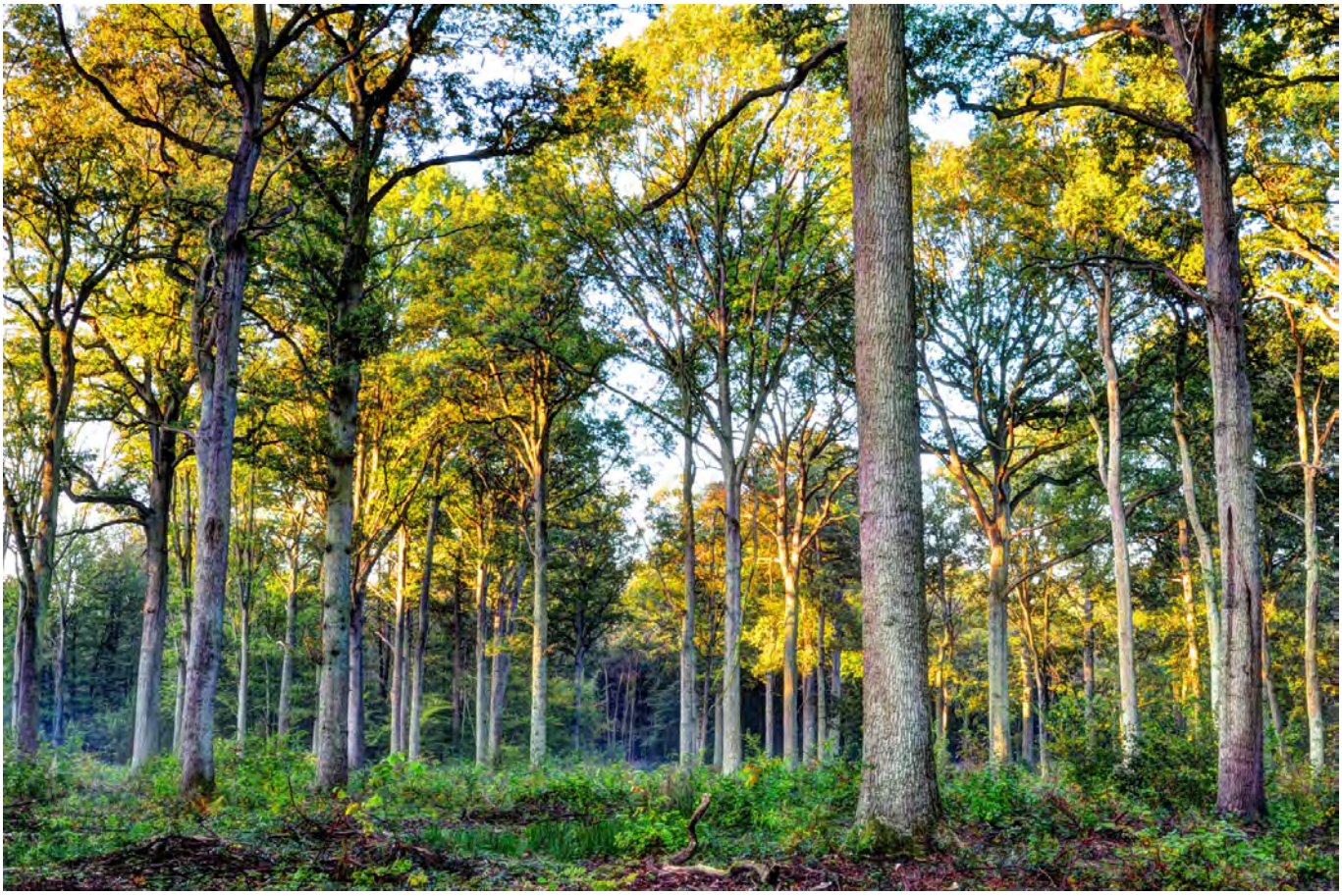








Wind-it, micro solar grid and wind turbine for developing countries
© Wind-it



©aquaphoto/Fotolia -National forest

Anne Girault
DIrector of the *Agence Parisienne du Climat*

« To move towards a low-carbon city requires two conditions: one condition of temporality, starting now, and a condition of method, to be done during the urban transformation and ciy construction, which is at the heart of the schedule for the decision-makers and the timeline for the lives of the inhabitants. Everything we need is accesible, particularly based on the the Paris 10-year climate results but even based on the weak signals that we see appearing in the past few years.»

2.6 / CAPTURING AND STORING THE REMAINDER

IN A NUTSHELL

The quality of the carbon neutrality strategy will therefore be assessed by estimating the surface area needed to capture and store final emissions. In fact, if Paris were not to reduce its current emissions and just aim for carbon neutrality by 2050 on the basis of emissions in 2016, it would have to plant 50,000km^2 of forests, the area of a French region, just to capture and store the emissions of Parisians!

It is therefore crucial to remember that capturing and storing emissions is the last-resort solution, when emission reduction measures have been pushed to their limit and offsetting has been carried out as a consequence.

CAPTURE AND STORAGE

The aim of carbon neutrality raises more questions of scope than of algebra: being neutral implies a "carbon count" of zero after a certain period. On the basis of an irreducible remainder of gross emissions, the same quantity has to be captured and stored which gives an overall result of zero. This target of neutrality is therefore based on:
what we decide to count or not count in emissions (choice of scope): this quantity corresponds to the gross emissions;
the extent of the capture and storage capacity, and in particular by the land surface area which can be specifically employed to offset the corresponding gross emissions.

Neutrality is therefore achieved when net emissions are zero or less, the capture and storage flow being higher than the flow of gross emissions within the scope of calculation in question.

Carbon capture and storage through afforestation is definitely one of the most effective types of carbon sink[1]. At national level[2], the forests of Metropolitan France occupy around 30% of French territory, representing about 16 million hectares. The ADEME reminds us that "forests help to mitigate climate change though two levers: a sequestration effect and a substitution effect."

In 2014 in Paris, within the scope of the Carbon Assessment, emissions stood at 25.6 million tCO_2eq. In the event of offsetting by forests, carbon neutrality in Paris would require a wooded area of around 50,000 km^2, allocated solely to the capture and storage of Parisian emissions (almost 500 times the surface area of Paris).

The scenario of a carbon-neutral Paris: an 80% reduction in emissions by 2050. In the first scenario, this central trajectory corresponds to an 80% reduction by 2050, or a shift from 25 Mt to 5 Mt in 35 years, on the basis of the scope of the carbon footprint. In order to reach neutrality by 2050, this would assume that the City of Paris would acquire and manage 300 km^2 of additional forest area every year. It would eventually own (or if not, would be a partner in) a forested area of a total size of almost 10,000 km^2 (the current surface area of Ile-de-France).

Overview of the different issues

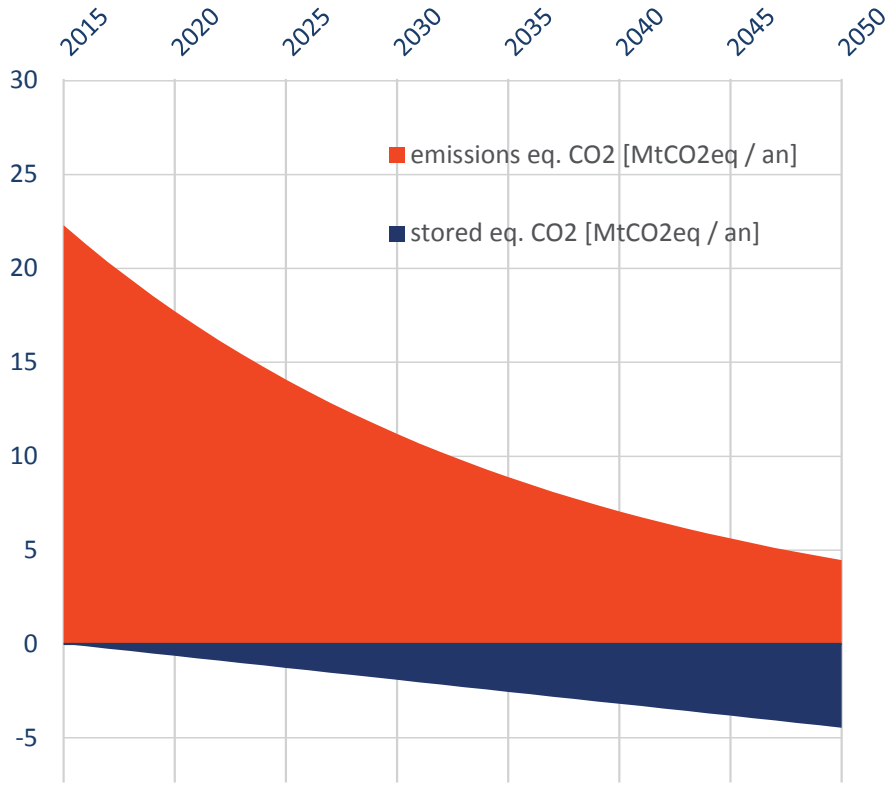
Without being exhaustive, the challenges of carbon capture and storage (land not in the land registry, the areas for reduction and/or offsetting, total net emissions over 36 years, what to do with the captured and stored stock) presuppose that decisive questions on policy should be raised as early as possible. In fact, metropolitan density and intensity requires on the one hand a surface area sufficiently large to allow vital flows to be harvested (food, energy, water and input materials) and on the other hand land areas for the treatment, storage or capture and storage of their outflows (waste or emissions from pollutants including greenhouse gases).

It is therefore a question of re-establishing a balanced connection between the countryside and the city and, in no event, of subjecting the countryside to urban greed, especially if it suggests a centralist superiority. To limit this danger of misunderstanding, this movement must be multiple and embarked on by other cities. Making this issue a universal one will require a decision to be made on the right terms of land allocation amongst the different catchment areas of high density communities.

As a provisional conclusion, it appears urgent to calculate the total surface area dedicated to carbon capture and storage, of which the minimum would be in line with the GPC scope and within a conservative trajectory, allowing us to secure the "GPC -80%" neutrality target with some room to spare. One recommendation would therefore be a total wooded area of around 7,000 km^2, with a carbon capture and storage potential of around 2.5 million tonnes of CO_2 equivalent. This target would also be close to the surface area necessary to offset the 10,000 km^2 necessary for a "-80%" trajectory, but on the basis of the scope of the Carbon Assessment. It will then become possible to attempt to achieve carbon neutrality by 2050 but based on the scope of the Carbon Assessment.

[1] Stranded Carbon Assets and Negative Emissions Technologies – February 2015, Ben Caldecott, Guy Lomax & Mark Workman, SSEE, University of Oxford, p. 15. http://bit.ly/1ESZYzT quoted by http://adrastia.org/technologies-emissions-negatives-racicot/

[2] Forests and mitigation of climate change, Ademe, June 2015. https://www.ofme.org/documents/actualite/201507/avis_ademe_foret-attenuation-cght-clim_vdef.pdf



Synthesis of possible sequestration hypotheses

		Ratio annual mean reduction	Emissions in 2050 [Mt CO2eq. by year]	% equivalent increase in forestation in the city in 2015	Final ammount of territory carbon stores in 2050 [Mha]	Final ammount of territory carbon stores in 2050 [km²]	annual extension of forests	annual extension of forests	net cumulative emissions	mean net emissions	total biomass production 2015-2050	equivalent capacity of park renewal in Paris
			%	Mha	km²	km² by year	x Paris by year		MtCO2eq	MtCO2eq/year	Mm3	%
Scenario -50%	*-2%*	*12,8*	*16%*	*2,6*	*25 600*	*731*	*6,9*		*435*	*12,4*	*285*	*349%*
Scenario -80%	**-4%**	**4,5**	**6%**	**0,9**	**8 920**	**255**	**2,4**		**321**	**9,2**	**80**	**98%**
Scenario -90%	*-6%*	*2,6*	*3%*	*0,5*	*5 120*	*146*	*1,4*		*318*	*9,1*	*46*	*56%*

3/ ALL ABOUT CARBON NEUTRALITY

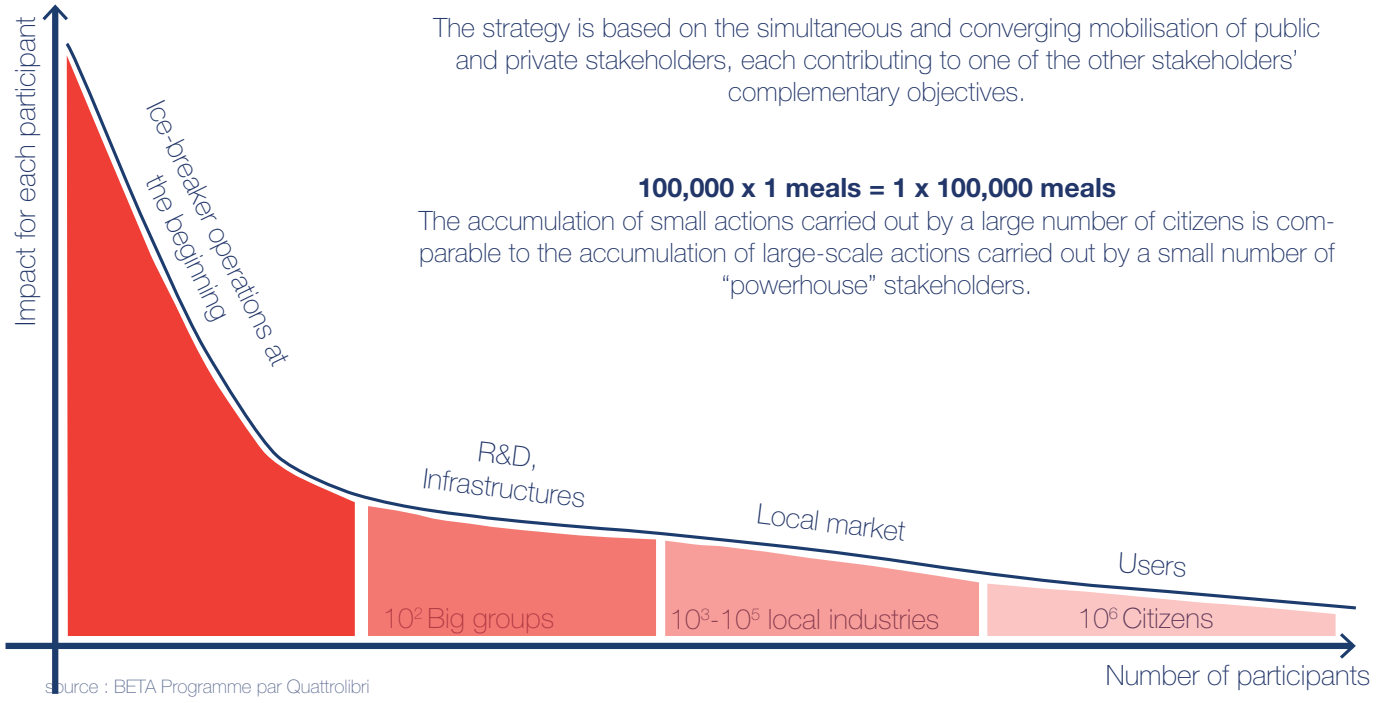


TO SUCCEED IN THE TRANSITION TOWARDS CARBON NEUTRALITY

① PLANNING THE TRANSITION

	DEMAND	SUPPLY
SHORT TERM	Immediate reduction of emissions through changes of uses (e.g. without changing the motor vehicle fleet) Market signal for manufacturers and investors to prepare for the delivery of low-carbon infrastructures (e.g. new dietary habits)	Closure of facilities and applications generating the highest levels of emissions (e.g. pedestrianisation of the city centre) Preparation of "zero-carbon" economic sectors (e.g. acquisition of agricultural land)
LONG TERM	Massive reduction of emissions through: The adoption of low-carbon uses by a larger proportion of the population (e.g. car-sharing) The adoption of low-carbon equipment / products (e.g. electric cars)	Intensification of investments: Renewal of the diffuse thermally-powered equipment stock (private vehicles, individual heating systems) Roll-out of second-generation "zero-carbon" solutions (e.g. local food supplies and "flexitarian" diets

② COORDINATING THE TRANSITION



source : BETA Programme par Quattrolibri

The strategy is based on the simultaneous and converging mobilisation of public and private stakeholders, each contributing to one of the other stakeholders' complementary objectives.

100,000 x 1 meals = 1 x 100,000 meals

The accumulation of small actions carried out by a large number of citizens is comparable to the accumulation of large-scale actions carried out by a small number of "powerhouse" stakeholders.

③ FINANCING THE TRANSITION

TAX INCENTIVES

The bonus-malus scheme exerts a differentiating effect on the Paris tax system and carries out redistribution from the biggest emitters to the most energy-efficient households. The bonus-malus principle could also be applied by adjusting local taxation according to the residential surface area per person.

Authorisations, grants or subsidies could also be adjusted according to eco-conditionality criteria.

TERRITORIAL INVESTMENT FUNDS

The aim is to collect savings in Paris to finance carbon neutrality projects: solar photovoltaic farms, wind energy projects, permaculture farms, land reserved for capture and storage projects, third-party payment programmes for building renovations, etc. Different instruments will be required to correspond to the different risk profiles.

A DEFEASANCE FUND

The aim is to prevent carbon emissions "escaping" from the territory. For example, 300,000 cars must be decommissioned and recycled. The assets in the fund could be indexed on the tonnes of CO_2 avoided and on motor vehicle insurance premiums, which could include a higher decommissioning risk for vehicles that emit the highest levels of CO_2 and generate the most pollution in terms of gas and particle emissions.

OVERVIEW

THE ESSENTIALS

Actions concerning uses take priority and can be implemented quickly.

They trigger an immediate drop in emissions, while creating momentum for the adoption of low-carbon products and services.

However, strong signals on the supply side must show that the changes of use are both credible and justified. The rapid renewal of buses is a powerful message encouraging Parisians to change their mobility habits.

A second, more ambitious wave of actions relating to uses is based on the commissioning of new infrastructures and changes in behaviours, which increases the acceptability of "ground-breaking" measures.

Modal transfers and the conversion of the Paris ring road are easier to implement when there is a bigger range of alternative solutions to the car.

The roll-out of infrastructures can break down the barriers at the technological level (e.g. hydrogen logistics) and in relation to uses (creation of farmhouse inns for the relocation of recreational activities).

Thomas Buberl
Directeur Général d'Axa

We share with the Mayor of Paris the conviction that it is high time to mobilise all actors of the civil society of Paris, including private businesses and financial companies, to make the French capital a world-renowned landmark for Green Finance and for urban sustainability



ZAC Clichy Batignolles, 17e © Mairie de Paris

Damien Carême
Mayor of Grande Synthe

«The regional project for the third industrial revolution put words on what is now happening in the great transition at Grande Synthe
This transitions aspires to go beyond the third industrial revolution in order to meet the negative effects of the old urban planning inherited from the 20th century.
It will also go beyond from the technical point of view. It is a cultural transition, which highlights itself and inhabitants and actors within the town in order to share a new development model.»

3.1 / THEMED ACTION PLANS

IN A NUTSHELL

The themed action plans all follow the same rationale, targeting the demand and uses on the one hand, and infrastructure and facilities on the other. The magnitude of the changes is realistic, iterative and staggered over time. Nevertheless, the changes are far-reaching and have a significant impact on the symbols of Parisian life and the city's urban landscape: its roofs, major traffic routes, food and gastronomy and recreational activities, etc.

3.1.1/ ENERGY

The national context

Paris's future energy development is intrinsically linked to the national energy trajectory. The energy mix – primarily generated outside Inner Paris– dictates the climate impact of the consumption that occurs within the city centre.

The national public policies envisage drastic changes in the national energy mix by 2050 with two primary focuses: more renewable energy sources and less carbon. While there are no signs of any reduction to date, the share of nuclear production in the electricity mix has been set at 50% for 2030[1] (French Energy Transition Law) and could stand at 25% for 2050.

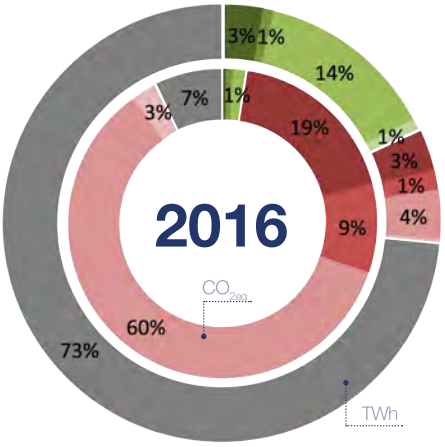
To this end, the State is envisaging the massive development of on-shore and offshore wind energy, while increasing the share of solar photovoltaic energy in the electricity mix. From 2030, it is reasonable to expect the widespread availability of carbon capture and storage technologies, which in particular will reduce the emission factors of peak and load-management resources. In response to the intermittent nature of production, the share of imports in the electricity mix will remain high (at around 10%): interconnections on the national borders will inevitably need to be increased as a consequence, despite the development of storage solutions.

Gas will remain an important energy source, which will require the greening of the natural gas grid. The forecasts provide for the injection of 10% of biomethane into the network by 2030[2]. 2015 marked a turning point for the industry with 11 new sites injecting into the grid, raising the total quantity of biomethane injected to 82 GWh, and tripling the maximum installed production capacity in one year.



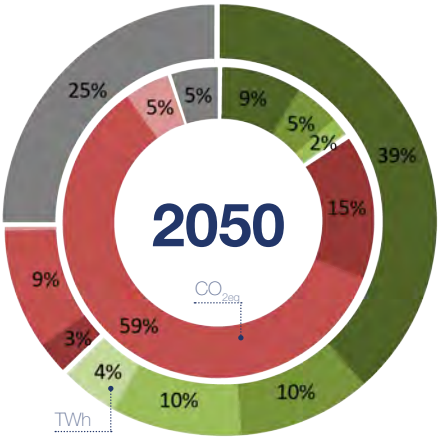
Centrale nucléaire, ©nmann77

550 TWh
17% Renewable
70% Nuclear
8% Fossil
82 g CO_2eq

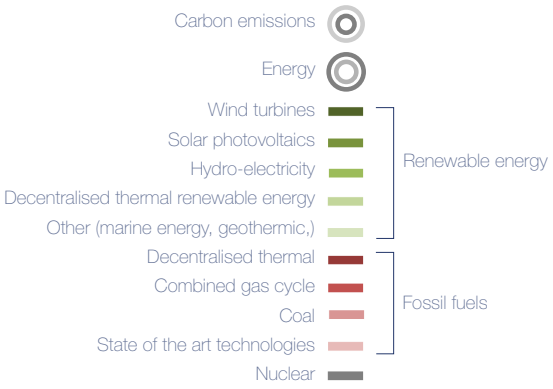


Source : RTE, Bilan Prévisionnel 2014

550 TWh
59% Renewable
25% Nuclear
10% Fossil
43 g CO_2eq



Source: Egis, based on RTE Bilan Prévisionnel 2014 + ADEME, 100% renewable electricity mix by 2050



[1] Stratégie Nationale Bas Carbone, 2015
[2] ADEME, *Green Gas Grids, une vision pour le biométhane en France pour 2030*, 2014

Paris, the solar city

During the Greater Paris international consultation on the development of the future Greater Paris metropolis in 2008 (towards the post-Kyoto metropolis), the team led by Rogers Stirk Harbour & Partners insisted on the need to exploit the city's roofs. Architects working for 169-architecture set out the following vision in their manifesto:[3]

"*Henceforth, the city needs to be resilient in order to meet some or all of its energy needs. Producing as little as one tenth of these needs would doubtless guarantee the ability to maintain its vital functions in the event of a failure of the energy supply. Self-production and micro-grids are our indispensable safeguards. Due to its human density, the stable or growing individual needs and the increasing scarcity of external fuels, the city has a responsibility to generate a fraction of its energy. […] In the future, only stochastic energy sources (solar and its derivatives, and to a lesser extent geothermal) can ensure a permanent supply. The city must therefore bring down its energy directly from its roofs* […]."

By 2050, the regulatory barriers will have changed and nearly 20% of Paris roofs[4] will be equipped with solar collectors, 85% of which are expected to be solar photovoltaic panels. These fixtures will be installed during energy renovations of the existing building stock combining sealing (or in certain cases extension or raising) of roofs with the 'geometric adjustment' of certain protrusions (dormers, chimney gables) in order to promote solar energy production on a large scale. In 2050, the average efficiency of the installed solar photovoltaic resources will exceed 25% and the electricity production[5] of Paris roofs will then amount to around 1,400 GWh per year – 10% of the electricity consumption of the entire Paris building stock. Most of the time, this energy will be self-consumed by the buildings on which the solar plants are installed, which will reduce the impacts on the management of the grid.

These installations, with the constantly falling prices of electricity storage and a fleet of electric vehicles with their own batteries acting as mobile storage facilities via micro-smart-grids, will operate entirely on the self-consumption principle, in other words, all of the production will be consumed within the Paris area.

This self-consumption will avoid the need to withdraw electricity from the French grid, which, despite a sharp drop in its carbon emission factor,[6] remains much less attractive from a carbon perspective[7] than solar photovoltaic. This justification on grounds of carbon reduction is almost a secondary benefit given that self-consumption will lower Parisians' electricity bills. Indeed, within the space of a few very short years, grid parity will be attained in Paris and, above all, the return on investment period will have dropped very sharply: it will be well below 10 years in 2050. This means that beyond this period, solar panels will generate electricity for free throughout their entire service life of over 30 years.

Following the example of solar photovoltaic panels, solar thermal panels, i.e. those primarily used for domestic hot water production, will cover an area of nearly 900,000 m² by 2050. This is a much smaller number because domestic hot water production cannot be easily injected into the grid and should therefore remain dimensioned below the consumption peaks. The total production by 2050 will amount to approximately 500 GWh or 15% of the domestic hot water consumption of Paris dwellings.

In pursuit of this ambition, the strategy to be implemented consists of firstly setting the example on buildings owned by the City of Paris (estimated at 5 million square metres of built space, corresponding to 17.4% of all built space in the Paris area), but above all, of adopting a policy of mobilising all stakeholders in general, and especially joint owners' associations, management companies and operators, which must lead to the development of service offerings and management and decision-making processes specific to these types of investments. At the same time, in order to mobilise the entire residential real estate ecosystem, this approach can be deployed by promoting associations such as "Energie Partagée" and consumer associations while increasing the number of Energy & Climate Information Points (*Points info énergie-climat*) and generalising third-party financing or advance funding mechanisms for upstream studies via dedicated funds.

[3] see [online] *https://www.ateliergrandparis.fr/aigp/conseil/consultation2008.php*
[4] see [online] *http://169-archi.tumblr.com/manifeste*
[5] An estimated 30 million m² of solar roof space.
[6] Considering that the average production will increase from approximately 160 to 270 kWh elec. per m² and per year, and taking account of sometimes sub-optimal aspects.
[7] The carbon emission factor defines the "carbon cost" for the production of one kilowatt-hour. We have adopted a carbon emission factor of 42 gCO_2eq for the French electricity mix in 2050 and 14 gCO_2eq for photovoltaic electricity. The latter factor may be even lower if it is produced locally.
[8] Three times less attractive.
[9] Grid parity corresponds to the date at which the production cost of the kWh drops below or matches the average cost of traditional energy vectors for the final user.
[10] Due to the combination of the drop in the prices of modules, the rise in the cost of electricity from the grid and many other factors…
[11] For more detailed information about different solar panels, read the APUR and Elioth publication entitled «*Analyse de potentiel solaire des toitures du grand Paris*»
[12] CPCU, *Chiffres clés*, 2015

Heating and cooling networks, vectors for the development of renewable and recovered energy sources

With nearly 5,800 customers at the end of 2015 and 4.7 TWh/year of heat supplied, the network managed by the CPCU (a subsidiary of the City of Paris and ENGIE) provides 21% of the energy required for the heating of Paris dwellings, and 16% of that required by tertiary buildings. Thanks to the partial conversion of the Saint-Ouen boiler plant from coal to biomass (wood pellets), and an end to the use of heavy fuel oil, the CPCU has significantly increased the share of green energy sources in its network. In 2016, its energy mix consisted of 50% renewable and recovered energy sources (41% from waste heat recovery, 10% from biomass, 2% from biofuel, 1% from geothermal), 30% gas and 16% coal, with a global emission factor of 195 gCO_2eq/kWh.

The CLIMESPACE cooling network serves 600 mainly tertiary clients covering nearly 5 million m^2 (hotels, department stores, offices and administrative premises), and supplies 470 GWh of cooling energy each year, corresponding to approximately 30% of the cooling needs of the Paris tertiary building stock. The chilled water distributed throughout the network is produced by refrigeration units cooled by water from the River Seine. In winter, this water is used directly, via plate heat exchangers, for cooling the network (free cooling). Thanks to this efficient technique, the emission factor of the Climespace network is reduced to 7 gCO_2eq/kWh.[13]

Therefore, the heating and cooling networks are fundamental tools in the City of Paris's carbon transition strategy. On this basis, and in preparation for the renewal of two public service delegations in 2018 and 2024, Paris is launching a master plan for its networks in 2017 which aims to identify the needs for work to be carried out in the medium and long terms, map the development potential and analyse the strategies to be deployed in order to continue the greening of their energy mixes. In particular, the opportunities to create interconnections between the two networks are being studied in order to optimise mid-season energy production (recovery of residual heat resulting from the production of cooling energy for use in the heating network).

By 2030, the energy distributed throughout the heating network will have stabilised, thanks to the combined effects of the thermal renovation of buildings, global warming and the densification of the network. The Climespace network will have significantly increased the dimensions of its productions and its network in response to the growing demand for cooling energy in the tertiary sector and the emerging demand in the residential sector.

Before 2030, the coal-fired boilers at the St Ouen boiler plant will have been definitively converted to biomass, supplied by the French and Ile-de-France timber industry. The share of heat supplied by incinerators will have been significantly reduced, after the closure of the Ivry incinerator in 2023. Indeed, following the implementation of an ambitious "zero waste" strategy in Paris, the effectiveness of prevention and sorting policies will allow for a massive reduction in the volumes of residual waste to be processed by the SYCTOM. This drop will be offset by the combustion of the methane produced by the Organic Recovery Unit (*Unité de Valorisation Organique* - UVO), using the biowaste generated by Parisians – private individuals and professionals. In the framework of the new Paris development operations, major investments will be made in order to increase the share of geothermal energy (in the Albian and Dogger aquifers) and hydrothermal energy (from the River Seine and canals) in the network.

Paris is supporting the densification of networks and their rollout to residential areas, outside neighbourhoods equipped with major infrastructures. As extension and maintenance works progress, the steam network will be gradually replaced by a more efficient superheated water network. The only parts to be retained will be the major high-temperature lines linking the heat production sites situated outside the city centre (St Ouen, Ivry and Issy) with central Paris. Locally, the major network will be structured into integrated networks equipped with hot-water loops, exploiting the renewables (geothermal, hydrothermal, solar thermal, etc.) and recovered resources produced locally (residual heat from datacentres and calories obtained from the Climespace network), with auxiliary energy from the heating network. These global dynamics will allow the emission factor for the CPCU network to be reduced to 55 gCO_2eq/kWh in 2050.

[13] ADEME, Base Carbone

Renewables outside central Paris

To obtain a 100% renewable mix in 2050, renewable energy sites will need to be envisaged outside Paris, in cooperation with other territories.

At the national level, our scenario is based on an average carbon intensity of 42 gCO_2eq per kWh for the national electricity grid.[14] However, between 2015 and 2050, there will be major improvements in renewable energy sources, allowing for a drop in their embedded carbon amortisation: a result of the reduction of their intrinsic footprint, and of the downward trend in the carbon intensity of electricity production at the global level. In 2050, the ratio adopted for photovoltaic production will stand at 14 gCO_2eq/kWh[15] and at 7 gCO_2eq/kWh[16] for wind energy.

The City of Paris is making a pioneering contribution to the financing and operation of renewable capacities outside its territory. In this way, Paris is boosting and accelerating the transformation of national energy production infrastructures. These contributions are allowing the city to measure the offsetting generated by the marginal deviation from the carbon intensity of the national mix.

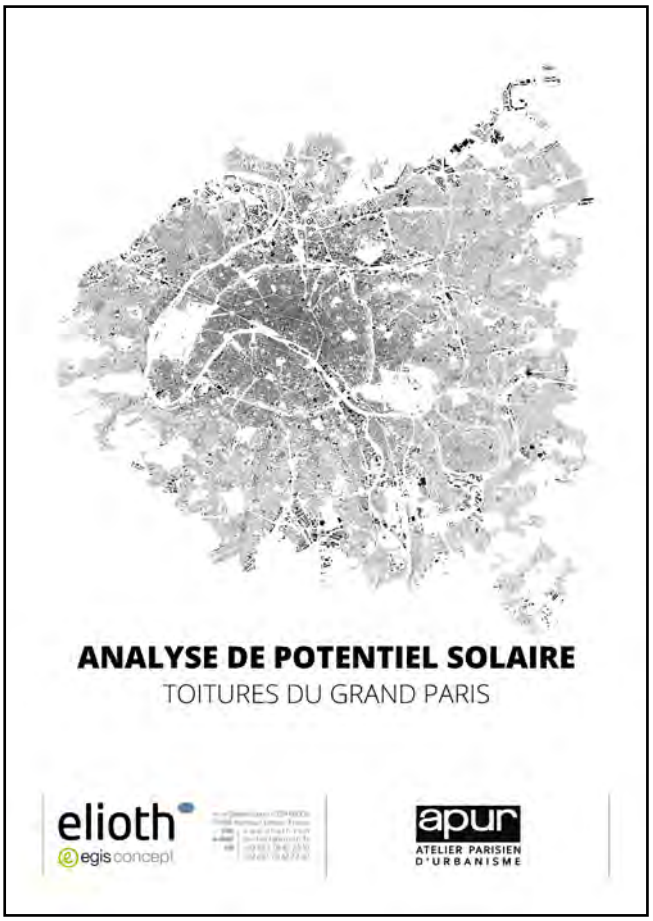
As far as development between now and 2050 is concerned, Paris is committing to a trajectory that makes an immediate impact on these investments in renewables and offsetting, whose effects are felt over the long term. Indeed, it is easier to initiate investments than to initiate transformations of sectors or groups of stakeholders with impacts on the built environment and mobility.

In addition, these direct and operational territorial cooperation activities are also an opportunity to combine best practices and speed up transfers of expertise or operational instruments between the Paris metropolis and other local authorities.

For example, for the offsetting of 1.9 million tonnes of CO_2eq by 2050, in a mix of 1/3 solar and 2/3 wind energy outside the city centre, Paris could undertake to create nearly 50 km^2 of solar farms and erect 3,000 wind turbines. This ambition will involve an intermediate milestone showing that Paris can attain 1 $MtCO_2eq$ in offset emissions by 2030, with an effort of 4% per year. This major ambition assumes the early implementation of this global policy for "renewables outside central Paris".



Bio-climatic HQE social housing © M. Verhille - Mairie de Paris



Report for APUR on the potential solar energy for rooftops within the region of Paris © Elioth

[14] Value established on the basis of the following assumptions: production consisting of 25% nuclear, 63% renewables (38% wind, 10% solar PV, 9% hydroelectricity, 4% decentralised thermal), 12% fossil. Demand remaining stable at ≈ 500 TWh/year. CO_2 capture and storage allowing for a 50% reduction in emissions from centralised fossil sources. 8% of line losses. 6% of the demand imported via cross-border interconnections.

[15] IEA, Life Cycle Assessment of Future Photovoltaic Electricity Production from Residential-scale Systems Operated in Europe, 2015. OPT Scenario.

[16] Base Carbone, ADEME. Installed wind energy in continental Europe.

Paris – the smart city

Beyond production issues, certain solutions need to be devised on the basis of the transformation of the electricity grid. Paris will need to contribute to the development of microgrids with self-production and self-consumption playing a dominant role in the new neighbourhoods. The renovation projects on iconic sites in Paris, such as La Pitié-Salpêtrière and Bichat hospital, provide opportunities to develop these local networks.

In 2026, Paris will sign a flexibility agreement with the local electricity distribution network manager: Parisians will undertake to manage their peak consumption loads, while the City will participate in the rollout of ad-hoc technical systems.

On this specific point, electric mobility operators, which will have a strong presence throughout the capital by 2030, will be made aware of their responsibilities as managers of local electricity storage and load-management resources.

The development of digital technology, which is supporting the new mobile teleworking practices, is generating digital infrastructure requirements – particularly for the building of numerous datacentres, which are becoming key links in the new neighbourhood energy networks: recovery of residual heat, use of back-up and redundancy capacities for load management and balancing of the network, etc.

Parisians as consumer-stakeholders

Since 2016, municipal buildings and public lighting in Paris have been supplied by 100% renewably sourced electricity. At the same time, only 0.10% of Parisians are customers of suppliers of renewably sourced electricity (Enercoop or Planète-Oui). Paris, through its influence networks, or support for the organisation of socially responsible purchasing consortia, could boost this migration of consumers, setting targets of 1% by 2020 and 5% to 10% by 2050. This dynamic market development process could require the dominant operators to develop comparable offerings.

At the same time, Paris is organising a purchasing consortium with the public and parapublic stakeholders to facilitate the purchasing of green electricity. This consortium could be established in a varied range of legal forms: cooperative, associative, as a local public company (SPL) or a mixed-ownership company (SEM).

2050

Offsetting of Paris's emissions by the production of renewables outside central Paris

-1 700 $MtCO_2eq/year$

Wind farm	Solar farms
	
3000 turbines	50 km^2

Renewable energy production

Installed capacity 15 GW	Installed capacity 15 GWc
Energy production 35 TWh/an	Energy production 20 TWh/an

Offsetting of Paris's emissions

Emission factor* 7 gCO_2eq/kWh	Emission factor* 14 gCO_2eq/kWh
Avoided emissions -1 100 $MtCO_2eq/an$	Avoided emissions -600 $MtCO_2eq/an$

* The emission factor for the electricity grid by 2050 stands at 43 gCO_2-eq/kWh, based on the assumptions adopted for the changes in the national mix (source: RTE, ADEME, Egis)

FOCUS ON BUILDINGS

2004
6,3 $MtCO_2eq$

2030
3,3 $MtCO_2eq$
-45%

IMAGINING NEW WAYS OF LIVING AND WORKING

Co-Habitat Plans (joint tenancy, intergenerational house sharing, shared living spaces)

Remote working and communication plans (collaborative work spaces, alternative facilities

Tax on empty and under-occupied homes (TLVSO)

WIDESPREAD RENOVATION OF SOCIAL & PRIVATE HOUSING

Low-carbon renovation for social housing (subsidised by the City of Paris and Greater Paris)

4 000 homes/year — 4 500 homes/year

Low-carbon renovation of jointly-owned private buildings (funding from FPPO)

3 200 homes/year — 12 000 homes/year

DORECO Programme (Ope

DECARBONISING TERTIARY-SECTOR BUILDINGS

Sustainable Digital Strategy

Low-Carbon Property Pact

Low-carbon renovation of public buildings (funding from the FPPO)

1 000 000 m²/year

PARISPACE Programme (renovation of small tertiary-sector

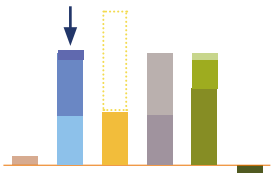
800 000 m²/year

CONSTRUCTING LOW-CARBON & POSITIVE-ENERGY BUILDINGS

Smart Paris Programme

DOREMA Programme (Operational Strategy for Recycling & Eco-Materials)

2016 2020 2026 2032 2038



2050
1,7 $MtCO_2eq$
-75%

s)

5 000 homes/year

24 000 homes/year

rational Strategy for the Energy Renovation of Jointly-Owned Buildings)

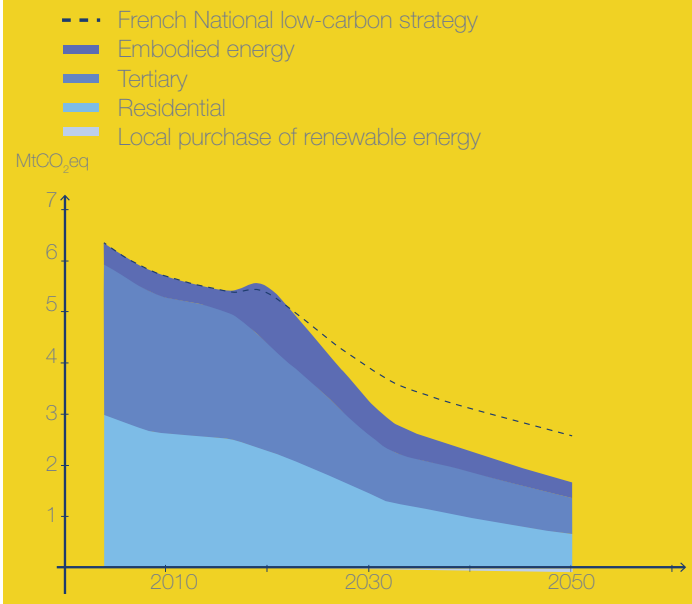
150 000 m²/year

buildings)

400 000 m²/year

2044 2050

OVERVIEW



RENOVATION OF EXISTING BUILDINGS

80% of the residential buildings were built before 1974, the year in which the first thermal efficiency regulations were introduced in France. 70% of buildings fall into categories E to G on the DPE energy performance scale, making them very energy-inefficient.
The tertiary sector is not far behind, accounting for 60 million m² of floorspace and 13% of the region's greenhouse gas emissions.
Renovation is therefore a crucial issue, with the power to substantially reduce the city's carbon footprint. In order to get the ball rolling, we will need to highlight the economic advantages involved, particularly amortisation mechanisms and return on investment. These measures must increase the profitability of renovation work, giving homeowners an incentive to take action.
Each year, only 1% of total housing stock is renewed. Reaching the remaining 99% is essential. Renovation is a fundamentally social endeavour, respecting the architectural and technical history of the building as well as the ways its residents use the space.

Legend
Ongoing
Support and awareness
Technical & regulatory actions

3.1.2/ BUILDINGS

With total carbon emissions of 5.4 $GtCO_2eq$ in 2014 (21% of total emissions as recorded in the Carbon Assessment), the buildings and construction sector is one of Paris' carbon heavyweights…and a major priority of the transition to carbon neutrality.

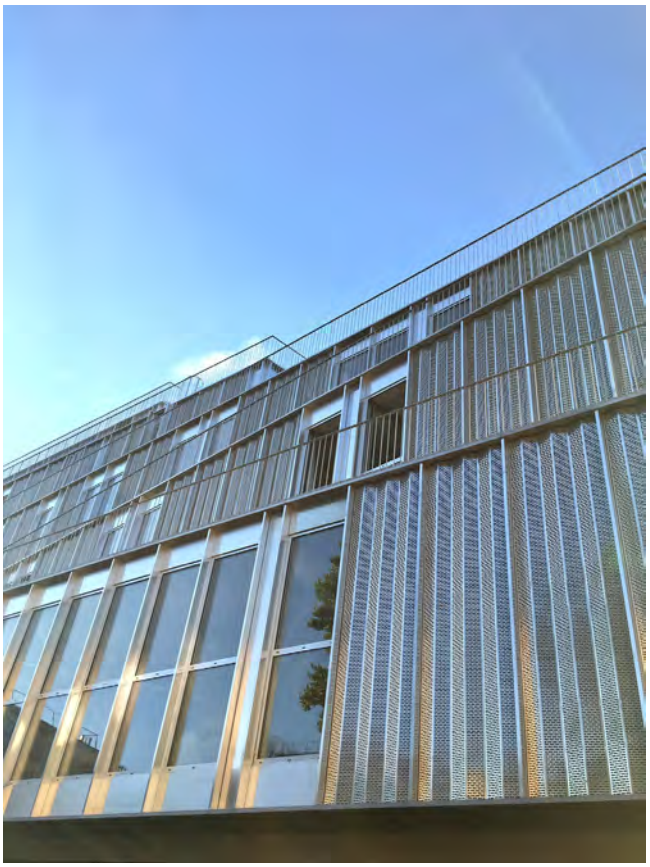
The scale of this challenge is considerable, requiring us to take action on multiple fronts. One of the first priorities will be the energy-efficient renovation of the city's existing residential and tertiary buildings: almost 80% of Parisian buildings[1] were built before the first thermal performance regulations came into force in 1974, and will need major renovations by 2050. In the meantime Paris will continue to build new homes to make up for the current shortfall in supply, building at a rate of 10,000 new units per year, of which three-quarters will be social housing[2]. At the metropolitan level, work on the Greater Paris Express and the areas around our train stations will continue apace.

These large-scale projects will generate major quantities of debris and waste, while also consuming huge volumes of materials. In the immediate short term, it is essential that we develop a metropolitan circular economy in the construction sector, promoting short supply circuits, boosting local reuse and recycling, limiting the consumption of raw materials and energy and making an active contribution to the reduction of "embedded" carbon emissions, i.e. carbon released by construction and the transformation of existing materials.

The tertiary and residential property markets will gradually adapt to the new demands of investors, owners and tenants: given the scale of the climate emergency, the carbon-efficiency label will become a major factor determining sale and rental prices.

With more and more Parisians working remotely or nomadically, a host of local, connected, flexible and fluid workspaces will spring up.

The population of Paris will continue to grow, and providing housing for all will remain a major priority for the city authorities: by 2050, we will need to make room for around 200,000 more Parisians.[3] The structure of Parisian households will have changed considerably since the turn of the millennium: couples moving in together later, more single-parent and reconstituted families, steady ageing of the population with the elderly preferring to receive care at home rather than in institutions. These changes will increase demand for new forms of housing which the existing stock, designed with traditional family structures in mind, will struggle to provide. As such, a large proportion of the new homes created will involve repurposing existing spaces.



School, architect Arnaud Nouvet © Mayor of Paris

[1] Department for Public Parks and the Environment, *Paris Energy Assessment* 2014
[2] Paris.fr [online] *http://www.paris.fr/actualites/decouvrez-le-pacte-logement-pour-tous-2127*
[3] Figure based on INSEE calculations and the forecast of 10,000 new homes/year between 2016 and 2030, then 7,000/year between 2030 and 2050.

Inventing new ways of living and working

Accommodating new ways to live together

In 2019, the City of Paris will publish its review of the actions conducted under the banner of the "Housing for All" pact: in the period covered by this project, 10,000 new homes will have been delivered each year, thanks to new-builds in the major redevelopment programmes(Paris Rive Gauche, Clichy Batignolles, Paris Nord Est, St Vincent de Paul etc.), the reassignment of property owned by the government and public bodies, and the transformation of 200,000m² of unused office space and 1,000 uninhabitable attic rooms. In the meantime, the rent cap policy enacted in 2015 will be the first in a string of measures to curb property speculation, alleviating some of the pressure on the rental market.

But in spite of these successes, the housing shortage will still be a problem. Finding a place to live will often be a serious struggle for students, young workers, single-parent families and mobile professionals, whose level of income essentially shuts them out of both the private and social sectors. In these circumstances, joint occupancy is an alternative which will begin to appeal to more and more Parisians. Aside from the obvious economic benefits, joint tenancy will allow people to live in bigger apartments and enjoy the advantages of a convivial, communal lifestyle. Nonetheless, with nine applicants for every one apartment which becomes available, reticent landlords and a lack of initiative from estate agents will continue to represent major obstacles to the development of joint tenancy in Paris[4].

In light of these challenges, the new "Co-Habitat Plan 2020-2032" drawn up in partnership with the Metropolitan Authority (responsible for housing since 2017) will extend the efforts made in the previous term of office to create more social, intermediate and private housing, and to boost the number of homes available for joint occupancy. The resources allotted to the MULTILOC initiative[5], first launched in 2015, will be significantly increased: almost 20,000 empty homes will thus be brought back onto the rental market,[6] including large apartments ideal for joint occupancy. The City of Paris will also greatly increase its support for associations[7] working to develop intergenerational joint occupancy, an effective means of reducing the isolation of elderly Parisians, helping them to stay in their homes while also providing affordable housing solutions for younger people on low or middle incomes. In the meantime, the property sector will begin restructuring its offer to respond to the growing demand (new housing programmes designed with joint occupancy in mind[8], specialist estate agencies offering individual leases for each member of jointly-rented homes etc.).[9]

In 2026, in order to free up unused space in the residential private sector, the City will lobby the national government to extend the Tax on Empty Homes (TLV) to under-occupied homes. This new tax (the TLVSO) will establish a threshold value for number of square metres per resident, above which the household will be taxed: 45m² for one person living alone, 60m² for a couple, 25m² for each extra person. Although unpopular upon its initial launch, the TLVSO will gradually become an accepted fact of life in an era when Parisians' lifestyles are becoming progressively more modest: by limiting the amount of space to be heated per person, this tax will become an important instrument in Paris' low-carbon strategy. The social value of the tax will come to be appreciated, with the majority of citizens understanding the need for this "space premium." The system will also introduce a new form of fiscal pressure, encouraging developers to prioritise the quality of homes rather than their size. Paris will thus be one of the first metropolises to reach "peak space usage," with clear consequences for carbon emissions. By limiting the amount of space occupied per capita, Paris will have created an extremely socially-effective means of redistributing space which also has clear environmental benefits.

In 2017, the Greater Paris Metropolis joined the national network of local authorities in favour of community housing. The first priority is to highlight the success of the first experiments with this format in the capital (including the three developments currently under construction in the 19th and 20th *arrondissements*, stemming from the call for tenders conducted in 2014), and to remove the remai-

[4] Appartager, Co-renting index 2015. Appartager + Action Logement, *De la colocation, à la location partagée*, 2016.
[5] The MULTILOC scheme is aimed at owners of homes which have been unoccupied for more than a month. It offers certain guarantees on rent payments and, where necessary, may offer funding to cover all or part of the cost of renovating old properties. In return, owners commit to renting their properties at a price 20% below the benchmark rate established by the Prefect. Source : *http://www.paris.fr/multiloc*
[6] Figure based on the number of empty homes identified in 2014 (114,383 homes), and the «normal» empty rate in a healthy market, estimated at 7%. Source: DEVE, Paris Energy Assessment 2014.
[7] The CoSI network (Cohabitation and Intergenerational Solidarity), ensemble2générations, etc.
[8] My Coloc' by Nexity, Coloc & Vie, etc.
[9] Paris-Colocations, the L'Auberge network etc.

ning obstacles to the development of this "third way" for the housing sector. Various groups of proactive citizens, looking for alternatives to the options proposed by professional estate agents, will come together to imagine, create and manage new collective living spaces, compatible with their income levels and lifestyle choices: bespoke homes with shared facilities (laundry, function rooms, guest rooms, workspaces, workshops, play areas etc.), limited environmental impact, roots in the local community and common values of sharing and solidarity. In order to meet the growing demand for such homes, and to accelerate the development of projects previously held back by exorbitant property prices, the Metropolitan Authority and the City will reserve space in new development programmes and schemes to transform disused offices into homes. Social housing agencies and council housing cooperatives will be closely involved, aiming to ensure a mix of ages and socio-cultural backgrounds while also providing technical support services for residents' collectives. The target for 2030: support the expansion of these projects so that 5% of new homes created in Paris are community housing.

These new ways of living together will no longer be dismissed as a passing fad, but recognised as a profound transformation in the way we live together in the 21st century. Along with "conventional" social housing and the private sector, these new shared spaces will contribute to the diversification of Parisian housing, integrating perfectly with existing homes and new projects devoted to urban renewal and development: Gare des Mines, Gare de Lyon-Daumesnil, Bercy Charenton and, from 2032, the new designated development zones created in the spaces freed up by converting sections of the ring road into an urban boulevard, as well as the work done to reconvert brownfield land near railway lines. As a general rule, priority will be afforded to projects to create grouped housing on an approachable scale, maintaining a balanced social mix within each neighbourhood: housing, local services, shared workspaces and relocated industrial and craft activities are all essential links in the chain of the low-carbon, eco-designed circular economy.

Facing up to social and migratory emergencies

Like all prosperous, attractive, global cities, Paris is no stranger to inequality and will need to face up to the growing pressures of social emergencies, including welcoming migrants fleeing the major political, economic and ecological crises which will shape the 21st century. The city will need to find acceptable temporary housing solutions for people in need, before redirecting them to more long-term homes in the "conventional" residential sector, spread across France.

In 2020, following in the footsteps of calls for proposals such as "Reinventing Paris" and "Inventing the Metropolis," the City of Paris will launch a new competition aimed at students, construction professionals, start-ups and private citizens. Its goal: to come up with new forms of temporary, nomadic and modular homes which can be used to house migrants and homeless people. These modular housing units could be set up in empty urban spaces (vacant lots, squares, rooftops etc.), on the banks of the river or along abandoned railway lines.
The proposals submitted will draw heavily on the ideas thrown up by the international consultation "Paris: City of Welcome" organised by the PEROU (Centre for the Exploration of Urban Resources),the Pavillon de l'Arsenal and the Fondation Abbé Pierre in 2014: minimalist constructions which are easy to disassemble and transport, while fulfilling all of the core functions of decent housing; all-purpose shelters inspired by big-tops, converted shipping containers which can be stacked to create multi-storey complexes… the variety of options available is huge, with the capacity to be rapidly operational[10]. One thing these proposals all have in common is their use of low-carbon materials and resources from the Parisian circular economy (bio-sourced or recycled). The people sheltered in these temporary homes will be encouraged to make the most of their skills and abilities, with literacy and professional integration schemes, urban agriculture initiatives and a close partnership with Paris' thriving recycling and upcycling sector.

These nomadic housing units, produced in large numbers, will be disassembled and stored away when demand subsides. They may also be used for seasonal uses or special events, as well as providing temporary site facilities for Paris' major development programmes. They could come in particularly handy during construction of the Olympic Village for the 2024 Olympic Games. These programmes also serve as a showcase for best practices in the development of urban resilience, and as we face up to the challenge of adapting to climate change.

[10] see perou-paris.org [online] *http://www.perou-paris.org/Actions.html#A%20Paris*

The changing way we work

Since the start of the 21st century, the dominant model of salaried employment has been on the wane in France. Non-salaried, independent workers are on the increase: in 2011, one in ten people in employment in France was engaged in non-salaried work either as their main activity or in addition to another job.[11] Over the same period, the proliferation of digital tools and the rise of powerful information networks have facilitated the growth in remote working, whether under contract (teleworking)[12] or not (known as "nomadism").[13] As tensions in the residential property market push young professionals and families with more than one child out of Paris, the increase in the time they spend commuting will have a direct impact on their quality of life: remote working, often from home, is an effective solution to this problem.

In the section dedicated to changes in the world of work, the "Co-Habitat Plan" for 2020, drawn up in partnership with the Metropolis, includes measures to facilitate remote working by designing flexible, connected property developments.

Thanks to successive plans to promote teleworking and telepresence, the number of people in the Ile-de-France region taking advantage of these opportunities will rise to 21% by 2025 and 40% by 2050. By 2030, demand for "conventional" office space will be 5% lower than it was in 2015,[14] with permanently unoccupied spaces converted to other uses.. Business centres, communication hubs and coworking spaces will pop up all over Paris, presenting a convivial alternative to the isolation of working at home and offering a range of services (facilities, events, advice etc.). These spaces allow users to work alone or in teams, acquiring new skills and developing their networks of partners. As part of this strategy of promoting teleworking, the City of Paris will provide financial backing for new collaborative working facilities (joint financing or loans from the Paris Green Investment Fund). This will allow for a significant reduction in the greenhouse gas emissions caused by commuting, and help Parisians to enjoy a better work-life balance.

Connectivity has long been one of the major criteria that nomadic workers look for in a workspace. In the workplace, at home, in public... we use more connected objects than ever before. These technologies have contributed to the spectacular growth of the "functional economy" over the past decade (where what is on sale is not so much the product as the uses it allows), made possible by the accumulation of enormous stocks of digital data and giving rise to new opportunities for innovation and value creation. Nevertheless, this big data is backed up by very real hardware and infrastructure, used to collect, store and process information. These systems consume vast amounts of energy, and generate a huge carbon footprint at every stage of their life cycle. In 2014, IT systems accounted for nearly 15% of Paris' electricity consumption[15]. Although progress is being made on boosting their energy efficiency, the number of data centres in the Ile de France region is rapidly increasing to keep pace with demand.
Acutely aware of the challenges at hand, in 2018 the City of Paris will launch its Sustainable Digital Strategy in partnership with key players in the regional economy and partners from civil society: the goal is to unite all stakeholders behind a commitment to sustainable development in the digital sector, in light of the climate change emergency.
By 2030, more than 25,000 non-transferable jobs will have been created in Paris in the fields of energy renovation, reuse, repairing and recycling.[16] New companies will set up shop in ground floor spaces near the Seine and the canals, facilitating the river-borne transportation of merchandise and materials. Start-ups will also flourish in the spaces freed up by transforming the ring road into an urban boulevard. These innovative new businesses will combine tertiary and industrial activities: coordinating production chains, designing, creating, marketing AND manufacturing, all backed up with local logistics, full life-cycle services and surface treatments. Paris will not revert to the industrial infrastructures of the 19th century: across the city a new web of micro-factories, workshops and labs will manufacture, store and work with eco-materials

[11] INSEE, *Emploi et revenus des indépendants*, 2015

[12] «(…) remote working refers to ways of organising work in which a job which could have been performed by an employee on the employer's premises is instead performed remotely, regularly and voluntarily, with the help of information and communication technologies.» Source: French Labour Code Article L1222-9, 2012.

[13] «Nomadism refers to professional activities which can be conducted from multiple locations (office, home or elsewhere), alternating regularly or randomly throughout the week.» Source: ORIE, *«Travail à distance, quel impact sur l'immobilier de bureau?»* 2015.

[14] ORIE, *Travail à distance, quel impact sur l'immobilier de bureau ?*, 2015.

[15] DEVE, Paris Energy Assessment 2014.

[16] see Paris.fr [online] *http://www.paris.fr/economiecirculaire* and the forecasts for employment and skills in the Ile-de-France region in 2020 published by the Regional Directorate for Business, Competition, Consumption, Work and Employment (DIRECCTE))

The City of Paris sets the example

The Paris Teleworking and Telepresence Plans include a chapter on the city's administrative personnel. For example, the city plans to introduce new contracts which include remote working for 2 or 3 days each week, available to those employees whose jobs are compatible with this set-up and who are willing to make the change. The offices freed up by this change will be converted into coworking hubs, with workspaces rented out via a dedicated online platform. In these spaces, nomadic employees of the City of Paris will rub shoulders with their fixed-post colleagues, as well as partners and suppliers.

In keeping with the Sustainable Digital Strategy, the City of Paris will undertake to limit the impact of NICT[17] usage by imposing tighter requirements in public contracts, optimising IT resources and streamlining our use of big data, while educating employees in best practices (efficient use of email and the internet).



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[17] New Information and Communication Technologies

Renovation of existing buildings, a key priority

Large-scale energy renovation in the housing sector

In 2014, Paris had over 1.4 million homes, of which 96% were apartments, and 47,000 condominiums, accounting for a total of nearly 80 million m².

80% of existing housing stock was built before 1974, the year in which the first thermal efficiency regulations were introduced in France. 70% of buildings fall into categories E to G on the DPE energy performance scale, making them very energy-inefficient. For residents of these old buildings, "heating" accounts for around 75% of total energy consumption and 50% of energy spending. Parisian homes are heated primarily by gas (42%), the CPCU district heating network (16%), electricity (34%) and oil (7%).[18]

The task of conducting energy renovations on residential buildings is not without its own challenges: the first priority is to reduce the energy consumption of old buildings, taking into account the specificities of the city's architecture in terms of its historical heritage, construction techniques and thermal efficiency. We will also need to make more effective use of renewable and recovered energies (which are more useful for boosting efficiency than primary production), either locally or via special networks, in order to reduce the proportion of carbonised energy sources and make the city's energy mix greener. As well as the threat posed by climate change and the need to plan ahead for the end of non-renewable energies, driving down household energy bills will be a major priority in the long term.

In 2019, Paris' second Climate-Energy Plan will reach its conclusion: in keeping with the objectives set out in 2012, energy consumption by social housing will be down 30% on its 2004 level thanks to the substantial renovation work undertaken by landlords and subsidised by the city. Almost 40,000 homes will have been renovated, with work focusing primarily on adding thermal insulation to outer walls, replacing old doors and windows and improving ventilation systems (4000 homes renovated each year, reaching 17% of all social housing in the space of 10 years).[19] The results will be very positive, and the next challenge will be to build on this momentum and accelerate the energy renovation of the city's social housing, based on the feedback picked up by the City of Paris and landlords regarding energy efficiency performance and the cost of renovation work.

However, energy-performance renovation in the private sector remains sluggish. The programmes backed by the city are still struggling to gain momentum: by 2020, around 500 condominiums containing 34,000 homes will have undergone energy renovation, thanks in part to OPATB13, OPAH 2D2E, OPATB19 and the "Paris Eco-Renovation Plan" launched in 2016 (3,200 homes/year and 2.5% of private homes in the space of 10 years).[20]

In 2017, the municipal authorities will sit down with the major stakeholders in the private renovation sector in order to prepare the next incarnation of the Climate Plan, identifying the means required to achieve our zero carbon objective. The challenge will be to massively reduce greenhouse emissions from residential buildings, undertaking advanced thermal renovations and decarbonising the energy mix (banning oil heaters, connecting homes to district heating networks, installing heat pumps and solar boilers, electricity from solar panels etc.)

Launched in 2013, the Coach Copro® has rapidly become an essential and effective tool providing information and support for citizens looking to undertake energy renovations, putting them in touch with professionals from the sector (companies, designers and architects, AMOs[21], co-ownership organisations). The City of Paris will provide unstinting financial support. But we still need to see a more radical change: the rate and efficiency of this renovation work need to be stepped up a gear. The new Climate Plan for 2020-2032 will therefore heavily prioritise the development of solutions to facilitate the decision-making process, encourage renovations on a large scale, accelerate project delivery and ensure that the results obtained live up to our ambitions. In order to achieve a four-fold improvement by 2050, the rate of renovation will need to be somewhere close to 5,500 homes/year in the social housing sector (2.3% of existing housing stock each year) and 24,000 homes/year in the private sector (2.1% of existing housing stock each year) by 2032...

[18] DEVE, Paris Energy Assessment 2014
[19] City of Paris, Housing section of the Climate-Energy Plan 2013
[20] City of Paris, Bleu Climat Energie, 2015
[21] Assistant à Maître d'Ouvrage

Co-owners' syndicates have a major role to play in encouraging homeowners to take the decisive step, but all too often they have little awareness of the technical and financial aspects of energy renovation, considering such matters to be outside the scope of their responsibilities. In this context, the City of Paris will call on the government to extend the RGE scheme to co-owners' syndicates in 2017. This will mean that public subsidies for energy renovations will only be awarded to accredited syndicates.

In 2020, inspired by SEM Energies POSIT'IF[22] and the Dutch EnergieSprong project[23], a consortium of professionals will launch an integrated package service known as HomeZero®. This package offers low-carbon renovation of condominiums (efficient energy consumption using locally-sourced renewables), and includes a performance guarantee. In order to win over Parisians, HomeZero® promises to deliver a complete renovation service within a week, without causing too much disruption to the occupants, thanks to the use of high-quality prefabricated components. This work can also be combined with other home improvements such as kitchen or bathroom renovations.

These renovation projects will be funded by the energy savings they permit, by external financing partners and by public loans and subsidies for home improvement work: Collective Interest-Free Eco-Loans, Tax Credits for the Energy Transition (CITE), Energy-Efficiency Certificates (CEE) and, for lower-income households, subsidies from the ANAH under the "Better Living" scheme.

While some condominiums are able to fund their energy renovations by selling the rights to add extra floors to their building, finding the necessary finances remains a challenge for lower-income households. In an effort to tackle this problem, the City of Paris will work in partnership with the Caisse des Dépôts et Consignations to create a range of attractive third-party finance options using money from the Paris Green Investment Fund (FFPV).

This new model will galvanise the renovation of jointly-owned residences in the capital, and pave the way for more SSEE (energy efficiency service providers) to enter this thriving market. In the Paris of 2030, drones will be a familiar sight. These robotic helpers will be hard at work dismantling the crumbling façades of buildings thrown up in the post-war period, replacing them with modular façades prefabricated using bio-sourced or recycled materials, with superior thermal performance credentials.

In 2026, with the energy renovation market continuing to grow exponentially, the Paris Climate Agency will decide to take action to boost professional practice in this sector and develop the skills of small building firms. The agency will join forces with the CINOV[24] and the CAPEB[25] to develop the DORECO programme (Operational Strategy for the Energy Renovation of Jointly-Owned Buildings). The aim of this programme will be to increase the number of qualified professionals, expanding the training opportunities on offer to meet the requirements of businesses. The goal is to develop comprehensive, local project development and construction services, with craftsmen and service providers joining forces to form project teams, consolidating their sector-led approach and promoting local industry.



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[22] see [online] *http://www.energiespositif.fr/*
[23] see [online] *http://www.energiesprong.nl/*

[24] Fédération des syndicats des métiers de la prestation intellectuelle du Conseil, de l'Ingénierie et du Numérique
[25] Confédération de l'Artisanat et des Petites Entreprises du Bâtiment

Above and beyond the massive investment of technical and financial resources in energy renovation, the ultimate goal is to establish a genuine culture of low-carbon living in Paris. With this goal in mind, in 2020 the City of Paris will launch a call for experimental projects under the banner of the "Re-Lab," offering support to partners from civil society and businesses involved with raising awareness, training and communicating on carbon issues, targeting both professionals and the general public. One particular highlight will be the foundation of the UPPT (the Parisian People's University for the Energy Transition). Conceived in partnership with the Compagnons Bâtisseurs network, the UPPT's courses on DIY renovations are sure to be a huge success.[26] The Re-Lab will also provide a boost to promising start-up Carboncat®. Carboncat collects data from in-home meters (Linky, Gazpar, water meters) and connected objects (thermostats, plug sockets etc.) and uses it to develop personalised services for clients: suggestions for simple energy-savings actions, tips on adjusting consumption in response to price windows and the carbon content of the energy mix, real-time heating adjustment in response to weather conditions, the thermal efficiency of the home and residents' lifestyles etc. A large-scale demonstration of the Carboncat® service, jointly-funded by ADEME and the City of Paris, will slash the energy consumption of participating households by 25%, and all for only a tiny initial investment.

Thanks to the efforts of average Parisians and the local economy, we will be able to hit our target for 2050: a 75% reduction in residential greenhouse gas emissions compared with their 2004 level, with the intermediary target of -45% reached in 2032.

[26] see [online] *http://www.compagnonsbatisseurs.org/*

Getting the carbon footprint of the tertiary sector under control

Paris is a major political, administrative and economic capital, and in 2016 the city's tertiary sector occupied 60 million m² and accounted for almost 13% of total greenhouse gas emissions. The sector's energy mix is made up primarily of gas (57%), electricity (29%), heat from the CPCU district network (7%) and oil (6%). The biggest sources of emissions are offices and administrative buildings (36%), cafés, hotels and restaurants (17%), shops (14%) and healthcare facilities (12%). Public administrations (government, region, city) and other public bodies (RATP, EDF, La Poste etc.) account for around 30% of energy consumption and emissions in the sector. The stakes are high when it comes to reducing the carbon footprint of Paris' tertiary sector, both in terms of the consequences for the climate and the city's public image: Paris' leading economic forces, public and private, need to step up to their responsibilities.

Nonetheless, since 2004, energy consumption in the tertiary sector has only slightly decreased. The energy savings made in heating have been offset by the continuous increase in electricity consumption and the construction of new buildings.[27] In order to hit our target of being carbon neutral by 2050, we need to change gear immediately.

In 2017, as part of the process of rebooting the Climate and Energy Plan, the City of Paris will sit down with the members of the "Tertiary Hub" and "Paris Climate Action" in order to sketch out the details of a "Low-Carbon Property Pact," designed to formally establish the responsibilities of the major owners, managers and users of Paris' property resources.[28]

The targets will be clear: following the example set by the City of Paris, the majority of contributors will undertake to reduce greenhouse gas emissions from their buildings by 40% by 2030, with a first milestone of -10% by 2020. These are ambitious objectives, and will require action on various fronts: first and foremost, we will need to educate occupants about environmentally-friendly actions while also improving technical systems to meet energy needs more efficiently. The first feedback from the CUBE 2020 contest shows that we can make energy savings of 20 to 25% with minimal investment![29]

Innovative solutions pioneered by the start-ups hosted in the Paris&Co business incubators will be widely mobilised to convert building operators into energy managers, responsible for leading the low-carbon transition: smart meters, analytical apps using big data, web services to pilot building maintenance and operations etc.

In the longer term, the signatories of this pact will produce detailed transition programmes incorporating thermal renovations to buildings, the replacement of old heating equipment with new, high-performance systems, prioritisation of local, decarbonised energy sources (geothermal, solar, waste heat recovery etc.) and even self-production of renewable heat, cold air and electricity. In order to meet the target of -40% by 2030, the BBC label is a minimum requirement.

From 2020 onwards, major renovations to public buildings will be covered by CPEs (Energy Performance Contracts), integrated deals whereby SSEEs develop and implement energy efficiency measures, and guarantee energy savings throughout the lifetime of the contract. Energy savings will cover all or part of the cost of renovation work. This work will receive third-party funding from the Paris Green Investment Fund (FFPV), the Caisse des Dépôts et Consignations and the EIB (European Investment Bank).

In 2020, in partnership with other major French metropolises, Greater Paris will found the National Observatory for Carbon Efficiency: this new institution will promote the work of green pioneers, map and document projects and the feedback they generate, and support the transition towards carbon neutral territories.

[27] City of Paris, DEVE, Bilan du Plan Climat Energie 2004-2014

[28] Launched in June 2016 by the Paris Climate Agency and the City of Paris, the Tertiary Hub is a collaborative platform which aims to develop sectoral cooperation communities and exchange best practices on reducing the carbon footprint of buildings.

[29] Efficient Building Contest 2020. http://cube2020.org

[30] http://pacenation.us/

While the leading operators in the field of public and private tertiary facilities have massively backed the initiatives launched by the City of Paris (schools and universities, hospitals, the government, the region, public property managers, major public and private-sector institutions etc.), there are still various obstacles which need to be overcome in order to extend these actions to the owners and operators of small offices, shops and other businesses. They have little expertise in such matters, the short timeframe of commercial leases is not compatible with long-term investment in renovation, and they have difficulty securing loans for such investments. In this context, the City of Paris lance will launch its PARISPACE programme in 2026, drawing inspiration from the American PACE[30] scheme (Property Assessed Clean Energy), with support from the national government. The principle of this programme is simple: financing for renovation work is fronted by a public or private investment fund, and the owner of the property then pays the money back by means of a surplus added to the annual property tax bill over a long period (c. 20 years). The debt is thus attached to the building itself, and not its owners in person, and landlords can easily pass on the cost to tenants in their rent prices.

In the long run, the Ministry for the Environment will extend the ICPE system to create ICPCs (Climate-Classified Facilities). The aim of this measure is to check the rise of specific electricity consumption (not connected to the building itself) and manage the rise in air conditioning as the average temperature in Paris increases. This system will cover all products which consume excessive amounts of energy or emit large volumes of GHGs: air conditioning units, IT servers, commercial refrigerators, saunas and hammams, laundries etc.

The City of Paris sets the example

In 2017 the City of Paris will launch the "Low Carbon Property Pact," promising to reduce greenhouse gas emissions from municipal buildings by 40% by 2030, continuing the current programme of renovation work on the city's schools.

Low-carbon buildings are revolutionising construction

Comprehensive carbon reduction, from construction through to the operational phase

With the arrival of the new Energy and Carbon Regulations in 2018 (replacing RT2012), positive-energy and low-carbon buildings will become the norm. New buildings will be particularly energy-efficient (<55kWh/m²/year for collective residences), with some even generating more energy than they consume (via solar roof panels etc.). Their carbon footprint will be two to three times smaller than that of existing buildings, taking into consideration their whole life cycle from construction right through to the end of their lifetime.

These regulatory changes will not pose any great problem to the City of Paris, where the use of energy and carbon labels on all public construction and renovation projects (BBCA - Low-Carbon Buildings, using the France Energy-Carbon scale) has been standard practice since 2016. The challenge of adapting to climate change will not be neglected, with the work of the Paris Climate Agency boosting renovation of existing buildings to cope with heat waves, as well as extra protective measures in new buildings.

Performance guarantees will be a systematic requirement for all construction and renovation projects, offering greater security for developers and investors. As early as 2026, the "Energy Performance Guarantee" will be replaced with a new "Low-Carbon Guarantee", looking at more than just the operational energy consumption of a building.

New, mixed property developments including homes and business premises will reflect the changing way we approach living and work spaces.

Developing the eco-materials sector

New construction sites and renovation projects all create large amounts of waste and debris, as well as using up considerable quantities of new materials.

In 2020 - in a bid to accelerate the reorganisation of the industrial sector devoted to reusing, recycling and decommissioning old products, and designing environmentally-friendly new ones - the Greater Paris Authority, the City of Paris and the Paris Climate Agency will join forces with the FFB[31] and the CSTB[32] to launch the DOREMA programme (the Operational Strategy for Recycling & Eco-Materials). This programme will be an integral component of the "Circular Economy Strategy" (cf. Waste chapter), aiming to boost the professional capabilities of the sector as a whole, finding new opportunities for experimentation and opening up private and public contracts to promising new players from the local circular economy.

Digital design, standardised construction processes and greater use of prefabrication will all help to reduce mistakes on building sites, a source of material and financial waste. From the design phase onwards, new buildings need to adopt a "zero-waste" philosophy. That means predicting the volume of waste which will be generated over the course of a building's life cycle and finding solutions which allow for the reuse, recycling and decommissioning of the materials involved.

New digital services will put secondary raw material producers in touch with businesses looking for eco-materials for new construction or renovation projects. Innovative local businesses will offer new construction materials obtained from demolition projects or recovered from the waste generated by businesses and households: insulation materials based on recycled fabrics, coatings made from lime and cellulose wadding, recycled concrete etc.

Meanwhile, the bio-sourced materials sector will be taking shape with help from the public sector: wood, cork, straw, hemp and wool are all potential alternatives to "conventional" materials used to make walls, cladding, frames and insulation. These materials are valuable "carbon sinks": they stock CO_2 which would otherwise be released into the atmosphere, and help to preserve natural resources.

[31] Fédération Française du Bâtiment.
[32] Centre Scientifique et Technique du Bâtiment

As early as 2020, Paris will have its first “high-rise” buildings made primarily from wood. The goal is to increase the use of wood as a building material threefold by 2030. The massive rise in bio-sourced materials will be galvanised by policies in favour of carbon capture. By investing massively in wood and the forestry sector, the City will secure a sufficient annual supply of biomass for use in bio-construction. In doing so, the city will keep large amounts of carbon out of the atmosphere. Every year, the APUR will issue a map showing the density of carbon storage in the Paris Metropolitan Area.

Under the DOREMA programme, building professionals, insurance firms and the CSTB will work together to update their standards and insurance products, ensuring that these new eco-materials are used as standard by all construction firms operating in Paris and the surrounding region.

Putting the Paris rooftops to work

During the Greater Paris international consultation held in 2008,[33] the team led by Rogers Stirk Harbour & Partners placed great emphasis on the importance of making use of the city's rooftops. By 2050 the current regulations will have evolved, and around 20% of Parisian roofs will be fitted with solar panels.[34] For buildings which receive less sunlight, rooftop gardens will be encouraged. This is a major opportunity for Paris to adapt to the changing climate. In implementing the urban development strategy, the City of Paris will also take into account the albedo of exposed surfaces in order to reduce the phenomenon of urban heat islands.

These factors will also be taken into consideration in all energy renovation projects, combining roof insulation (or extension, in certain cases) with the “geometrical realignment” of certain features (dormer windows, chimneys etc.) to allow for a massive increase in solar panels and rooftop gardens. On some buildings, experiments will be launched combining greenhouses for small-scale agriculture and solar panels for electricity generation. By 2050 the average yield of solar panels will be over 20%, and the rooftops of Paris will produce between 1200 and 1500 GWh of electricity every year.[35]

[33] see [online] *https://www.ateliergrandparis.fr/aigp/conseil/consultation2008.php*

[34] Projection of about 30 to 35 million m² of rooftops [to be confirmed]

[35] Considering that average production will be about 200 to 250 kWh elec per m² and per year, and taking account of orientations that are not always optimal

Buildings, an integral component of smart energy systems

The spread of home automation and intelligent building management systems, the widespread deployment of connected meters and the rise of big data will all help property developers to develop new energy-efficient and environmentally-conscious services including the monitoring and management of local energy consumption, production and storage.

Just as the centralised, one-directional approach to managing the national energy grid is beginning to show its limitations, positive-energy and smart buildings are becoming essential components of the modern network, capable of handling surges in peak-time demand and contributing to effective load management.

In 2018, in partnership with the organisation responsible for managing the local electricity grid, the City of Paris will launch the "Smart Paris" initiative, aimed at identifying the actions required to reduce the carbon footprint of Paris' energy consumption. Small-scale experiments will be launched with renewable local energy production, with buildings covering their own needs and re-injecting surplus energy back into the grid for other users. Innovative projects encouraging users of tertiary and residential buildings to shift their energy consumption to off-peak periods and/or renewable sources, with price incentives. A pilot scheme will also be launched to test the "vehicle-to-grid" (V2G) concept, which involves using the batteries of electric vehicles as mobile storage units: they inject energy into the grid in peak periods and recharge during the off-peak hours. The Autolib service and an increase in the number of charging stations for electric vehicles will also help to boost this green dynamic.

In 2026, based on the lessons learned from these pilot schemes, the City of Paris will update its Climate Plan so that all construction and renovation projects must be "smart grid ready." For both the city and energy suppliers, making better use of potential flexibility will avoid the need for major investments in new generators and network infrastructures.

The City of Paris sets the example

From 2020 onwards, the City of Paris' public contract awarding process will include obligations to use materials which are locally-sourced, bio-sourced or sourced from reuse and recycle schemes. All new or renovated municipal buildings will be "smart grid ready."



Exposition +2°C… Paris s'invente ! © Collectif et alors Y. Gourvil et C. Leroux, 2010

FOCUS ON TRANSPORT

2004
3,1 $MtCO_2eq$

2030
1,1 $MtCO_2eq$
-65%

REDUCING TRAVEL

Promote and verify Company Mobility Plans

Teleworking and Telepresence Plans

REGULATING POLLUTING VEHICLE TRAFFIC

Plans to promote shared mobility (carpooling and carsharing: reserved traffic lanes, eco-rewards, etc.)

Ban on vehicles first registered before:

1st january 1997 — 1st january 2005 — 1st january 2011 — Euro 7 standard

Vehicle scrappage support scheme

Defeasance Fund

Positive toll

Urban toll (preferential rates according to number of vehicle occupants and vehicle emiss

Transformation of the Paris ring road into an urban bou

ENCOURAGING MODAL SHIFT AND INTERMODALITY

Car-free days :

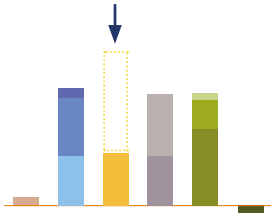
1d/year — 1 day / quarter — 1 day / month — 1 weekend / month

Cycling Plan

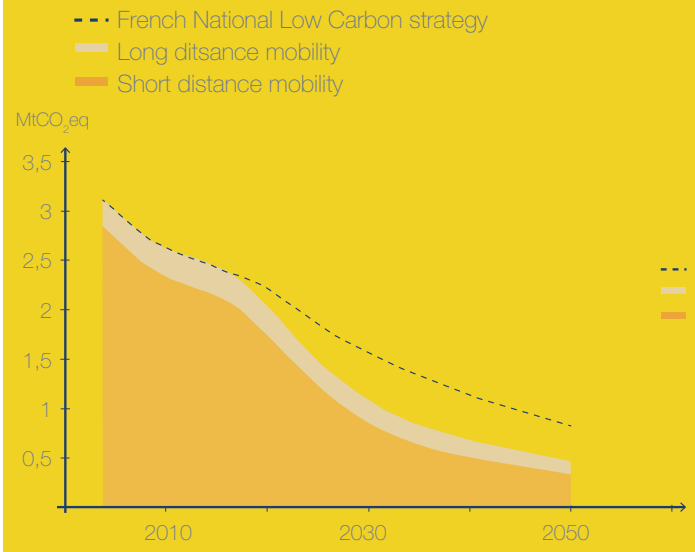
Active Mobility Plans (30kmh zones, mobility ambassadors, electric bicycle/trailer rental, etc

Adapt and develop the range of public transport (bus rapid-transit, DRT, etc.)

2016 2020 2026 2032 2038



2050
0,5 $MtCO_2eq$
-85%

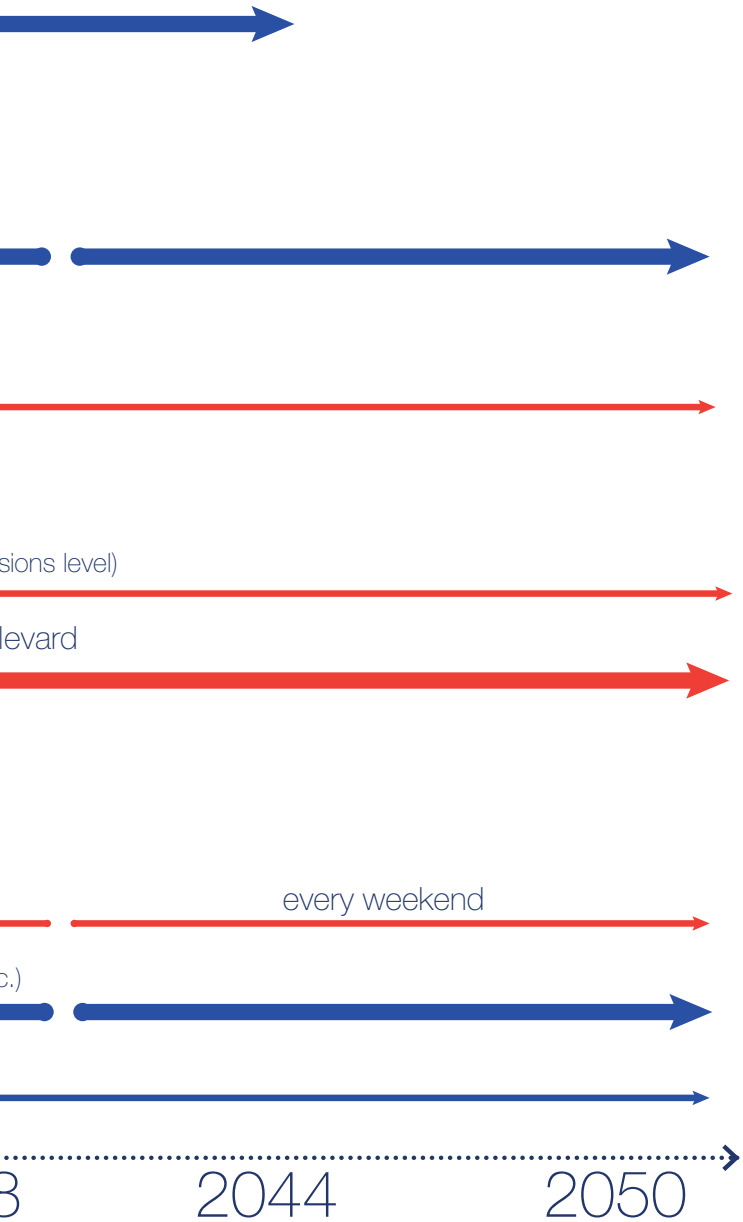


AND WHAT ABOUT AVIATION?

At the end of 2016, the International Civil Aviation Organisation (ICAO) introduced a system of greenhouse-gas emissions offsetting. The idea is that this system coupled with mitigation measures should stabilise the volume of emissions through to 2035, despite the increase in air traffic.

The share of air transportation in the carbon footprint of Paris corresponds to the emission of 6 $MtCO_2eq$, representing almost one-quarter of total emissions (it should be remembered that this item is not taken into account in the Paris carbon neutrality strategy). Per capita, this corresponds to the emission of 11 tCO_2eq per year and per Parisian. As a reminder, a Paris-New York round trip corresponds to emissions of over 1.1 tCO_2eq. Finally, professional mobility requiring a Paris-Toulouse round trip once every two months represents 1 tonne over a full year.

Although the airport hubs of the Paris region do not have any direct ties with the municipality, the city can take part in raising awareness of the importance of mobility choices among the local population and encouraging alternatives to air transport for holidays, professional mobility and family visits.



Legend

- Ongoing
- Support and awareness
- Technical & regulatory actions

3.1.3/ SHORT-DISTANCE TRANSPORT

Walking and public transport already represent a large part of Parisians' daily mobility. However, car trips within Paris and to and from the capital have a negative impact on the city's carbon footprint and air quality, even today when traffic has been reduced by 40% in 15 years. To accompany the transformation of mobility, the City of Paris must work on both supply and demand in transport. Limiting car traffic must go hand in hand with providing alternatives.

Reducing polluting personal vehicle traffic

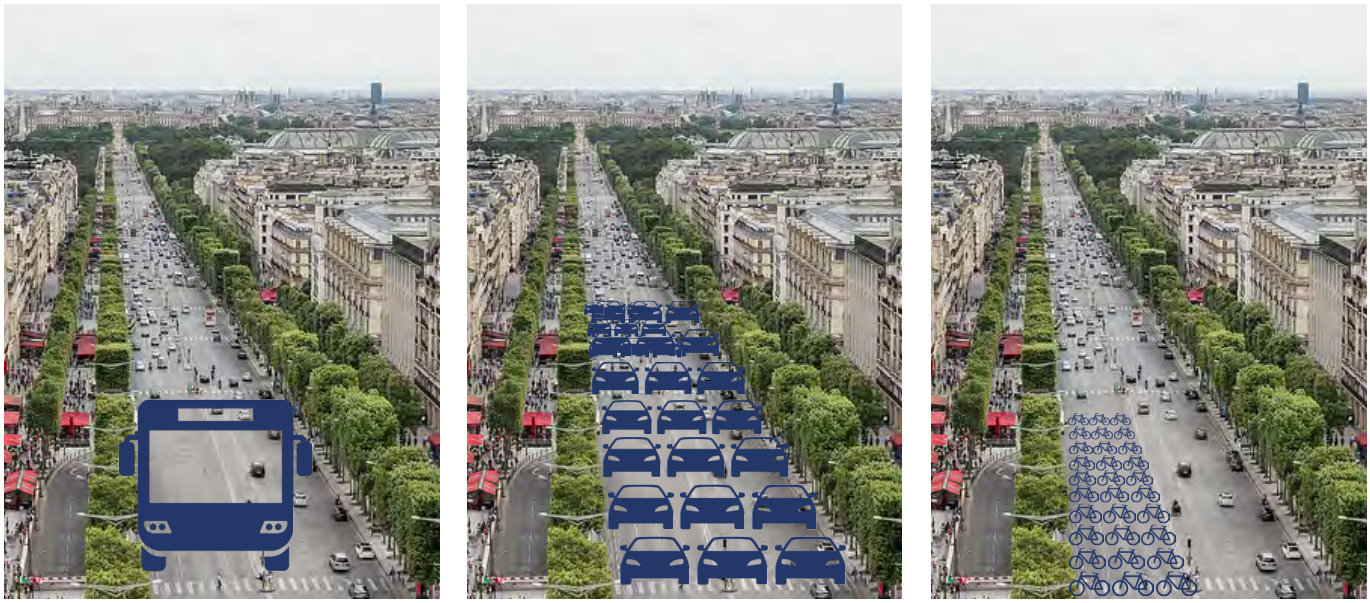
Reducing the number of car trips mainly implies **increasing vehicle occupancy**. The City of Paris is therefore placing the emphasis on shared mobility, in particular for commuting to and from work.

From 2017, it is subsidising and conducting extensive advertising for shared mobility systems and shared transport on request on the scale of the whole Ile de France region.

On the one hand, it is promoting professional transport services that pool requests from individuals (Uber Pool®, Padambus®, Pro-voiturage®, etc.)

The city is also supporting local car-sharing in the region around Paris. Putting private individuals in touch with each other either via mobile applications (such as BlaBlaCar® or Karos®) or physically at carpooling terminals and areas (Rézo Pouce® or Covoit'ici®). A comparative intermodal route planner shows users the best solutions in terms of cost, comfort, journey time and carbon footprint. The idea is to rationalise supply in order to facilitate the dissemination of these solutions. Two or three easy-to-use systems will become must-haves throughout the Ile de France region by 2020. The advantages reserved for multiple-occupant vehicles will contribute to developing shared mobility: the possibility of using bus lanes, the creation of special reserved lanes on the Paris ring road, etc.

All these different measures will be combined in successive Shared Mobility Plans, with the objective being to achieve an average occupancy rate of 1.8 persons per car in 2030[1] and over 2 people by 2050.



The path of an individual vehicle «partially full» compared to a collective logic (bus, car sharing) or even better soft-transport (bikes, scooters) allows us to free up public space for other users.
Example of 30 people using the different modes, above.

photo © Edgardo W. Olivera

[1] See the National Low-Carbon Strategy (2015) referred to on page 38 for the baseline scenario, an occupancy rate of two people per private vehicle in 2030.

The first half of the 21st century will see a total reversal in people's relationship with cars : they will no longer want to buy a car for its own sake, but a mobility service. The private car will be seen less as an object of freedom than as an unnecessary financial burden and use of space. The City's decision to reduce advertising space in public places from 2018 (notably the many ads for cars) is perhaps not unconnected with this. We will be moving from an individual approach to a model based on the "vehicle as a service", with carpooling and carsharing.

Started by the City of Paris via the Autolib and SVP services, **carpooling** will become more widespread and take on new forms. To boost this trend, the City of Paris will be introducing a variety of measures: reserved parking spaces, preferential rates, etc. From 2020, shared ownership of vehicles between occupants of condominiums could become widespread, as could renting a car when it is needed. This solution has the advantage of increasing the intensity of use of each vehicle, sharing the costs and also reducing vehicle production and therefore the embedded energy induced by their manufacture.

The ADEME considers that carpooling and carsharing will account for 10% of urban transport flows in 2030 and 30% in 2050, representing respectively 16% and then 60% of car trips.[2] One objective of the successive "Shared Mobility Promotion Plans" could be to reach 30% of automobile flows in 2030 and 60% in 2050 by carpooling and carsharing.

The increase in the "cost of using a car" will facilitate the modal shift to public transport and environmentally-friendly transport modes.[3]

For example, parking spaces along streets could gradually be eliminated in favour of other uses (gardens, cycle parking, temporary events, etc.). This will go hand in hand from 2018 with parking rates based on vehicle emissions and with an increase in checks. Unnecessary driving around just to find a parking space will be reduced to a minimum, however, thanks to the introduction of digital solutions to optimise use of public and private parking spaces (e.g. Smart Park®, Zen Park®, Yespark®, etc.).

To reduce traffic and increase vehicle occupancy, the City is considering introducing an urban toll. In response to the reluctance of a part of public opinion, a co-called "positive" or "voluntary" toll will be created in 2020. Those users of vehicles who so wish will thus be supported and rewarded for changing their mode of transport.

Thanks to intense political lobbying by the City of Paris among other elected representatives in Ile de France, this system will become a genuine urban toll on the A86 motorway with a "restricted traffic zone" in 2022. Its introduction is being supported by the ADEME and State services further to the "Breathable Cities in Five Years" Call for Projects (in which the Greater Paris Metropolitan Area was selected in 2016). In order to foster social equity, this toll will be proportional both to vehicle emissions and to the number of people in it. The system will be rapid thanks to the registration plate recognition system and infrared cameras installed to detect the presence of several passengers.[4] Any vehicles that are full will be exempted.



Evolution of the use of cars towards electric cars, ridesharing, car sharing and a higher occupancy rate

[2] ADEME, *Contribution de l'ADEME à l'élaboration des visions énergétiques 2030-2050*, 2012

[3] DRIEA, *Études de trafic du Grand Paris Express : quels enseignements ?*, 2012 : "Supposing that the cost of a car doubles in relation to that of public transport (test2), road traffic volume in 2030 should be stabilised in relation to the current situation, while journey time and distances covered should be reduced."

[4] See the example of the Xerox infrared camera system tested on a car-sharing lane in Franche-Comté, ADEME, *Evaluation d'un capteur de mesure du taux d'occupation des véhicules, Phase d'expérimentation du 27 mai au 16 juin 2015 à Jougne*, 2015.

The effect will be immediate: the number of vehicles entering Paris will fall by at least 20% within 5 years.[5] The price will then be increased gradually over the years to boost the effect of the toll.

After a long consultation, the **gradual transformation of the Paris ring road** will finally be passed by the Paris Council. The measure will become operational in 2026, with the start of work on the roadways. By 2050, half of the area of the ring road should have been transformed. About 50% of that surface area will be dedicated to zones that are impermeable or built-up (residential, tertiary, logistics, renewable energy, materials storage, etc.) while the rest will contribute to the de-densification of Paris (urban agriculture, parks, etc.). The surface areas that have not been developed will serve for temporary uses (recreation, storage, etc.)

At the request of community groups such as "Paris sans Voiture", the City of Paris will boost the number of **"car-free" days**. Through to 2020, one such day will be organised per quarter, with their scope being extended to cover the whole of Paris. The frequency will then be increased gradually to one day a month from 2026 (every first Sunday of the month, for example), then to one whole weekend a month after 2030, and then every weekend from 2038. The aim of this measure is not only to reduce traffic, but also to allow local people to take back ownership of their street space as places for meeting each other, socialising and community activities. As the number of private vehicles on the roads gradually falls, the City must accompany individuals and professionals in the automobile sector through this change. From 2016, the City will be communicating more about its grants for individuals and condominiums (grants to give up their vehicles, to create bike shelters or to install vehicle charging terminals, etc.).



A day without cars, 2016 ©Henri Garat -Mairie de Paris

To make these measures easier to understand and enhance communication, they will be replaced by a "Defeasance Fund" which undertakes to buy back and recycle the cars of private individuals between 2020 and 2032, provided that they give up their vehicle. The recycling sector created by this measure will provide jobs, with work for engineers, designers and mechanics to create new forms of mobility or products made with the recycled materials from the vehicles. As a symbolic measure, the first vehicles that are given up will go into the City of Paris Fossil-Fuels Museum. The land occupied by petrol stations and former garages will be redeveloped to accompany the new forms of mobility ("smart garages", electric transport, etc.) or will be converted to other uses (co-corking spaces, resource centres, etc.)

[5] The introduction of a toll system reduced traffic by 15% in London and Milan, by 22% in Stockholm and by 45% in Singapore (ADEME, *État de l'art sur les péages urbains*, 2014).

Generalising clean vehicles

Parallel to the introduction of the toll system, the Anti-Pollution Plan will step up the restrictions on vehicle traffic according to emissions levels or even vehicle weight or power. In 2020, the ban on driving in Paris will be updated to apply to private vehicles first registered before 1st January 2005, meaning those with CRIT'Air 4 and 5 discs[6]. Due to more regular checks and higher fines, drivers will comply with the rules strictly. The following reform in 2026 will affect those vehicles first registered before 1st January 2011 (CRIT'Air 2 and 3 discs), and will be combined with a limit on the power of the vehicle. In 2030, the rules will be tightened to ban all vehicles that do not comply with the Euro 7 standard (about 95 gCO_2/km). The objective is to reach 100% clean vehicles by 2050 (60 gCO_2/km).[7]
In addition to the progress made on the vehicles themselves, new tools will also make it possible for all vehicles to consume less by optimising driving and vehicle maintenance (such as the Oocar® box, for example). Drivers will be all the more interested as the tax on car fuel in Ile-de-France is constantly increasing.

Electric mobility networks will be extended to cover the whole of Ile de France including, among others, the Autolib car network, Bélib charging points and the Cityscoot electric kick scooter network. Passenger transport on the Seine by electric (Sea Bubble®) or hydrogen-powered boats[8] will develop less quickly, but will be met with great success once they are popularised by the 2024 Olympic Games. At the same time, the RATP will switch 100% of its fleet over to renewable-energy buses from 2025.[9] Further to the City of Paris Clean Fleet and Taxi Programme 2020-2025, the bulk of the captive fleets (businesses, ambulances, buses, etc.) and taxis will have shifted to low-emission vehicles.[10]

The vehicles themselves will also be changing to become smaller, lighter and less powerful,[11] as well as taking up less space and consuming less energy.[12] The new generation of vehicles will probably be more like modular golf carts than like today's vehicles.[13]

To limit the impact of the large-scale replacement of vehicles, the City of Paris will be a pioneer of activities to re-use polluting vehicles, a subject that is the key focus of one of its incubators. Once the engine has been replaced by "clean" technologies, the emissions level of the "old" polluting vehicles will be cut and they will be put back onto the market at preferential prices.[14]

The share of "clean" electric and hybrid vehicles will soar for those trips that continue to be made by private vehicle. However, due to questions of congestion and declining resources (notably as regards the materials used in batteries), the City's priorities will remain to reduce car traffic in favour of other forms of shared mobility, before generalising clean vehicles.



Example of light cars ©*La renaissance des fabriques*, 169 architecture-Obras-Elioth, Prize winners of the EDF Low-carbon competition, illustration : Diane Berg

[6] CO_2 emissions (resulting naturally from combustion) are not taken directly into account in the Euro standards. However, the ADEME provides data on the CO_2 emissions of vehickes based on the year they were manufactured. Ther average CO_2 emissions of the vehicles sold in France stood at 152 gCO2 / km in 2005. In ADEME, *Évolution du marché, caractéristiques environnementales et techniques des Véhicules particuliers neufs vendus en France Chiffres clés*. 2006.
[7] See the definition of the Ministry for the Environment, Energy and the Sea *http://www.developpement-durable.gouv.fr/Definitions,26797.html*
[8] The first H2 Bateaux-Mouches should be delivered in 2020.
[9] This hypothesis is in line with the RATP Bus Plan 2025.
[10] This hypothesis is more ambitious that the Energy Transition Law which requires taxi companies, private-hire vehicles and car-rental companies to acquire at least 10% of low-emissions vehicles when they renew their fleets.
[11] Less powerful engines are lighter and better suited to their use. Why have an engine that can exceed 200 kmh when you are not driving on a race track?
[12] «The vehicle fleet should be radically transformed and made up of light vehicles […], made of materials that are recyclable and mainly biosourced and powered by electricity or by fuels that are also biosourced.» *Scénario de référence à l'horizon 2050 de la Stratégie Nationale Bas Carbone* (2015)
[13] See XYT® for example.
[14] Thanks to services such as CarWatt®, for example.

The number of trips

Commuting between home and work is the reason for the biggest number of trips.[15] The City of Paris will therefore work in consultation with the companies that are partners of Paris Climate Action and the Chamber of Commerce on Telework and Telepresence Plans. The aim is to democratise "immobility" solutions in order to reduce the mileage that is done travelling between home and work (telework, third places, etc.) and on professional trips (meetings, training courses, etc.). It is estimated that 12% of employees currently do teleworking for a duration of 2 days a week. [16] By mobilising the political and business stakeholders in Paris, it should be possible to reach a rate of teleworking of 21% in 2025 (2.5 days a week) and of 40% in 2050 (3 days a week).[17] These new work practices should rarely trigger a rebound effect. Due to its price and the obligations it imposes, dual residence[18] is likely to be found only among very wealthy households and in certain militant circles (such as the example of Mutinerie Village).

Video-conferences, virtual training courses and other solutions enabled by the new technologies will be given preference over professional trips (meetings, field visits, professional congresses, etc.). Our hypothesis is a fall of 20% in 2030 and 35% in 2050.

For "non-work" trips, the digital revolution is central to driving the reconfiguration of travel.[19] A certain number of activities will be dematerialised (tax and administrative formalities, cultural practices, e-commerce, training, etc.), thereby avoiding personal trips or having them done by optimised logistics services. Caution is necessary, however, to limit any rebound effect. The carbon impact of the computer equipment associated with these solutions must not offset the gains that are made.

The reduction in the number of "forced" commuter trips will only be partially offset by the increase in "chosen" trips. The upward trend in trips for "recreation" purposes observed between 1976 and 2010 according to the National Transport School has been taken into account in this analysis. This modification in the type rather than the number of trips should make it possible to smooth out rush hour phenomena and increase levels of satisfaction with public transport.

Finally, the ageing of the population should not drive an increase in the number of trips by private car. The PAM service will be modernised to become all-electric and pool more trips together. For the elderly, there will also be private services such as Citizen Mobility®. With the diversification of the range of transportation on offer, and in particular electrically-assisted bicycles, senior citizens will give up their vehicles or leave them in the garage of their secondary residence.



Solution of video conferencing and telepresence, source : ©Jordan Reeder - Fotolia

[15] As a reminder, a Parisian makes an average of 4.34 trips per weekday. 38% of these trips are due to work. 39% of Parisians work outside Paris (Mairie de Paris, *Bilan des déplacements en 2014 à Paris*, 2015).

[16] Page 12, Caisse des Dépôts, *Rapport sur les externalités des télé-centres*, 2014.

[17] The trend scenario of the Caisse des Dépôts Group indicates 21% of teleworkers by 2025 in Ile-de-France (*Rapport sur les externalités des télécentres*, 2014, page 8). It is more ambitious than that of the National Low-Carbon Strategy (10% of days worked). The ambitious scenario in this study indicates as many as 30% of the active population doing telework by 2025 (page 75).

[18] Dual residence increases the carbon assessment per individual, but reduces that of Paris.

[19] Régis Bigot et Patricia Croutte, *La diffusion des technologies de l'information et de la communication dans la société française*, study for the Conseil Général de l'Economie and the ARCEP, December 2013décembre 2013

Encouraging a modal shift

However, reducing car traffic implies proposing alternatives and facilitating their adoption by the people who live or work in Paris.

Active transport modes such as cycling and walking may take up a part of that modal shift, notably for the shorter trips (less than 5km) that are currently done in private cars or by public transport.[20] The Active Mobility Plan 2020-2025 will extend the Cycle Plan of the previous term of office, aiming in particular to reach a proportion of 25% of commuting trips by bicycle or similar modes of transport (kick scooter, roller-skates, etc.).[21]

This Plan will go hand in hand with a series of roadworks to increase the number of lanes for environmentally-friendly forms of mobility (express cycle lanes, meeting points, secured parking for bicycles, etc.), redesign strategic public routes (greening, fountains, benches, etc.), and increase the number of "reserved" lanes (for buses and shared mobility, etc.), etc.

In addition, the City will support the introduction of new, low-carbon mobility services adapted to all types of uses: rental of electric bicycles for steeper routes or for older people, rental of cargo bicycles for removals, rental of trailers to transport children or shopping, etc.

Finally, the Active Mobility Plan will include an awareness-raising and communication component with measures targeting different audiences. For example, the City will offer a reduction for the over-65s on electrically-assisted bicycle rentals. And if they accept to serve for 6 months as a "Mobility Ambassador", the City will even give them an electric bicycle.

Over the next two terms of office (2026-2032 and 2033-2038), this Plan will be updated to ensure an increasingly dense coverage by these services and raise awareness among those groups that are the most reluctant or disinterested. The target is to exceed 30% of commuting trips by bicycle or similar means. Roadworks will also be targeted on facilitating access to the least convenient places for the disabled.[22] The low-carbon transport offerings will also be adapted as new lightweight, safe and comfortable means of mobility are developed by the "Sustainable City" incubator of the City of Paris. Ecological, modular rickshaws are likely to replace the models currently in use.

Use of all these alternatives to the car will be facilitated by the **creation of a single card** to use all the different forms of mobility (Vélib, Autolib, SVP, public transport, local carpooling application, etc.) and pay for the trip. A comparative intermodal route planner application will facilitate the user's choice from among the different solutions. One-stop mobility shops will offer an information and service portal including all the public and private solutions.



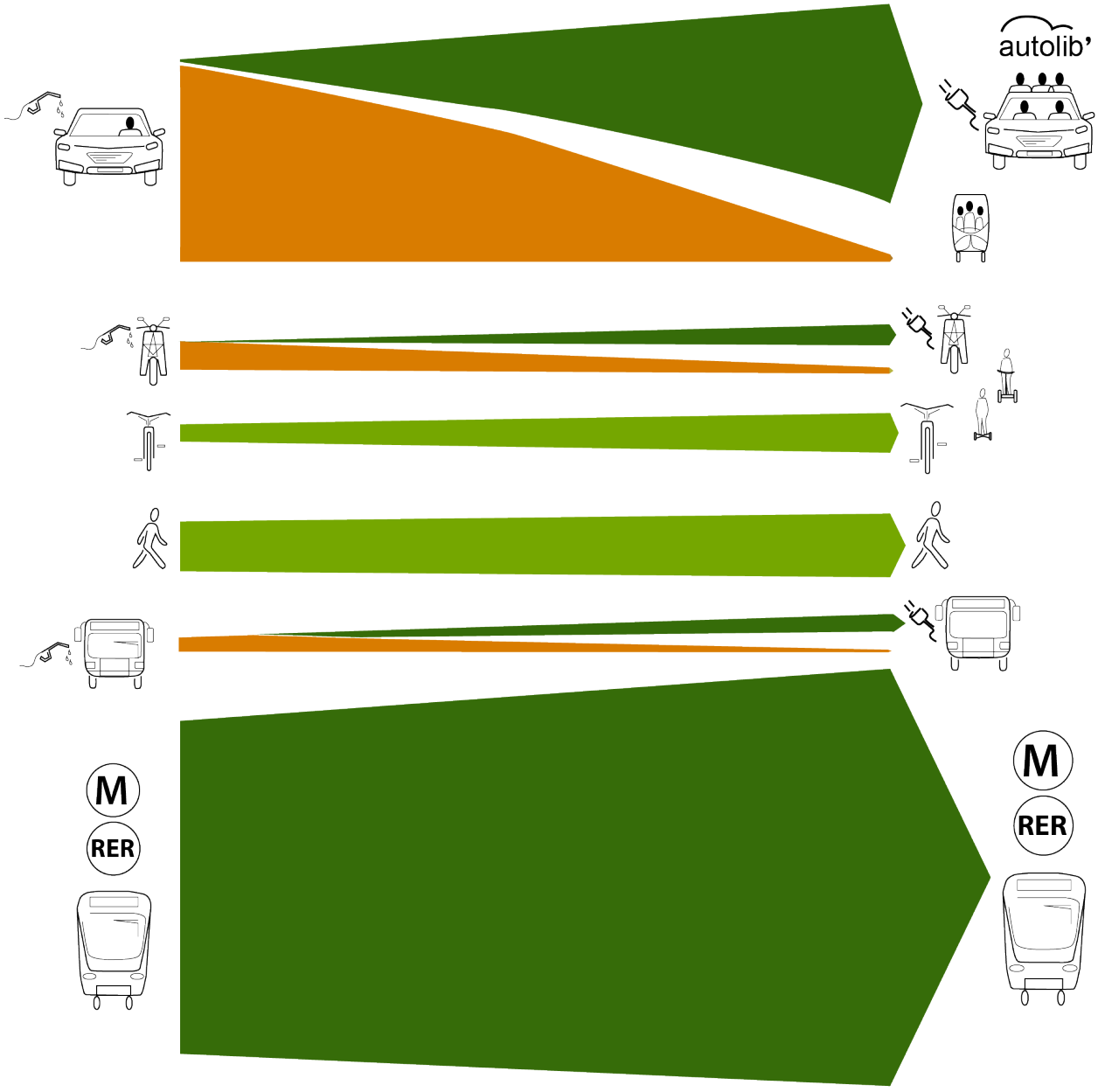
The increase of bikes in the public place, source : Fotolia

[20] Organising a modal shift from public transport to more active modes provides a way of limiting saturation. Taking just the example of trips of less than 500m, 20% are currently done by metro. By switching them over to active modes of mobility, the saturation of the public transport system can be reduced.

[21] In Denmark, cycling represents 17% of trips (all trips included) and 24% of commuting trips. In Copenhagen, 45% of people who work and study go by bicycle to their office or school/university (Danish Cycling Embassy, Bicycle Statistics from Denmark, 2015) (Ambassade danoise du vélo, Statistiques sur la pratique du vélo au Danemark, 2015)

[22] For example further to user feedback via the *I Wheel Share®* interface.

Transport mode trends from today through to 2050



The City will be advocating the introduction of **Company Mobility Plans** (PDE). It will conduct strict checks of compliance with Article 51 of the Energy Transition for Green Growth Law[23] which requires such a plan to be drawn up by companies with over 100 employees from 2018. It will also work more broadly with the Paris Climate Action Network and the Chamber of Commerce and Industry to ensure that companies with 50 to 100 employees adopt their own or an inter-company Mobility Plan. More particularly, it will support measures such as:
- reimbursement of part of the cost of buying an active form of mobility (bicycle, electric bicycle, kick scooter, etc.);
- reimbursement of removal costs if employees choose to move closer to their place of work, or staggered arrival times;
- staggered opening times to reduce traffic peaks, etc.

For a variety of reasons (distance, tiredness, etc.), a part of the modal shift will be towards **public transport**. On the level of Paris as a whole, the requalification of public spaces will allow an increase in the number of bus and bus rapid transit (BRT) lines. Thanks to the mobilisation of the population and lobbying by the municipality, the public transport offering of the STIF will improve in terms of safety, comfort and convenience, etc. Intermodal possibilities in Ile-de-France will be boosted (park and ride, cycle-train links, Véligo, etc.). The new Greater Paris Express network will contribute to this trend from 2030 onwards, slightly reducing congestion in the Paris network.

At the same time, private players supported by the City of Paris will develop the **public transport "on demand"** offering in the form of ecological mini-buses (Bluebus®). This transport company will develop gradually throughout Ile-de-France and enhance its offering of autonomous vehicles.

It provides a way of pooling trips between private individuals, while still offering a point-to-point service. In Paris itself, the service considerably reduces night-time traffic. In peri-urban areas where the public transport network is less dense, they provide an alternative to the car for many trips.

The City of Paris sets the example

Since 2011, the City has undertaken its own municipal mobility programme through its Paris Administration Mobility Plan. It will continue through each of the following terms of office to target carbon neutrality in all the trips made by its staff, elected councillors and service providers. A chapter is dedicated to this in the Telework and Telepresence Plan 2025. The objective is that the whole of the municipal fleet of vehicles should be "clean" by 2030.

The City will also be taking the decision in 2018 to communicate on the subject of the trips made by its elected members, in the same way that it does about their personal assets. It calls upon the other public institutions in Paris to do the same. Acting in line with the principles defended in the Council of Paris is a criterion when people make their choices in elections. Seeing councillors on their bicycles, ministers in an Autolib or senior civil servants on their kick scooters will become a part of daily life and contribute to making such behaviour the social norm.



Bluebus as a new mutualised transport on demand ?
source : ©Billy69150 - Wikipédia

[23] Article 51 of the Energy Transition for Green Growth Law requires that within the scope of the Urban Mobility Plan, companies having over 100 employees on a single site must draw up a mobility plan by 1st January 2018 to enhance the mobility of their personnel and encourage the use of public transport and carpooling. This mobility plan must be submitted to the authority in charge of organising the Urban Mobility Plan.

3.1.4/ LONG-DISTANCE TRAVEL

The carbon impact of long-distance travel is increased by that of air transport. The current scenarios suggest an increase in air traffic through to 2050.[1] In Europe, the number of flights grew by 80% between 1990 and 2014, and is likely to increase by a further 45% through to 2035. [2] Emissions have also increased in the same proportions. The first avenue of work in which the prospects for progress are the most promising is therefore to increase the carbon efficiency of this means of transport. The real challenge, however, is to reduce the number of trips by air and provide low-carbon alternatives. The City of Paris has little direct influence on these two factors. However, the proposals below aim at proposing an optimistic vision of the reduction in the carbon impact of air travel by 2050.

Reducing air transport sector emissions

Manufacturers and airline companies have been working for several decades to optimise their aircraft (weight, engines, fuel management, etc.) and modify the composition of their fuel (biofuel). With the rise in fuel prices and potential changes to the regulations, the race for greater aircraft energy efficiency is set to continue. The hypothesis of the ICAO is that this efficiency should improve by 2.5% a year. At the same time, R&D centres are also looking into new generations of aircraft (high-speed airships, solar impulse, etc.) which do not seem likely to be available on the market before 2045. With the C40, the City of Paris will be taking part in this R&D movement in the aviation sector by organising a prize, inspired by the X-Prize, for the purpose of highlighting the best innovations.

Pending the introduction of a legal obligation, the City of Paris will set up a Parisian offsetting platform open to businesses and residents. The funds will go to financing the transition on the local level. The major corporations taking part in the Paris Climate Action network will contribute to it systematically and proportionally to their travel.

Reducing the number and distance of trips by air

Based on the available data, however, any attempt to reduce the carbon impact of air travel necessarily implies reducing the number and distance of trips. For the City of Paris, the challenge is a complex one, as air travel touches upon sensitive issues that lie outside the scope of its powers, such as the organisation of people's private life (tourism choices) or the workings of the professional world and the economy (home countries of economic partners, corporate policies, etc.).

One common and decisive factor for all these groups is air fares. The inevitable rise in kerosene prices in coming decades will be responsible for a part of the rise in fares. Given the urgency of the climate situation, however, the national, European and international measures that are introduced will also drive this phenomenon. With the support of the C40, the City of Paris is therefore lobbying to have airline companies internalise the cost of their carbon emissions from 2017. Pending this regulation, it is working with C40 to study the possibilities for action at city level: eliminating all grants or subsidies awarded by local authorities to airports, introducing an additional airport tax to finance a Carbon Offsetting Fund, introducing a "carbon-based tourist tax" that is variable according to the mode of transport used, addition of a "climate health warning" on advertisements for air transport, etc.



source : ©Hin255 - Fotolia

[1] IATA, Vision 2050, 2011
[2] UE, European Aviation Environmental Report, 2016

Successive reforms of the European emissions allowance market will finally provide an incentive by setting minimum prices per tonne of carbon and confirming the inclusion of flights outside the EU. On the national level, an increase in the VAT rate applied to domestic airline tickets will come into force before 2020 and the tax incentives granted to the air transport sector will gradually be phased out. All these factors will contribute to an increase in air fares.

This rise in prices will outstrip that in the standard of living, thereby forcing residents to travel less by air. If they do choose to fly, they will opt for destinations that are closer and therefore less expensive. While the price issue will change the recreation and tourism habits of the majority of Parisians, there will also be a growing minority that switches voluntarily from air travel to other modes of transportation.

The notions of authentic tourism and sociability will once again become central. The younger and wealthier creative classes will be the first to launch this movement in favour of slower tourism practices. This phenomenon mirrors the frequent complaints that are heard as to the constant acceleration in the pace at which we live and a loss of meaning. Slow tourism will be the new trend of the 2040s and 50s, in the same way that slow food was in the 2000s. It will consist in appreciating slower and/or less remote journeys.

Long-haul travel will recover its former image of "adventure", with long journeys also including active modes of transport and travel by rail or sea. Households will increasingly focus on the "quality" of their trips, rather than their "quantity". Changes in employment law and organisation will facilitate this choice, as periods of sabbatical leave become more usual in businesses, teleworking becomes more widespread, and the number of self-employed workers increases, etc.

In addition to this, the improved living environment in Paris will make the city more pleasant and entertaining. Parisians will be keener to spend their weekends or holidays in the Ile-de-France region, swimming in the Seine, wwoofing on a farm in the Yvelines or going on a cycling tour along the Marne, etc. Trips to "get away from it all" or "get a breath of fresh air" will increasingly be possible closer to home. Aspirations to meet people and enhance social ties[3] will also become stronger, driving a move towards more "local" tourism and sociability.

Families and senior citizens will particularly appreciate staying closer to home, due to the uncertainties surrounding the climate conditions or political situations in more remote destinations (heatwaves, cyclones, war, etc.). With the support of the City, a whole range of recreation possibilities tailored to their needs will be developed within a radius of 200 km around Paris. Short-distance journeys will be much appreciated. In addition to this, new technologies will enable the gradual development of virtual tourism from 2030. This will provide interesting possibilities in that it will allow Parisians in search of the exotic to discover a destination less expensively and without fearing the risks inherent to travelling there.

Air travel for professional purposes will also evolve, driven by transformations in business models and new corporate practices. To avoid long-distance travel, companies will have access to a more extended range of available technologies: HD video-conferences and telepresence for meetings, virtual reality hotspots and augmented reality applications for congresses and trade shows, etc.



Paris Plage, source : Flickr



Eco-tourism on bike, source : Flickr

[3] CREDOC, « Les Francais veulent vivre plus intensement » *Consommation et modes de vie*, n°268, 2014

Telework and Telepresence Plans will enable the initial coordinated roll-out of this offering in companies and third places (coworking spaces, telecentres, etc.). It will also guide the support provided by the City of Paris to certain start-ups that are developing products in this area. At the same time, the City will be lobbying the C40 to have such measures introduced in other cities and facilitate their spread. In 2035, local companies will find it quite normal to rent telepresence rooms in their district for a few hours for a sales appointment or a training session for their foreign personnel.

In liaison with the C40, VIP Paris will extend its events package to include a "virtual" service offering (fairs, tradeshows, congresses, etc.). It will attract growing numbers of companies interested in the possibility of visiting the show at will and at an affordable price, without travelling all the way to Paris.

From 2020 onwards, a gradual relocation of the economy will be observed. Professional trips will increasingly be to less remote destinations, thereby reducing distances and facilitating the modal shift. The main economic partners will henceforth be in Ile-de-France, Europe and perhaps North Africa, rather than in Asia (see chapters on "Consumption" and the "Economy").

Stimulating "low-carbon" alternatives to short and medium-haul flights

The City is supporting the development of alternatives to air travel. Rail and river transport will make gains in market share thanks to an enhanced offering and better comfort. The City and the C40 will provide political support to maintain and improve rail lines that are considered of strategic importance, and infrastructure projects that are deemed to be relevant (rail/maritime intermodal hubs for passenger transport in Le Havre, extension of the "Silk Road" rail project as far as Paris, etc.). For medium-haul travel, the offer of alternatives to the plane will become denser and more varied. Enhanced comfort and service (wi-fi, punctuality, etc.) combined with more reasonable prices than air travel will make these alternatives more credible in the eyes of the public.

Via the Paris Climate Action network, the City will roll out an obligation for CSR policies to favour a modal shift to the train for journeys of less than 2,000 km (with automatic blocks in purchasing systems). It will also get companies to publish their Company Mobility Plans for analysis by environmental protection associations, in order to push companies to give greater importance to the long-distance trips of their employees. Specific awareness-raising actions will be organised in each company for those profiles who travel the most (generally managers) and those who represent the professional future (under 35s).



source : ©Jordan Reeder - Fotolia



source : Fotolia

Although these measures will initially be on a voluntary basis, from 2025 they will become a condition of eligibility for any subsidies from the City of Paris. Driven by the success of this process, the modal shift and carbon offsetting obligation should be adopted in 2030 on the national and European levels for all companies subject to CSR reporting obligations. At the same time, the City will engage in lobbying to have air routes of less than 2,000 km closed down, beginning by domestic flights.

In 2020, the City of Paris will be the first in the C40 to create a "carbon card" with eco-rewards for local people and companies. Initially on a voluntary basis, this system is designed to reward participants with the most virtuous behaviour in terms of transport, housing and consumption by earning "points". These points can then be converted into units in the "local currency" (subject to a limit set by the City).[4] For the launch, the City will focus its action on the "transport" component.

Specific action will be taken in *Grandes Ecoles* and universities to raise awareness among the young people who are the executives of the future of the impact of their current personal travel (visits to parents, weekends, holidays, etc.) and future business trips. The idea is to make them aware of their collective impact so that they modify their individual choices and propose solutions. Participation in a "carbon card" system could become mandatory for individuals and businesses. In time, it could comprise an annual CO_2 allowance.

The City of Paris sets the example

In 2020, the City will take the decision to set the example in its air travel. The City of Paris purchasing unit will thus require all employees and elected councillors to use "low-carbon" modes of transport for professional trips of under 2,000 km. It will take part from the beginning in the "carbon card" system it is promoting, by offsetting all the air tickets that it purchases. To ensure that this has a knock-on effect, the City will communicate about its most iconic travel operations, for example about the fact that all the visits to go out and "sell" Paris 2024 were made by train, boat or electric vehicle.

From a symbolic point of view, the City of Paris will be taking action within the C40 to make sure that special "low-carbon" offers are available to attend major events (Universal Exhibition, Championships, Euro, etc.). The organisers will get into the habit of setting up "themed" trips by electric bus, boat or train from the main areas from which visitors will be coming. The atmosphere and quality of the service will make it particularly attractive for the public.

To go even further, the Paris institutions will choose to give their preference to collaboration in culture and sports with cities that are close to Paris, and will consider the introduction of eco-conditions for eligibility for City of Paris subsidies.

To facilitate change, the political and media personalities of Paris will be invited to set an example and to communicate about the changes they have made to their tourism habits and modes of transport (modal shift to the train, holidays in Europe, etc.). Via the C40, the City will also urge public institutions in different countries to take this approach. These testimonies will promote the advantages of alternatives to the plane (a slower and better pace of life, time to enjoy the landscape, etc.).

[4] Rather like the "Green Card" eco-reward programme launched in South Korea by the Ministry for the Environment in 2011.

FOCUS ON FREIGHT

2004
6,4 $MtCO_2eq$

2030
3,5 $MtCO_2eq$
-45%

PROMOTING LOW-CARBON FREIGHT MODES

Ban on the running of light commercial vehicles & heavy goods vehicles brought into service before:

1st January 1997 — 1st January 2005 — 1st janury 2011 — Euro 7 norm

Help in replacing vehicles

Breakdown fund

Urban toll (preferential rate according to the rate of occupancy)

Transformation of the «périphérque» into an integrated

Call for projects: «Sustainable urban logistics»

Development of successful experiments

New call for project: «Sustainable urban logistics»

Development of successful experiments

«Su

Increase in river and railway freight transport as well as delivery in the last kilomete

ADAPT THE LOGISTICAL ORGANISATION FOR «ILE-DE-FRANCE»

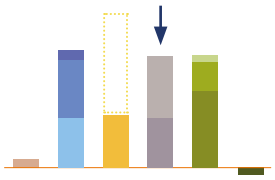
Charter: Durable Urban Logistics

Logistic Plan for Ile-de-France

Creation of the OPP for Ile-de-France

Economic relocation: local production,Fablab,made in France

2016 2020 2026 2032 2038



2050
2,1 $MtCO_2eq$
-65%

urban boulevard

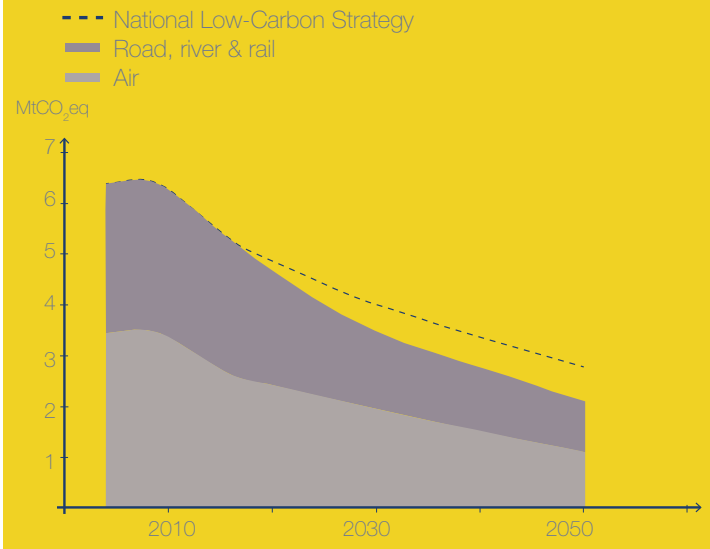
New call for project:
ustainable urban logistics»

Development of
successful experiments

er by active modes

3 2044 2050

OVERVIEW



MOBILISING STAKEHOLDERS AND RESOURCES IN THE MOVEMENT TOWARDS LOW-CARBON FREIGHT

Freight transport is an important item in the Carbon Assessment but it has received much less attention than passenger transport. Road freight still accounts for 90% of the tonne-kilometres transported in Paris. The majority of light commercial vehicles and heavy goods vehicles are still powered by diesel.
The City of Paris has already started to mobilise freight transport stakeholders via the Charter and the "Sustainable Urban Logistics" Call for Projects. But today, given the importance of this item in the Carbon Assessment, the stated objectives must be more ambitious and the measures undertaken need to be organised more effectively in order to attain the goal of carbon neutrality by 2050.
Organising freight transport stakeholders will facilitate this mobilisation. But change will also take place through the mobilisation of real estate and territorial organisation: aspects that the City of Paris can influence.

Legend
Ongoing
Support and awareness
Technical & regulatory actions

3.1.5/ REDUCING THE CARBON IMPACT OF FREIGHT TRANSPORT

Freight is an important item in the Carbon Assessment, concerning both short journeys (within the boundaries of the City of Paris) and long-distance freight transportation. Consequently, the City of Paris does not have the same margin for manoeuvre on both of these subjects. Nevertheless, the current assessment shows that reducing the carbon impact of the freight transport sector will primarily require the reduction of road and air freight emissions and the provision of suitable alternative offerings, especially by rail and inland waterways.

Reducing the share of carbon-intensive freight

Reducing the shares of road and air freight in emissions implies lowering their carbon intensity for the same quantity transported, by reducing the tonnes/km travelled and developing modal transfers to other means of transport (inland waterways and rail). These transformations will originate from technological innovations concerning propulsion systems ("clean" vehicles) as well as the optimisation of journeys and load factors.

Since 2007, the City of Paris has imposed requirements on dimensions, times and engine types. Starting in 2017, the monitoring is being intensified and fines are being increased to ensure compliance with the Paris regulations, which are being progressively tightened – always in a pioneering manner in relation to the standards in force. The stated aim is to exclude heavy goods vehicles that do not meet the Euro 5 and 6 standards by 2020.

Freight transport will be impacted gradually by the measures designed to reduce individual car traffic in central Paris: establishment of urban tolls from 2020, downgrading of the main Paris ring road (*Périphérique*) to urban boulevard status in 2026 and actions to increase the number of car-free journeys from 2018. These measures will only be viable if they are consistent with a general logistics plan for Paris and the Ile-de-France region.

At the European level, the authorised vehicle emission thresholds are gradually becoming more restrictive. Although the European Commission has not yet brought in carbon emission standards for light commercial vehicles (LCVs) and heavy goods vehicles (HGVs), its strategy for 2030 entails establishing a CO_2 certification scheme designed to improve transparency and therefore increase the opportunities for intervention.[1] The European White Paper also sets the target of halving the use of internal combustion-engine-powered vehicles in urban centres by 2030.

Acknowledging these developments at the local and international levels, the freight transport and logistics sector has launched R&D programmes designed to improve its vehicle fleet and the organisation of its logistics between now and 2025. The improvement of vehicles is also accompanied by a wide range of optimisations: designing lighter vehicles whose dimensions and engines are better suited to the needs,[2] increasing the range of electric vehicles, improving the load factor[3] and optimising journeys,[4] etc. This makes urban logistics a rich field of opportunities for information technology services: delivery round optimisation via TMS (Transport Management System or transport management support tools) incorporating mapping and geolocation, measurement of the negative externalities of transport (obligation to measure CO_2), transport service comparators/aggregators, tracking and improved communication solutions, etc. Many services providers are thriving in these different fields with the City's help.

[1] *Information CO_2 des prestations de Transport*, Ministry for Ecology, Sustainable Development and Energy, October 2012
[2] See the example of the Deliver.ee start-up by the Paris & Co incubator regarding the adaptation of vehicles to the needs
[3] See the "Instafret" project selected by Paris & Co for the "Sustainable Logistics" Call for Projects, for example
[4] See the "CITODI" project selected by Paris & Co for the "Sustainable Logistics" Call for Projects, for example

Adaptation is difficult for small businesses[5] and other self-employed operators responsible for own-account transport operations.[6] To speed up the widespread introduction of low-emission vehicles,[7] a wide variety of actions will be implemented to promote the renewal of the fleet.[8] The City will help self-employed people and shopkeepers to adopt digital tools that can facilitate journey optimisation and sharing. A "Defeasance Fund" supported by the City of Paris will be available to professionals for two terms of office (2020-2032). The vehicle repurchase price will be dependent on the choice of replacement: quite low if the choice concerns a relatively powerful internal combustion-engine-powered vehicle, and higher if a soft mode or an electric vehicle is chosen. The vast majority of the repurchased vehicles will be reused after the replacement of their propulsion systems and other optimisations to reduce their emissions. A target of requiring 60% of all mileage to be travelled by vehicles conforming to the Euro 6 standard or higher could be set for 2020[9] and 90% for 2030.[10]

The share of electric-powered cars and vehicles powered by gas and third-generation biofuels is increasing in the professional car fleet. For 2030, the ADEME is aiming for 66% of vehicles to be powered by combustion fuels (including gas and biofuels) and 34% by electricity. This is a substantial increase, given that in 2016, electric LCVs represented less than 2% of new vehicle registrations (against 97% for diesel LCVs), and that the use of electric HGVs, although very encouraging, is still in its infancy.

For air transport, technological innovations and the size of aircraft (see "Long-distance passenger transportation") will have positive effects. The experiment with a freight train covering 11,300 km[11] between Wuhan and Lyon in April 2016 boosted hopes of a significant modal shift of certain intercontinental air flows to rail. Indeed, with a transit time of fifteen days, this could be an attractive option for a certain number of goods (varying between several days for aircraft and 50 days for ships). However, the best-case scenario would involve the relocation of activities to Europe or neighbouring countries (North Africa, Turkey, etc.), in the emerging scenario of deglobalisation.[12]

3D printer-type solutions will also offer a vast range of opportunities to revolutionise deliveries by reducing journeys and allowing products to be manufactured locally. In the future, Fab Labs[13] equipped with 3D printers should allow for the manufacture of products, on demand, and in proximity to the customer. Therefore, the volume of goods transported by aeroplane – and the distances travelled – are likely to drop.



source : Fotolia

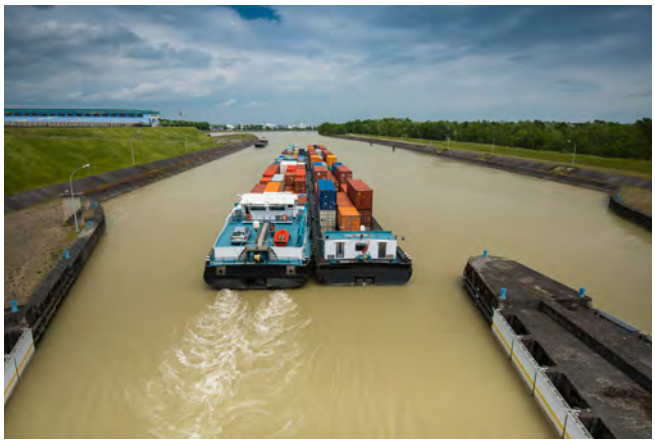
[5] The small business sector generates the majority of flows with 24% of the goods movements in Paris.
[6] APUR, Logistique urbaine, 2014, page 14: "Vehicles used for own-account operations: smaller and older with sub-optimal journeys (75% of the movements for 25% of the tonnage)". To be considered in light of the fact that over 60% of the light vehicles and vans in circulation throughout Paris were manufactured before 2010 (Mairie de Paris, Bilan des déplacements, 2014) and that 61% of the freight movements in the Ile-de-France region are carried out using vehicles of less than 3.5 tonnes (IDF, Enquête TMV, 2014).
[7] «A 20% improvement in unit consumptions for freight transport» page 78 of the National Low-Carbon Strategy
[8] The rate of renewal has slowed down in recent years and the age of the HGV fleet has risen from 5.1 years in 2009 to 6.7 in 2014 (source: French National Assembly, 5 February 2014).
[9] In 2015, 58% of kilometres were travelled by vehicles conforming to the Euro 5 standards.
[10] Source CEMT
[11] From China to Europe, the train transported mechanical, electronic and textile products, and from Europe to China, it carried vehicles, wine and agricultural products.
[12] According to WTO forecasts, 2016 is expected to be the year in which the trade growth/global GDP growth ratio fell below 1 to 1 for the first time in 15 years
[13] FABrication LABoratory, referring to a workshop equipped with machine tools capable of manufacturing varied types of goods on demand, according to a charter established by MIT and united in a global network

Promoting alternative modes

The massive development of "clean" LCVs and HGVs must be accompanied by a vast increase in inter-modality with rail and waterways. The City of Paris is politically supporting the development of new capacities. In particular, the municipality is backing the investments and the major projects of the Sustainable Urban Logistics Cluster (Cluster Logistique Urbaine Durable) and HAROPA - Ports of Paris.

As far as inland waterway transport is concerned, political support is being given to projects on a regional or national scale[14] and support of a more operational nature is provided at the Paris level. Traditionally active in the aggregate and construction materials segment, inland waterway transport has been attracting new flows in recent years and more and more experiments are being carried out in Paris. XPO logistics barges for the Franprix operator have played a pioneering role in the 2010s, accounting for 523,840 km that would otherwise have been travelled by road over a five-year period.

By 2030, inland waterway shuttle vessels will be operating on the Seine on a daily basis.[15] Equipped with mobile equipment, no permanent installations will be required and will ensure that the docks remain accessible for mixed uses. Self-unloading vessels (similar to those used for delivering beer barrels to Amsterdam) and Ro-Ro vessels capable of the direct loading / unloading of delivery vehicles (small lorries for DistriSeine, tricycles for the initial project of Vert Chez Vous, etc.) will facilitate handling operations. Lastly, inland waterway transport will benefit from technological advances capable of reducing its emissions. By the horizon of 2050, it seems probable that the entire fleet will be equipped with hydrogen fuel cells, thus contributing to the decarbonisation of inland waterway freight, and exceeding the effects of modal rebalancing.



©HassanBensliman

In the rail freight sector, there is likely to be an increase in experiments such as the Monoprix shuttle service. However, this will be dependent on the possibility of mobilising real estate for these operations and envisaging the urban integration of these projects to make them acceptable. The City of Paris must maintain this ambitious and courageous position, the first stage of which will consist of the preservation of sites connected to the network in urban areas where the land use pressures are high. The La Chapelle International site should be used as an example in this matter (see images opposite)[16] . The diverse range of functions with varying levels of profitability allow for the balancing of the overall budget for the project (logistics centre with office blocks, datacentres, and a vocational training college, etc.), but to operate efficiently, the site must be linked by rail shuttles to logistics sites situated upstream (outer suburbs or Paris Basin). A general logistics plan will therefore hold the key to the Paris ecological equation.

The test-running mission of the Local Railway Operator (OFP) for the Ile-de-France region, which began in 2016,[17] is being monitored closely by the City. It is based on the same principle and same need for an overall vision. On the one hand, this operator should be capable of running complete trains from Ile-de-France to the rest of Europe. On the other hand, it could facilitate the reconsolidation of individual wagons and facilitate local access for them within Ile-de-France. As a result of the political mobilisation, the OFP could be operational from 2022.

Although alternative offerings are gaining a growing share of the market, road freight still accounts for a significant modal share. Our assumption for 2030 is that rail and inland waterway traffic will double in tonnage but with no change in the overall volume. This leads to a road freight market share of 80% of the tonnage and 63% of the tkm, against a rail freight share of 10% of the tonnage and 25% of the tkm, with 10% of the tonnage and 11% of the tkm for inland waterways.[18] The assumption for 2050 is that rail and inland waterway traffic will triple in tonnage with no change in the overall volume in relation to 2014.

The share of freight transportation carried out by active modes will also need to rise in the decades to come. Following the measures to limit vehicle traffic in Paris, there will be a sharp rise in the number of last-mile delivery services using these modes. Delivery by bicycles, delivery tricycles,

[14] Such as the rollout of containerised shuttle vessels capable of entering the Ile-de-France region from Le Havre and of travelling to the Benelux countries via the Seine Nord Europe Canal in the future; or the installation of electricity terminals for the *Comité des Armateurs Fluviaux and Logistique Normandie* at the port of loading, and at the berthing and waiting areas for the locks on the Seine route.

[15] See the projects presented in the Sustainable Urban Logistics Cluster's brochure

[16] The site will include a 26,000 m² dedicated logistics area handling 14,000 packages and carrying out 7,500 movements per day.

[17] See *Nouvelle étape pour la création d'un OFP Île-de-France*, Olivier Constant, [online] *http://www.wk-transport-logistique.fr/actualites/detail/91538/nouvelle-etape-pour-la-creation-d-un-ofp-ile-de-france.html#&panel1-1*

[18] Compared to current modal shares of 90 / 5 / 5% of the tonnage in Ile de France and 80 / 14 / 6% of the tkm

cargocycles or on foot with delivery carts allow access to the most confined and congested urban spaces (such as the services offered by The Green Link and La Boite à Vélo, etc.). These schemes support the development of new modes of consumption (e-commerce), policies to revitalise local shops and businesses (pooled and home deliveries by traders in a single street or neighbourhood) and the development of "crowdshipping" (collaborative deliveries). To prevent abuses (a social aspect of uberisation), the City is supporting initiatives that combine deliveries with social actions. We are assuming that 30% of last-mile deliveries will be carried out by active modes in 2030 and 70% in 2050.

Improvements to containers in urban logistics will play an important role in facilitating this development (plastic trays, reusable flexible containers, etc.). The eco-design of packaging is a step towards stabilising the tonnages transported despite the rise in the number of packages (with the adaptation of packaging to suit the product being transported). The City of Paris is backing this change by issuing its "Sustainable Logistics" Calls for Projects. Specific containers are being developed for the fresh product delivery market. Efforts are also being made to reduce intermediate reloading operations. The containerisation of goods via electric vehicles operating on a deposit system is gradually reaching Paris.



The drone: delivery in the future? © tiero

At a more distant but already visible horizon, several technologies could revolutionise urban deliveries. Drones are ideally suited to deliveries in hard-to-access areas, for example, with the benefits of speed and lower cost. They are currently being tested in different urban areas. After initial hesitations, the national and local regulations are easing on this matter. These silent, sometimes autonomous appliances, powered by renewable energy sources, are capable of performing straight-line journeys just above the rooftops within a radius of approximately 20 km. They allow for the efficient delivery of light and compact goods without increasing traffic levels.[19] By 2050, they will be supplementing the range of alternatives to road transport, but their market share will remain marginal.

Régine Brehier
CEO of HAROPA, Port of Paris

« The development of 'massified' modes of transport, i.e. inland waterway and rail, generates much fewer greenhouse gas emissions than road transport and is particularly vital to a region whose roads are so clearly saturated.

In response to its key issues, Ports de Paris joined forces with the seaports of Rouen and Le Havre within the HAROPA in 2012, with the aim of developing high-performance but environmentally friendly logistics chains at the Seine Valley level serving the Paris conurbation. These logistics chains are based on inland waterway transport and rail transport which are more CO_2-efficient alternatives to road transport. […] This increasingly developed logistical framework is a response to the needs of large logistical flows and urban distribution by allowing for exchanges of goods using transport modes that emit the lowest levels of CO_2. Today: rail and inland waterway transport for long-distance freight, and electric or gas-powered road transport for short distances. Tomorrow: continued adaptations and evolutions to allow for the use of the most efficient and environmentally friendly means of transport regardless of the predominant consumption and production modes in 2050."

[19] Jeff Bezos, CEO of Amazon points out that "86% of packages are light enough to be delivered by drone." In L'Express for the week of 29 August 2016

Adapting the organisational structure of logistics in Ile-de-France

As well as improving the performance of the vehicle fleet, the City of Paris needs to prioritise the optimisation of logistics chains. This issue involves the land that is available for logistics functions, which falls within the City's direct sphere of influence, and the creation of a logistics plan at the Ile-de-France level.

Real estate for logistics

Due to the rapid development of solutions such as e-commerce, the number of recipients and delivery rounds is increasing, the packages are becoming smaller and the large number of returns must also be managed.[20] This massive increase in flows is generating adverse environmental effects and significant additional costs: the last mile represents nearly one third of the total cost of a delivery. To avoid any increase in the number of kilometres travelled, and indeed to reduce these distances, steps must be taken to prevent each of the "last-mile" operators from carrying out their own delivery rounds.

New logistics centres incorporated into the high-density urban environment are required for the pooling of goods and their distribution via short and optimised delivery rounds (Urban Distribution Centres, Vehicle Reception Points, etc.). Generally speaking, central Paris requires a sufficient number of logistics centres that are better adapted to requirements.[25] There is a particular need to mobilise real estate for very small logistics sites (urban logistics centres) situated at the ground-floor level of mixed-use buildings (tertiary and residential). The City is participating in this movement via its Local Urban Planning Scheme ("reserved locations", obligation to establish a logistics centre on the ground floor or basement level of new buildings, etc.) or via pre-emption.

The City is also in favour of deliveries to shops (click & collect), automatic parcel collection machines and collection points (points relais) which allow consumers to pick up their orders on foot where and when they decide and, in this way, to reduce the number of kilometres travelled by transport operators. It is facilitating the provision of sites in the public domain (Abricolis®, Bluedistrib'®, etc.) and the development of new services (e.g. Voisin Relais®). For the first "Low-Carbon Logistics Plan" ("Schéma Logistique Bas Carbone") from 2020-2025, the City will reduce its taxes on companies that incorporate these schemes rather than home deliveries into their commercial strategies. At the same time, to take account of low-mobility groups and consumer expectations, it is promoting collaborative delivery schemes, combined with community initiatives (e.g. Climate Centres (Maisons Climat).

By addressing the issue of available real estate, the City will provide better conditions for the development of these modes and multi-modal chains. Through its annual "Sustainable Urban Logistics" Calls for Projects it will make real estate available at an attractive price via public property occupancy agreements. These sites will allow stakeholders in the freight transport sector to experiment with innovative solutions offering a high replication potential. In this way, the gradual transformation of the main Paris ring road will be carried out in consultation with stakeholders in the transport and logistics sectors. Their needs will be taken into account at the earliest stages. Freight considerations will be integrated at the project design phase.

The Ile-de-France Low-Carbon Logistics Plan

All of these transformations must be combined with a mode of governance for the Ile-de-France logistics system that guarantees the coherence of projects (in the absence of an Organising Authority as exists for passengers). The Paris logistics system, focusing primarily on the reception of goods, cannot be envisaged without taking account of the flows that are exchanged with its partner *départements* and regions, whose organisation defines the structure of delivery processes in high-density areas.

By incorporating all of these actions into a logistics plan, the City of Paris will become a key player in improving the coordination between key issues at different geographical levels, and in generating diversified traffic: the city street (which sees organisational and social innovations, numerous and diversified flows but small quantities in terms of tonnage), the Metropolis and the "World" (a major logistics centre, flows with more distant origins entering Paris, which can be handled by alternative modes and account for most of the volumes)[22].

The Ile-de-France Low-Carbon Logistics Plan (*Schéma Logistique Bas Carbone d'Ile-de-France*) must combine ways of pooling last-mile deliveries (to improve vehicle load factors) and a development strategy that improves the coordination, location and connection of logistics functions using alternatives to road transport. In this way, large multimodal zones will be connected by inland waterway and rail shuttles services to smaller "city gateway" sites, and then to very small logistics centres in high-density areas.

[20] Approximately 670 million packages are generated by electronic commerce in the B2C and C2C segments each year. The sector is growing at a rate of approximately 15% per year. As a consequence, around 100 million additional packages are being added to the existing flows of goods each year, primarily in cities subject to the greatest traffic and parking constraints. As the Ile-de-France region accounts for 30% of French GDP, it can be assumed that 30 million of the 100 million packages are bound for destinations in Ile de France.

[21] APUR, *Logistique urbaine*, 2014

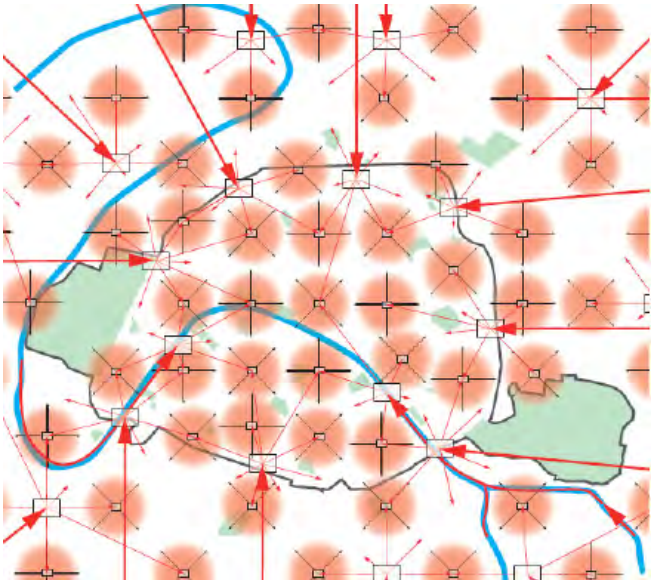
To contribute to the strengthening of the Ile-de-France intermodal scheme, the City is planning to implement new combined rail-road transport and inland waterway container port projects on a scale that corresponds to the needs: 2 to 3 very large terminals in areas with very high potential,[23] and small projects in areas that are less congested from a logistical perspective but which have smaller local markets.[24] It will incorporate a high-speed rail freight (*TGV Fret*) service (running at night) with the ability to transport perishable goods. The Seine Nord canal and the Western loop of the "Francilienne" trunk road will allow for the creation of new junctions and new logistics centres at the intersection of ring roads and arterial routes.[25] The River Seine, with its links to ports in Normandy, assumes new importance as a logistics corridor. Its use for freight transportation at off-peak times (mainly at night) facilitates mixed uses and improves the acceptability of the project. The Plan allows for the implementation of concerted actions which are beneficial to the integrated organisation of freight in the Ile-de-France region: control of building permits, support for warehouses on railway sidings/ waterway docks that make effective use of alternative modes, support for the establishment of urban logistics centres in high-density areas, incorporation of crowdshipping[26] functions and social actions into these centres, etc.

Freight is no longer considered to be a necessary evil but a component of the economic vitality of the City. It is taken into account at a very early stage in the design of any new infrastructures, underground railway or tramway lines. The stations and trains are designed in advance to allow for mixed uses, although the preference is given to freight late in the evening, at night and early in the morning. In the same way, freight is being taken into consideration in the project to transform the main Paris ring road – the Périphérique: the possibility of a lane reserved for freight solutions has been included in the draft phase (driverless vehicles, automatic freight-trams, etc.).

Certain subjects such as the construction sector and waste have been identified as priorities for 2020-2025 Low-Carbon Logistics Plan. The possibility of creating construction waste sorting / recovery sites is being considered, in compliance with the urban integration rules required for this type of development. Since 2016, contractors have been able to participate in the market to transport biowaste to methanisation and composting centres via inland waterways. By 2030, it will be common to see environmentally friendly biowaste collection lorries transporting their loads to collection points along the River Seine for transfer onto barges (see the Moulinot® project for mobile dockside skips, and the Love your Waste® project with stationary, underground tanks at dockside locations).

The City of Paris sets the example

Through its Exemplary Administration Plan for each elective term of office, the City of Paris is making increasingly radical commitments. It is signing contracts to promote the disposal – by alternative modes – of excavation materials and rubble generated by the construction and renovation of its built environment and public spaces. From 2020 onwards, it will be introducing eco-conditionality principles into its public procurements, which will include freight. It will require its suppliers to use "low-carbon" modes to carry out all last-mile deliveries, for example.



Example to explain the logistics plan by zone for different sizes proposed by APUR
APUR, *Logistique urbaine : vers un schéma d'orientation logistique parisien,* 2014

[22] In 2015 in France (TRM survey), flows within 50 km represented only 12% of the tonnage against 88% carried out more than 50 km away, and not considered to be "city freight"
[23] 94-91, 93, north of 77, Achères
[24] Châtres, Val Bréon, Bruyères,…
[25] Example: Achères, but there is a need for a broader examination of how to establish a balance in the logistics and intermodal transport system in the Western area
[26] Collaborative delivery of parcels by private individuals (to other private individuals)

FOCUS ON CONSUMPTION

2004
6,4 $MtCO_2eq$

2030
4,3 $MtCO_2eq$
-30%

TAKING STEPS TOWARD SUSTAINABLE FOOD

In-depth study on food in Paris and
Convention on Sustainable Food Services

Combat Food Wastage and support for associations

«Sustainable Food Service in Paris» Plans

Ecoconditionality for authorisations to temporarily occu

Meat-free day in institutional food service

Parisian Green Investment Fund

Development of urban agriculture

Mass development of urban agriculture through transf

REDUCING THE QUANTITY OF WASTE, IMPROVING SORTING AND RE

«Circular Economy» Plans

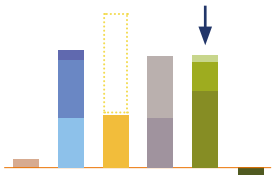
Studies and Experiments

Incentive-based pricing

Selective collection of biowaste (composting and producing methane gas)

Deposits for glass and certain types of packaging

2016 2020 2026 2032 2038



2050
1,9 $MtCO_2eq$
-70%

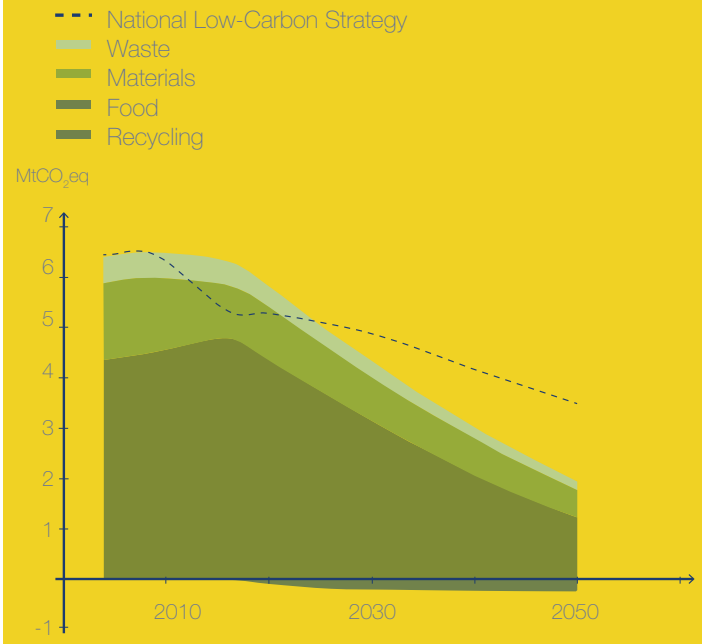
upy public places

formation of ring road

ECOVERY

2044 2050

OVERVIEW



REDUCING MEAT CONSUMPTION

Food is the biggest item of the consumption section of the Carbon Assessment, which is itself the second-largest item in the overall Carbon Assessment. This topic is not addressed within the scope of the GPC and is therefore often an overlooked part of the analysis. The City of Paris has made the bold decision to include it and take action to reduce this element.

A vegetarian meal emits an average of 440 gCO_2-eq, compared to 1,320 gCO_2-eq for a predominantly meat-based meal with chicken and 5,650 gCO_2-eq for a predominantly meat-based meal with beef, according to the ADEME (French Environment and Energy Management Agency). Our daily food choices therefore matter more than we may think.

People are increasingly cutting back on their consumption of meat for health and environmental reasons. This can take a variety of forms, including eating smaller portions or eating meat with lower carbon emissions, choosing dedicated meat-free days etc. The demitarian (or «half-vegetarian») diet allows individuals to make easy, everyday decisions in order to reduce their emissions without making too great a sacrifice.

Legend

- Ongoing
- Support and awareness
- Technical & regulatory actions

3.1.6/ CONSUMING DIFFERENTLY AND REDUCING WASTE PRODUCTION

Waste, as it is currently taken into account in the calculation, represents a smaller component of the City of Paris's carbon footprint than the other elements. In fact, this item includes only waste collected by the City of Paris (green, yellow and white bins, bulky items, etc.).

However, the City's review of carbon neutrality extends beyond this scope. It focuses on all the waste produced in Paris and all segments of the public (residents, businesses, tourists, etc.). It takes a broader look at residents' consumption habits and businesses' production methods (since it is businesses which supply the goods which will be bought, consumed and the disposed of).

The reduction of the carbon impact of the «waste» component will therefore come about as much by improving waste sorting and recovery as by reducing the source and amount of waste produced every year. This final element implies a more fundamental transformation of consumption habits and production methods.

Though the City certainly has a different degree of control over each of these aspects, the original intention is indeed comprehensive. The 2007 Climate Plan has set a target of reducing production of household and similar waste by 15% between 2005 and 2020 (which amounts to 84 kg per resident). In June 2014, the Paris Council unanimously passed a resolution committing Paris to a «Zero Waste» trajectory. In 2015, a further step was taken with the organisation of a Circular Economy Convention.

Increasing waste sorting and recovery

In order to reduce the volume of waste and increase its recovery, the City is first focusing on waste management itself, within the scope for which it has the greatest influence.

Establishing an incentive-based pricing system is the first project of the City of Paris. Incentive-based pricing aims to prevent waste production and increase sorting. Feedback has been very positive. Changing pricing facilitates the mobilisation of stakeholders and accelerates the results of local plans for waste prevention and management. In order for it to be effective, however, it must take a form which corresponds to the local context and its principle must be thoroughly explained to the population, especially in collective housing.[1]

The City could therefore launch an operational study starting in 2017 in order to determine the best way to make waste producers aware of their responsibilities by internalising collection costs with regard to the Parisian context. Two different options exist: a bag tax (charge for bin bags as an incentive to reduce waste) or a weight tax (integrated chip in the collection bin read by smart containers which then credit the account associated with the address). Each of these two solutions would be combined with a rather low flat-rate tax which is the same for everyone. It will be implemented gradually over time and by arrondissement and will be completed in 2030. Pricing will vary depending on type of bin, with the cost of collecting bins for recyclable and biowaste being less expensive than those for household waste.
The City of Paris will support this development through two major focus areas: awareness-raising and debriefing. As its effectiveness has already been proved in other cities, detailed campaigns to raise awareness will be carried out by going door-to-door in condominiums with communication materials which are simple to use and easily understood.[2] The City will rely on actions and ideas of «Actors of a Sustainable Paris» as well as its ever-growing number «sorting ambassadors».

[1] ADEME, *Habitat collectif et tarification incitative*, 2012

[2] See for example San Francisco's emblematic «Zero Waste» approach to this subject.

A real plan for distributing sorting instructions will be set up. Neighbourhood-wide contests will be organised for participants to compare themselves to their neighbours. Climate Houses will become «zero waste» reference houses where residents may ask questions and see how to go about managing their waste in concrete terms. They will be designed as platforms for «local urban services» (collection, repairs, raising awareness etc.). On a more direct level, the City will offer free audits for condominiums (residents and managers) in order to help them improve waste management according to their specific problems. Personalised monitoring will be offered, which can extend to door-to-door checks.

Employees in charge of verifying the content of rubbish bins before collection can therefore identify recurring sorting errors by building or by street. Communication can then be even more targeted or personalised. Over time, fines will be applied for repeat offenders, as is the case in San Francisco, for example.[3] In public places, sorting bins adapted to the new instructions will become widely available, as well as voluntary drop-off receptacles for specific waste such as textiles.

Parisian example of communication medium



Source : City of Paris

The new pricing system has led to a decrease in tonnage of household waste collected In all the municipalities in which it has been implemented. This decrease has only been offset in part by an increase in tonnage of sorting bins reserved for recyclables. Illegal waste dumping and other adverse effects often remain minimal and do not call into question the beneficial impact of the introducing this sort of pricing system.[4] The City of Paris collection system will therefore be profoundly reformed (reduction of number of trips, refuse collection vehicles adapted for collecting different types of waste in the same trip...)

2050 Target : Massive reduction of household waste and increase the quantity of recycled or reused waste, to a total waste lower than the current level



[3] In Zurich, offenders are even pursued by police specialised in tracking illegal waste dumping. Investigators open illegal bags to look for proof of identity of the wrongdoer.

[4] Feedback actually indicates that «these adverse effects are much less significant than affirmed by certain sources,» ADEME, *Tarification incitative conseils et retours d'expérience*, 2014

The City will also focus on certain categories of waste and certain actors or geographical areas which are considered high-priority.

For example, it will implement the selective collection of organic waste as a general practice five years ahead of the date set out in the Energy Transition for Green Growth Law. This practice will be used in all the arrondissements of Paris starting in 2020. Organic waste tonnage from households will be modest at first, but will gradually grow to reach 70% in 2050. Producing methane gas and composting are the favoured treatment solutions for this type of waste. A finely-woven network of neighbourhood composters will be developed. Condominiums will be equipped with composters just outside the building when feasible. The proliferation of planted areas will therefore facilitate the local use of a portion of this compost. The organic recovery unit in Ivry will gather momentum and replace the incinerator project. The budget originally dedicated to this operation will be invested in prevention and raising awareness. In collaboration with the Ile-de-France region and stakeholders, sites will have been identified for creating treatment and methane production facilities near Paris. Land remains a crucial issue in permitting the development of such a solution.

For businesses, thresholds imposed by the Environmental Code requiring organic waste to be sorted at the source and recovered are expected to decrease in order to affect all producers of biowaste. The City will therefore implement a specific support plan for biowaste-producing businesses. Verification of sorting at the source will eventually become incorporated with health inspection operations. Reinforcement of legislative constraints and support from the City of Paris will extend to all types of waste produced by businesses activities.

Businesses are major producers of waste. Targeted operations such as «Committed Enterprises» will be greatly

Examples of communication medium on sorting household refuse for recycling
Title : Produce your own compost !



source : City of Paris



source : ©Yann Avril - Fotolia

increased. Partners of the Paris Climate Action network will be particularly mobilised in order to significantly reduce the quantity of paper and cardboard produced, and make arrangements for optimising their sorting and recycling practices. In order to have a better leverage effect during the first few years, the City will concentrate its efforts on the greatest producers and the arrondissements with the strongest economic activity (especially the 1st, 2nd, 4th, 6th, 8th and 9th).[5] It will then establish a list of the 100 businesses with the most employees working in Paris in order to contact them directly.

In the specific case of glass and certain containers, the City of Paris will establish ties with groups such as Réseau Consigne (Deposit Network) and Jean Bouteille. Deposits allow for a significant reduction in emissions: instead of heating glass to over 1000° in order to melt and subsequently recycle it, it can simply be cleaned and re-used directly. The City will therefore support the development of a network of partners. In 2024 it will cover the entire territory in order to be operational for the Olympic Games.

The Olympic Games will therefore represent an opportunity to highlight the City's new waste management policy. Based on its experience with major sporting events (marathons), it will provide the necessary funding to set up specially-designed sorting areas in public places and give out goodies which convey appropriate messages (reusable water bottles and cutlery with the Olympic image, eco-cups...) This must be a key moment which leaves people with a lasting impression and establishes Paris as the C40 leader for this issue. The athletes and VIPs invited can help the City to communicate useful messages. Their influence can sometimes be similar to that of fashion icons and they can therefore help increase awareness about environmental issues amongst those who may not originally be very informed. Specific monitoring will make it possible to report the results.

The City of Paris «Zero Waste» plan has ambitious goals for reducing household and similar waste by 2030 and 2050. The targeted average rate of reduction of tonnage is 2% per year between 2020 and 2030, then 1.5% per year until 2050. Total per capita waste production would therefore be 330kg/year in 2030 and 220kg/year in 2050.

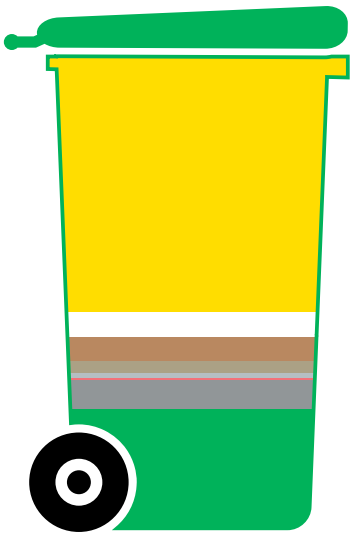
In 2030, the City will additionally seek to divert the majority of recyclable waste currently in the green bin to the appropriate form of collection. The goal is to obtain a shift toward recycling (paper, cardboard, plastic, food cartons, metals, glass and textiles) or toward composting and methane gas production (for biowaste, 17.5% in 2016)[6] in order to reach an overall volume of 25% for this waste in 2030 and 50% in 2050. However, an increase in tonnage of sorted waste must not be offset by a decrease in quality of waste sorting. The City strives for under 13% sorting errors by 2030 and 8% by 2050 (compared to 19.2% today)[7] Following the example of San Francisco, the City additionally strives for zero stored/buried waste as of 2030.
In terms of treatment, innovative technology will lead to improvements in recycling and waste recovery. The ring road rehabilitation programme could make it possible to situate waste sorting facilities in the very centre of the metropole.

[5] Page 38, City of Paris, *Rapport Annuel sur le prix et la qualité du service public de gestion des déchets à Paris,* 2014

[6] Page 37, City of Paris, *Rapport Annuel sur le prix et la qualité du service public de gestion des déchets à Paris*, 2014

[7] Page 41 City of Paris, *Rapport Annuel sur le prix et la qualité du service public de gestion des déchets à Paris*, 2014

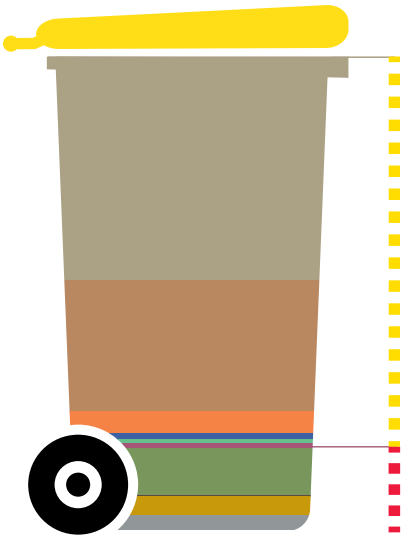
CONTENTS OF BINS WITH GREEN LIDS (MODECOM 2013)



19,3 %	PAPERS, NEWSPAPERS, MAGAZINES
17,6%	PLASTIC
9,4 %	CARDBOARD BOXES
4,5 %	METAL
3,4 %	FOOD CARTONS
5,3 %	GLASS
5,3 %	WOOD AND OTHER COMBUSTIBLES
2,4 %	USED CLOTHING AND TEXTILES
1,2 %	RUBBLE AND OTHER NON-COMBUSTIBLE MATERIALS
0,4 %	SPECIAL WASTE
6,2 %	FINE ITEMS (<20MM)
17,5%	PUTRESCIBLE WASTE
7,4 %	SANITARY TEXTILES

Source: City of Paris, *Rapport Annuel sur le prix et la qualité du service public de gestion des déchets à Paris*, 2014

CONTENTS OF BIN WITH YELLOW LID AFTER SECOND CHECK (MODECOM 2014)



80,8 %	**RECYCLABLES**
44,4 %	PAPER, NEWSPAPERS, MAGAZINES
27,7 %	CARDBOARD AND PAPER PACKAGES
5,3 %	PLASTIC PACKAGES
1,5 %	STEEL AND ALUMINUM PACKAGES
0,9 %	FOOD PACKAGING (CARTON-TYPE)
1,0 %	SMALL ELECTRICAL APPLIANCES
19,2 %	**ERRORS PICKED OUT IN RECYCLING FACILITIES**
11,5 %	HOUSEHOLD WASTE
0,6 %	INTERLOCKED OR DIRTY COMPONENTS
4,3 %	THER (GLASS, PLASTIC BAGS AND FILM...)
2,8 %	FINE WASTE (<60MM)

Source: City of Paris, *Rapport Annuel sur le prix et la qualité du service public de gestion des déchets à Paris*, 2014

Taking action to change consumption habits and production methods in order to reduce waste at the source

In order to reduce waste production at the source, the City of Paris encourages prevention and reuse. The Circular Economy Convention organised in Paris in 2015 resulted in the creation of the «Plan for the Circular Economy.» In terms of consumers, its goal is to support ongoing changes in buying behaviours in order to achieve more «responsible» consumption.

Questioning the need to buy itself will become the first reflex for Parisians following targeted programmes to raise awareness. Frugality will no longer be a radical practice reserved for followers of the «voluntary simplicity» movement. An increasing number of condominiums and residents will pool their equipment goods (tools, washing machine...) and choose to rent products for occasional use. The City's incubators will support the development of «collaborative» services and functional economy practices[8] which will rapidly become widespread.

Today a great number of goods are still thrown away simply as a result of passing fads, despite the fact that they are still in working condition or require only simple repairs (electronics, furniture, clothing, etc.). To prevent this practice, the City of Paris, in association with various co-operatives which it largely subsidises, will actively participate in the promotion of another vision. Depending on the situation, recovery, repair, or re-use can provide economic and «trendy» solutions. [9]

The City will particularly support DIY/repair workshops[10] and other FabLabs.[11] Parisians will become accustomed to systematically selling or giving away goods they no longer want, regardless of their social category. The City of Paris network of recycling and recovery centres will become particularly dynamic and extend to all the arrondissements. Starting in 2025, it will even guarantee the quality of second-hand products, especially costly technical products such as large appliances and computer equipment.

Furniture waste and electrical and electronic equipment waste will be particularly affected by this transformation from the status of «waste» to that of «resource». The City will therefore work on the development of recovery programmes in the Ile-de-France region in order to divert waste from ending its life in a waste storage facility or in far-off recycling facilities. Support for these programmes will include subventions, providing land or low rent for waste recovery and recycling organisations, as well as support for training programmes necessary to developing a large number of these organisations.

Starting in 2018, ties will be established between players in this sector and the Envie network to help facilitate development. Additionally, the City's carbon eco-rewards programme will reward households which bring reusable goods to the partner network of recycling and recycling/recovery centres. Key events such as «recovery villages» featuring temporary neighbourhood collection areas (mobile eco-point) to help raise awareness amongst residents while organising regular collections in every arrondissement.



Photo taken during the conference on the General State of the Circular Economy in Paris, May 2015
source : City of Paris

[8] Favouring use over possession and selling services linked to products rather than products themselves.
[9] Already in 2012, 95% of consumers declared that they had a good image of shops that sold used goods and 75% bought used goods (compared to 59% in 2004). ADEME, *Les Français et le réemploi des produits usagés*, 2012.

[10] These «collective DIY workshops» will provide tools, spare parts and/or skills to extend the lifespan of goods (maintenance, repairs, customisation...)
[11] A FabLab is a workshop open to the public in which all sorts of tools, especially computer-controlled machine-tools, are available for designing and creating objects.

Financial gain for households is often the first argument brought forward in order to change their consumption habits.[12] But decision criteria are progressing and laws are facilitating these changes (law against excessive packaging, laws to develop environmental labelling etc.) Informing consumers contributes significantly to guiding them toward more virtuous practices.[13] As for buying new products, in 2050 consumers will be able to consult displayed information about products' environmental impacts. This factor will therefore play a larger role in selection criteria for products with a preference for reusable, repairable, rechargeable products or those awarded eco-labels. Buying loose or single items will also have become commonplace through the City's support for these sorts of businesses and organisations.

This transformation is called for by a large part of civil society but involves business as well. The majority of the industrial-tertiary sector will therefore profoundly change its model. The change initiated in the 2000s by legislative[14] and local[15] measures will be reinforced. The City of Paris will especially support the ADEME's actions to support, train, and communicate with the CCI and industry leaders in relation to eco-design, «Cradle to Cradle,» and responsible procurement.[16] The introduction of a carbon tax on consumer goods would also encourage buyers to take a product's entire lifecycle into account.

For households and businesses (other than the construction industry), as a result of these new consumption and work practices, the total volume will be reduced by 20% in 2030 and by 40% in 2050.[17]



Paper bale in a waste-sorting center, source : ©k.paddubski - Fotolia

The City of Paris sets the example

The City of Paris is strongly committed to reducing waste within its own field of activity, most notably through its responsible purchasing charter, and is developing a large-scale action plan for schools. This plan would encourage learning about the «practical» aspects of eco-citizenship from an early age. Just as pupils study responsible eating habits or ways to reduce energy consumption, every year they would learn about best practices in terms of reducing waste at the source and waste sorting, understanding advertising strategies which encourage over-consumption etc. The City could, for example, commit to ensuring that all classes of one level (5th grade, for example) would visit a recycling facility in Ile-de-France every year. A collection could also be organised in coordination with these awareness-raising activities.

Jean Robert Mazaud
Urban architect, President of S'PACE & S'IAMA

« With Paris as an attraction, it is conceivable that the same level of performance can be achieved in le Havre: one liner per day with a third of the passengers choosing a trip to the French capital. This requires suitable infrastructures and it will subsequently be difficult to determine if tourism spurred their construction or if their creation contributed to the development of this industry in such great demand.

Two high-speed trains a day in both directions are therefore economically justified (approximately 1,200 passengers). Additionally, multimodal transport equipment in the form of cable cars, required by the rapidity and fluidity of ship-railway station connections, become justified and will also be available to residents and their companies (the cruise industry also creates jobs in the ports and their surrounding area).»

»

[12] Study carried out for ADME by Régis Bigot and Sandra Hoibian, *Évolutions du comportement des français face au développement de l'économie circulaire*, 2014
[13] As illustrated by the Californian initiative to compare electricity bills from similar households, which resulted in a significant reduction in consumption.
[14] Example: law condemning planned obsolescence
[15] Example: Adoption of a responsible public ordering scheme for the Paris Council.
[16] Purchasing represents an average of 50% of a business's turnover. It could therefore have a considerable leverage effect.
[17] The LTECV describes a 10% decrease in production of household waste and waste from certain activities by 2020.

3.1.7/ PROMOTING MORE SUSTAINABLE FOOD

The City of Paris considers choice of diet to be a more private, sensitive subject than the other topics discussed above. Food does not fall within its direct jurisdiction. Furthermore, this topic is not included within the scope of the calculation of cities' carbon impact contained in the GPC.

The City has therefore made the bold decision to include it in its process, by taking account of meals eaten by residents and workers in Paris. It has also begun to work on municipal and departmental institutional food services through its 2015-2020 Sustainable Food Plan.

However, given the weight of food in the capital's carbon footprint, it would appear that the City must take further steps by guiding a greater number of Parisians toward choosing more sustainable diets as well as by developing local, lower-carbon agriculture.

The transition movement must therefore include all participants in this sector: institutional food service and restaurants, mass distribution, private customers, the agricultural world, etc. The initial review is expected to take on greater proportions. Mobilising the various stakeholders and consulting the different sectors will therefore be central to the process.

This document aims to propose overall guidelines and a general framework. The City of Paris will then attend to drafting detailed action plans with each new term of office.



Roof of the Paris council building © Mayor of Paris

Towards a change in diet?

Assessing the current situation

At present, the City of Paris must rely upon national studies and emissions factors in its approach to the topic of food. Unlike other subjects such as transport or building, few studies allow for a clear, complete understanding of the specific characteristics of Parisians with regard to this topic. In order to fine-tune its analysis and decision-making, The City of Paris must first understand the initial condition more fully.

In order to do so, the first step will be to launch a study in order to gain a better understanding of the eating habits of those who work and live in Paris. First of all, better qualitative and quantitative data must be gathered about the types of diets present in the city in terms of their carbon footprint. Existing obstacles (financial burden, health issues, etc.) and levers (associations, population segments to target, etc.) must then be identified in order to transition toward more sustainable food.

This technical study will need to be complemented by a Food Service Convention, following the example of the Convention organised on the topic of the circular economy in 2015 or on the subject of night-time activities in 2010. This event will provide an occasion to bring together and mobilise all stakeholders in the restaurant and institutional food service sector in Paris. An assessment of the current situation will first be established in order to determine several clear objectives, along with a list of joint propositions and solutions. The City will also have the opportunity to identify the most willing participants, on whom it can rely for its subsequent measures. The ensuing White Paper will help the City to organise its next 2020-2025 plan in an informed manner.

Certain municipalities, such as Ghent or Sao Paolo, have taken measures over the last few decades to help reduce their constituents' carbon impact resulting from food, especially by reducing their meat consumption. These measures have had varying degrees of success and have not all been renewed. As part of the C40 or the initial study, the City of Paris could lead a critical review of these public policies. The compilation and analysis of all existing feedback will greatly contribute to the City's consideration of these questions in the coming years.

Raising awareness and mobilising Parisians

Along with these steps, a programme to raise awareness could be launched in order to reach a wider audience and educate all Parisians about the carbon and health impacts of their dietary choices. It would serve as a public display of the City's commitment to encouraging all residents to adopt a diet composed of more local, seasonal products with less meat.

It could be launched, for example, with a special exhibition and a large, community-wide banquet on the banks of the Seine. Citizen groups and associations committed to this subject would be invited to support the event. The menu could feature local and unsold food prepared by associations such as Disco Soup or Freegan Pony. Explanatory signs would clearly display key messages and figures in an interesting, straightforward manner. For example, «Meat products represent only 8% of the average weight of a shopping basket, but represent a third of its carbon content».[1] This exhibition would strive to help educate visitors about the issue and lead them to change their habits. In the example of organic food, greater general awareness of the benefits of this type of agriculture has led to significant growth in consumption of these products (+10% per year according to Agence Bio).

Between 2020 and 2032, the awareness-raising programme could continue, but focus on a different audience every year. Targeted campaigns have proven to be more effective.[2] At first, different social groups would be targeted, including those with the greatest carbon impact per individual, those with a strong leverage effect (opinion leaders) or those who represent the future (children, adolescents). Important places within the community (schools, associations, works councils, festivals...) will also be targeted as they provide an opportunity for increasing people's awareness independent from any preoccupation with the subject.

For example, the City could organise a «VLS» (Vegetarian, Local and Seasonal) family challenge. Its purpose would be to show people that it is possible to eat more healthily while also reducing the carbon content on their plates. It would focus primarily on the lowest-income households in order to demonstrate that such a diet is possible for a low cost and is not necessarily more expensive, but most importantly, that it requires significant changes in habits.

Example of a flyer that can be made in 2032 for the «Climate Generation» who will be 18 years old in 2050



(photo by MFer Photography, Flickr)

[1] Utopias with the collaboration of the ADEME, *La Vie Happy*, 2016
[2] CGDD *«Le contenu carbone du panier de consommation courante, Observation et statistiques* n°121, April 2012

In a second phase, individuals would be targeted at different moments in their lives which are most conducive to change. At certain moments including pregnancy, back-to-school time, leisure activities, recovery etc., individuals are more open to hearing messages and making lifestyle changes. Since 2032 will represent the «Climate Generation,» who will turn 18 in 2050, that year's priority will be future parents and medical personnel. For example, booklets and posters will be distributed in all maternity wards as well as in midwives' and obstetricians' surgeries in Paris. Key events for the City, such as the organisation of the Olympic Games in 2024, can also be a way to inform people about this subject. Athletes' great focus on their diet would then help reaffirm the health and ecological issues associated with a more sustainable diet.

The City can also influence buying behaviour more directly in order to privilege local, seasonal and organic products while limiting meat products.[3] In 2020, the City will reorganise the system for managing sites for open-air food markets in line with this objective. It will work to bring «Food Halls» to all arrondissements based on the model of the two which were opened in 2017.

This approach will respond to changes in social demand. [4] Parisians, tired of repeated health scandals and increasingly concerned about their health, will turn toward alternative eating habits (organic agriculture, locavore diet, producing food themselves, entomophogy etc.) These types of diets will gradually become standard practices. With support from the «Actors in a Sustainable Paris,» the alternative, short supply chain distribution network will be significantly improved and more accessible for consumers (community-supported agriculture, Ruche qui dit Oui!, monpotager.com...) Using the Monoprix brand as an example, mass distribution and restaurants will promote local food and the «terroir» of the Ile-de-France region.

Maxime de Rostolan
Permaculturist and founder of Fermes d'Avenir and BlueBees

«When we talk about changing the paradigm, agriculture and food must be considered as essential building blocks that are vital to the foundation of a new model. We have externalised production work, either to machines which preside over completely controlled off-soil environments, or to foreign countries. A society cannot function with farmers representing only 2% of the population and food travelling an average of 1,000 km before reaching our plates. Rather, it can function like that as long as petrol isn't worth anything...but it must be understood that, above all, this situation harms our climate, poisons our food with pesticides (derived from petrol), and destroys local jobs...»



Paris merket © S. Robichon Mairie de Paris

[3] In terms of carbon impact, seasonality can have a greater effect than transport distance. Food grown locally but out of season in heated greenhouses can be more energy-consuming than food imported from a great distance but grown in open air. (AMDE, *Les circuits courts alimentaires de proximité*, April 2012)
[4] 64% of consumers consumed organic food in 2010, compared to 31% in 1995. This growth in consumption of organic products is confirmed in all population categories, including households with modest incomes (CREDOC, «*Conditions de vie et aspirations*» survey, 1995-2012). This market has increased by nearly 10% per year since 2007. .

Consulting and engaging industry players, especially the restaurant sector

To accelerate the process, the City of Paris Action must extend beyond raising awareness. Restaurants are easier to identify and mobilise than the general population. Because customers already increasingly request organic and local ingredients, the City will focus its efforts on promoting a less meat-based diet.

After a first phase of mobilising stakeholders and analysing the current situation (the Food Service Convention), the City will coordinate its efforts with the actors and sectors involved so that they may take real action. The proposed drafting of the «Plan for Sustainable Food Service in Paris» will serve as an opportunity to determine a shared roadmap for a duration of five years, for every term of office. Examples of key measures which seem essential to achieving carbon neutrality by 2050 are outlined below.

From 2018, the City will support an international meat-free day in a highly visible, publicised manner and will also encourage a large number of players in the food service industry to participate in this day. It will campaign for private institutional food service players to offer appealing vegetarian menus, either by featuring smaller portions of meat or lower-carbon meat products, or by introducing one meat-free day per week, and gradually increasing this number to two or three days per week. The municipal «carbon card» system of eco-rewards launched in 2020 could also include food products. Each vegetarian meal in a partner restaurant or canteen could allow individuals to earn points which can later be turned into units of currency in the new «local currency».

At the same time, the City will help raise awareness in the commercial food service industry about the importance of carbon and health issues in choosing suppliers and menus. The idea is to encourage the industry to propose «low-carbon» dishes (vegetarian offerings, local and seasonal products), while working to increase the popularity of meat alternatives (insects, algae-based food products...). In 2020, the City of Paris will launch a contest for restaurant-owners in order to create the Michelin Guide or Fooding for low-carbon dining in Paris. Menus will be rated by Parisians and the best restaurants in every arrondissement will win awards. This campaign will lead to the distribution of the guide and its map to Parisians and tourists.

This contest will be accompanied by a certain degree of lobbying for each restaurant to offer a minimum of one vegetarian option on its menu, or even propose one meat-free day per week.

An example of this practice is the «Vegetarian Thursdays» programme launched by the municipality of Ghent, which began with a vegetarian menu on Thursdays in its municipal institutional food service. Corporate food services and private restaurants soon followed its example. Initiatives for commercial restaurants focused more on awareness and education (vegetarian cooking lessons) as well as support (in establishing a vegetarian meal on the menu on Thursdays) -with activities and events playing a central role in the process.

With authorisations to temporarily occupy public places, the City has strong leverage for restaurant-owners with terraces. In 2026, it could impose eco-conditionality for restaurant-owners to receive this authorisation. For example, they could be required to offer a certain percentage of sustainable food or to have signed a charter similar to «Bon Pour le Climat» (climate-friendly) restaurants in order to keep their outdoor terrace.

The City of Paris can also take action at the national level through lobbying, by introducing a carbon tax on consumer goods (which would therefore particularly affect imports of exotic food and meat products) for example.

In France the number of vegetarians has remained relatively steady over time. It was estimated to be 3% of the population in 2014.[5] However, from a social-professional point of view, this type of diet appears to be over-represented in senior and mid-level management positions, as well as professional occupations.[6] This trend is favourable to the development of vegetarianism in the Parisian environment, where the higher professional classes are also over-represented.

The model is based on the hypothesis that vegetarianism will increase over the coming decades. According to this hypothesis, the vegetarian population will have doubled in 2030 (6%) and will have grown to represent 12% of the Parisian population in 2050.[7]

[5] FranceAgriMer *Les synthèses de FranceAgriMer* n°21, June 2015
[6] Centre d'étude et de prospective «*Disparités sociales et alimentation*» Working paper n°9, November 2013
[7] The reasons vary according to individuals: scandals involving well-being of animals, public health questions, concern for climate change...

The radical choice of vegetarianism is especially difficult for generations born in the 20th century. «Demitarianism» or «flexitarianism» — which involve limiting meat consumption by 30 to 50% without being a vegetarian[8] — could appeal to a larger number of Parisians. Demitarianism combines various methods: eating smaller portions or lower-carbon meat,[9] observing meat-free days every week, limiting meat consumption to certain social events (dining with friends or eating out), etc.[10] Meat consumption does not therefore disappear from one's diet, but its forms change.

The demitarian population is estimated to be 25% today and will grow to include 50% of the population in 2030 and 75% in 2050.[11] The movement which initiated in the 2000s will therefore accelerate, with overall meat consumption being reduced by 30% in 2030[12] and by 50% in 2050, in comparison to 2014. For all types of uses (home, out-of-home dining and industry) consumption of meat could go from 86 kg cw/person/year in 2015[13] to approximately 65 kg cw/person/year in 2030 and almost 40 kg cw/person/year less in 2050.

Transforming the agro-food industry in Ile-de-France

Encouraged by civil society and local authorities, the agro-food world in Ile-de-France will continue its metamorphosis until 2050. The City of Paris can, however provide support through specific actions, as it has already with its Sustainable Food Plan.

Initial studies will make it possible to better identify levers of change in order to establish new propositions, in collaboration with different actors in the sector. Drafting the «Plans for Sustainable Food Service in Paris» will help it organise these measures over time.

More sustainable agriculture in the Ile-de-France region

The City of Paris particularly supports the development of organic, subsistence agriculture in Ile-de-France. The organisation and development of «local, sustainable supply chains» at the core of its 2015-2020 Sustainable Food Plan will benefit the entire sector, well beyond public institutional food service. This action contributes to organising logistics for these supply chains (optimisation of delivery circuit, vehicle filling...) and therefore avoid certain contradictory effects of buying local [14]. It is expected that the most effective agricultural practices on an environmental level will become widespread in the Ile-de-France region, therefore allowing for a 12% decrease in the impact of agricultural production in 2030 and a 50% decrease in 2050. [15]

The «Green Investment Funds» or «Territorial Investment Funds» proposed above will be used to finance this process. These funds will enable Parisians to invest their savings with the knowledge that they will truly finance local transition. The funds would particularly invest in supporting Ile-de-France farms convert to organic farming practices and in setting up new vegetable-farming operations (which will sell their products in Parisian markets). The funds could also support deploying the latest innovations in agronomy and food (optimisation software for short supply chains, algae-based meat alternatives etc.)



[8] FranceAgriMer *Les synthèses de FranceAgriMer* n°21, June 2015
[9] Such as poultry instead of bovine meat.
[10] To determine this model, this is defined as a diet which is 50% vegetarian, 25% poultry, 25% bovine meat.
[11] «27% of non-vegetarians would be ready to become at least flexitrian, or even vegetarian» according to the Baromètre INPES, a survey carried out by Institut OpinionWay for the magazine Terra Eco, May 2012.
[12] This hypothesis is more ambitious than ADEME's vision, which is based on a 10% decrease per individual on average between 2007 and 2030. ADEME, *Alléger l'empreinte environnementale de la consommation des français en 2030* report 2014, p.32
[13] «Meat consumption in France reached a peak in 1998 with 94.1 kg carcass weight equivalent consumed per person (kg cw/person). Since then, it has steadily decreased to reach 86 kg cw/person in 2014.» FranceAgriMer Les synthèses de FranceAgriMer n°21, June 2015
[14] Though buying local shortens distribution chains for food, logistics are less optimised and centralised and more dispersed. According to plans, transport of merchandise can be less efficient overall and therefore more energy-consuming. (ADEME, *Les circuits courts alimentaires de proximité,* April 2012
[15] «The objective in the reference scenario is to succeed in lowering emissions by 12% by the third carbon budget, in comparison to 2013, and by half in 2050, in comparison to 1990.» in Page 13, MEDDE, *Stratégie National Bas Carbone, Résumé pour décideurs,* 2015 which is also in line with the Afterres scenario *(Un scénario soutenable pour l'agriculture et l'utilisation des terres en France à l'horizon 2050,* 2014)

Promoting the development of urban agriculture

Urban agriculture is developing in Paris itself. The objective is to reach 33 cultivated hectares by 2020. The reconversion of urban waste lands, such as the Petite Ceinture railway line, along with the establishment of a supportive legal framework[16] makes it possible to free up land for this activity over the coming decades. However, it is the transformation of the ring road that will really boost this activity. The City could, for example, make an ambitious decision to reach 150 hectares of urban agriculture by 2050[17] and incorporate this goal from the outset of the redevelopment project for this space.

The City of Paris and the CCI support a network of «Pariculteurs» (ParisFarmers). This new breed of urban farmers, who received training based on the «Farms of the future» or «V'île Fertile» (Fertile City) models, farm small areas for market gardening in densely-populated areas. Though they alone cannot feed the population of Paris, this type of farming helps reconnect city-dwellers with the earth and raise awareness amongst schoolchildren in a concrete way.

The consumption of local food in Ile de France was estimated to be 60% in 2011 (with local being defined as within a distance of 250 km around the capital).[18] The proportion of local food consumed by Parisians is expected to grow as a result of initiatives introduced by the City of Paris. It could grow to 70% in 2030, and as high as 80% in 2050.



Gardening house © Mairie de Paris

[16] Facilitated procedures for exemption from urban planning regulations for creating removable balcony/shutter systems for planting, imposed % in the PLU (Local Urban Planning Scheme) dedicated to food production in building programmes...
[17] As a comparison, the City of Montreal has a total of 135 hectares of urban agriculture (collective gardens, community vegetable patches, institutional gardens, corporate vegetable patches...) for an area of 365 km² in 2016.
[18] Billen G. *L'empreinte alimentaire de Paris en 2030*, final report December 2011.

Combating food wastage

On all ends of the supply chain, the fight against food wastage which was initiated in 2013 through the «National Pact Against Food Wastage» will bear its fruit.

To this end, the City of Paris will carry out lobbying to encourage optimisation in institutional food service and commercial restaurants (reduce portion size, offer special prices at the end of service to unload unsold meals, encourage booking, better shelf management etc.)

The City will financially support associations and businesses[19] whose main activity is combating food wastage, especially those identified within the «Actors in a Sustainable Paris» network (raising awareness in targeted groups for a better understanding of expiration dates and conservation techniques, ideas for appealing recipes for using leftovers...)

Climate Houses will also be a way for young people to learn how to cook healthy meals while limiting waste production. Technological innovations will accelerate change in the wealthiest households with «smart» cooking automatically proposing meals using the food present in the cupboards and refrigerator, according to expiration dates.

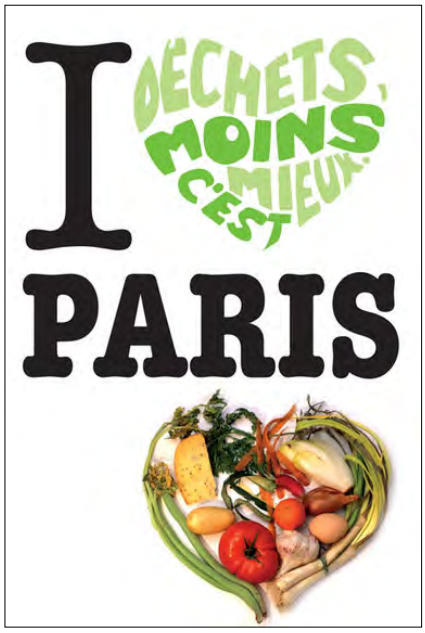
According to available studies, it seems to be conceivable to reduce waste for the entire food supply chain by 30% by 2030[20] (of which 33% of the weight currently comes from the consumption portion)[21] and by -60% by 2050 .[22]

The City of Paris sets the example

In its 2015-2020 Sustainable Food Plan, the City of Paris aims to reduce the consumption of meat products by 20% in its institutional food service. This is primarily achieved by choosing lower-carbon meat (poultry or pork in the place of bovine meat). In time it could also impose one meat-free day per week from Autumn 2018, and could gradually progress to two days per week.

The goal to achieve 50% sustainable food in 2020 could be increased to more than 70% by 2030. But the question of supply remains central to this goal since, in its current organisation it is difficult at times for the City to buy the desired products. Depending on discussions with industry players and the progress of its action plans, the City may or may not consider creating an Agricultural Management Board for direct procurement (see smaller-scale example of Mouans Sartoux). Certain water supply feeding sites in Paris could also be cultivated as part of this measure.

To educate the future generation, it is important to develop annual campaigns in schools to raise awareness about the most sustainable types of diets. Children would have fun while learning about consuming fresh, local and seasonal food. Canteen meals could then illustrate examples of «low-carbon» nutrition. Once a year, each class would be invited to participate in planning a well-balanced menu for the school, with limited environmental impact. Furthermore, visits to «the farm» (in the city or Ile-de-France region, under public management or not) would provide other ways to help make children more aware about the importance of sustainable food.

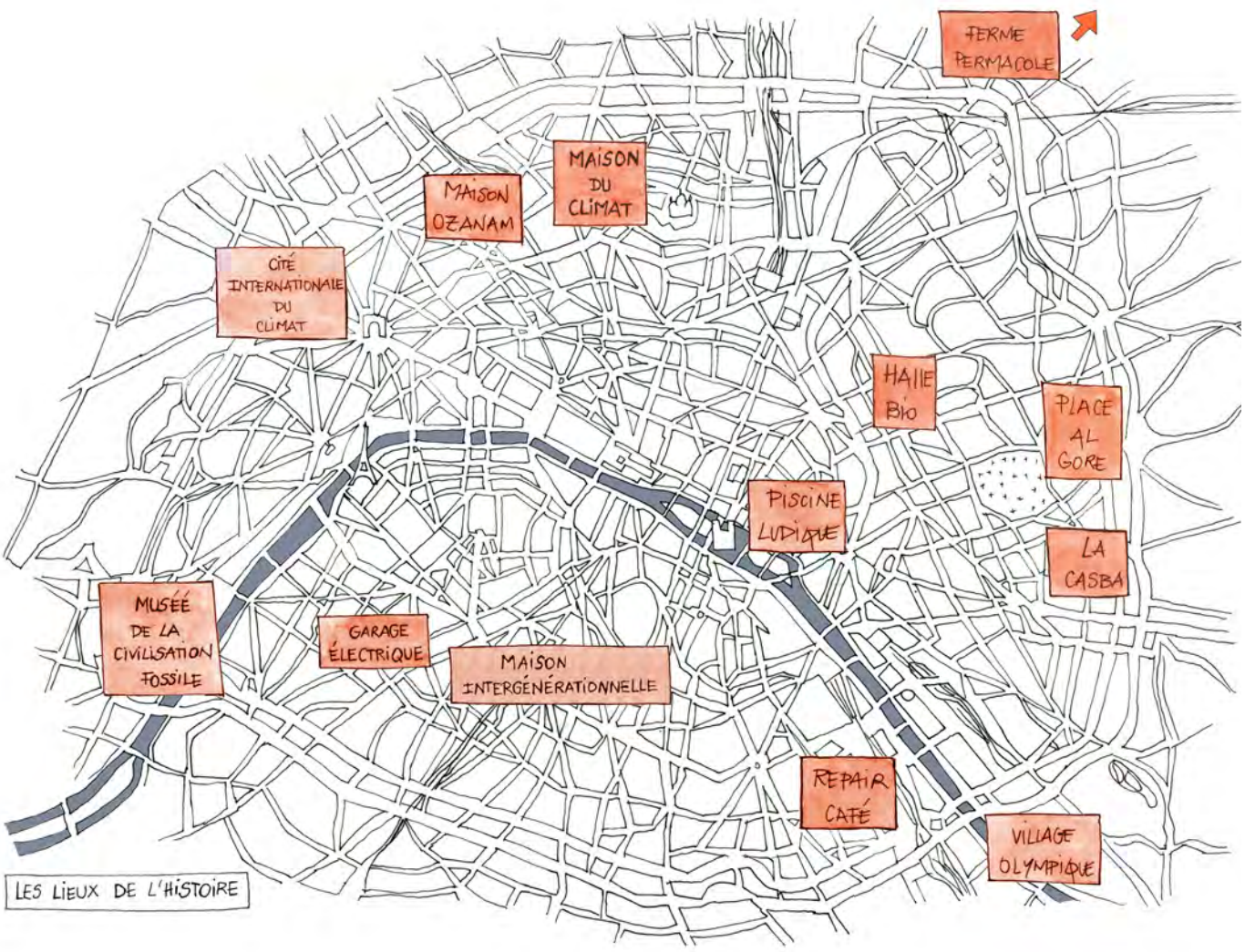


Source : City of Paris

[19] See start-ups supported by Paris & Co such as Wearephenix ®
[20] Compared to 2007 according to the recommendation of ADME (*Alléger l'empreinte environnementale de la consommation des français en 2030 par rapport à 2014*, p.32)
[21] Page 151, ADEME, *Pertes et gaspillages alimentaires : l'état des lieux et leur gestion par étapes de la chaine alimentaire* 2016
[22] Page 25, ADEME, *Contribution de l'ADEME à l'élaboration de visions énergétiques 2030-2050*, 2012




MUSÉE
DES ÉNERGIES
FOSSILES



Places of the saga : Repair café, International Climate campus, Al Gore square, electric garage...

Anne Girault
Director of the Paris Climate Agency

« Defining a vision for the metropolis in 2050 is also an opportunity to build a positive vision with a project that means something to local people in their districts today, while preparing trajectories that apply to our daily lives and which, step by step, can enable the greatest number of us to take ownership of the changes to come. »

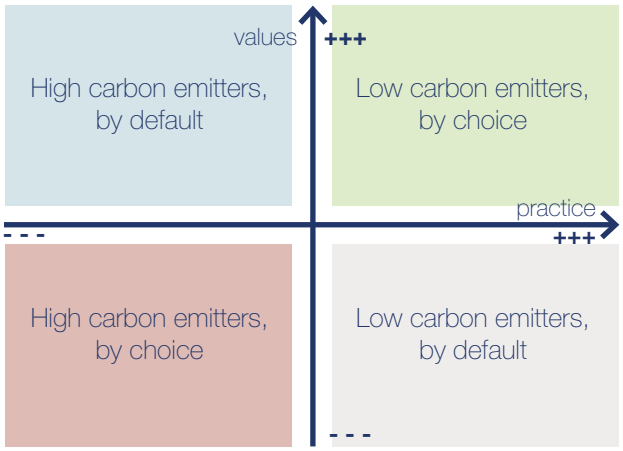
3.2 / THE CARBON NEUTRALITY SAGA

IN A NUTSHELL

The carbon neutrality strategy is of such magnitude that it can (and must) be viewed in terms of a great urban saga, a narrative fresco that takes its references from mythology, rather like a Star Wars epic, or a gripping serial in which the public identifies with the key figures.
Will you be Camille, Eric, Monique or Thierry? Will you tremble along with Stephanie or Olga? Will you champion the cause of Adnan and Theo?

WINNING OVER HEARTS AND MINDS

THE NEW CARBON MAP



Our aim is to show the diversity of activities and values among Parisians.

Those Parisians who have a low-carbon lifestyle, in accordance with their values, are expected to play a leading role in relation to other social groups, in changing the habits of families who are less militant or less aware of the issues involved.

Some families have adopted a low-carbon lifestyle out of necessity, but in fact aspire to potentially higher-emitting lifestyles. For these families, carbon neutrality should provide social solutions, and enhance their skills and know-how.

Other families have chosen lifestyles with considerable carbon impact. Although reality will ultimately become self-evident for climate change sceptics, there are other social, psychological and economic levers that will influence Parisians who have not yet incorporated climate change into their scale of values.

Lastly, there are some families with intensely high-carbon activities, which do not correspond to their values. These families need to align their actions with their convictions. Some of them will have a "Eureka" moment which will encourage them to change, while others will adapt their actions through economic or social measures.

SPREADING THE MOMENTUM

PARIS IS A CELEBRATION!

"To save the planet, you've got to throw a better party than the people destroying it". The watchword of Tristram Stuart, creator of the Feeding the 5000 campaign, applies to the Olympic Games, to car-free days, to the "Nuit Blanche" overnight celebrations ... These moments demonstrate some innovative uses, enabling us to experience carbon neutrality.

CLIMATE CENTRES

Carbon neutrality laboratories are local places where we invent new uses, new trades and new equipment. These interdisciplinary campuses are organised, designed and produced by young people. We must not forget that the average age of the engineers who landed Apollo 11 on the moon was just 26. Give them the tools, give them the means!

CLIMATE AMBASSADORS

Word of mouth, social networks, work canteens, restaurant tables, cafés, all these can be levers for socialisation, for involvement. Climate ambassadors are the leaders of the dialogue between citizens, the mouthpiece for the strategy, but they are also messengers who can pass back observations or objections.



OVERVIEW

THE ESSENTIALS

If our behaviour were always straightforward, logical, rational, this document would not be needed. So how do we translate this strategy into reality? How do we trigger changes in use and investment? How do we adapt professions and economic sectors? How can we mobilise Parisians to make this their story?

We cannot always do what we want, we are not all subjected to the same constraints or the same priorities, we do not all understand identical messages in the same way, our behaviour does not always match our actions and our actions are not always in our best interest..

It is essential to understand how Parisians will receive the strategy. What economic, cultural, psychological and operational levers are required to ensure that the measures put in place to reduce greenhouse gas emissions will be successful? And conversely, what obstacles will slow, restrict or prevent the achievement of these objectives?

This analysis leads us to implement the strategy in innovative ways, to look for levers that may be convoluted, to appeal not only to the imagination, emotions, traditions and tastes, but also to alliances of convenience with various sectors such as health, food, culture, sport, tourism, education, entrepreneurship, the media, etc.

Damien Carême
Mayor of Grande-Synthe, Nord department

Just like the Third Industrial Revolution master plan for the region, a major transition is taking place today in Grande-Synthe. This transition is gradual, taking its cue from the population, and it reveals hopes of a better life, of achieving well-being for everyone and resilience for the territory. A transition which validates and enhances urban renovation and energy transition measures, extending its scope to cover the environment, health, food, mobility, education and culture.

MANAGING CONFLICT

A POLITICAL CHARTER

Rather like Nicolas Hulot's "Ecological Pact", which was signed by virtually all the French presidential candidates in 2007, the aim of a "Neutrality Charter" is to set in stone goals relating to reducing emissions and to introduce multi-party governance, responsible in particular for arbitrating on major issues.

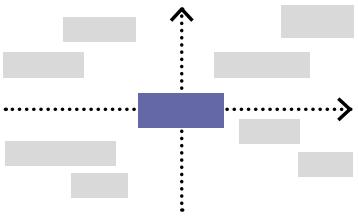
A METROPOLITAN VISION

A «New Era for Paris», the city's carbon neutrality strategy, sets great store by including the City in a wider territory: logistics flows, flows of people, real estate management, network infrastructure, energy strategy... This is a commitment to a metropolitan vision, with pooled resources and common goals.

MUSEUM OF FOSSIL FUEL CIVILISATION

Among all the strong cultural markers, this Museum symbolises the new era: it highlights apparently harmless products and objects, puts them away in the past, celebrates their memory, from the perspective of a philosopher like Barthes scrutinising a DS. It is a way of retaining a link with a past that is so hard to leave behind.





THE PRAGMATISTS



Leïla
aged 28

Julien
aged 32

Dynamics of change

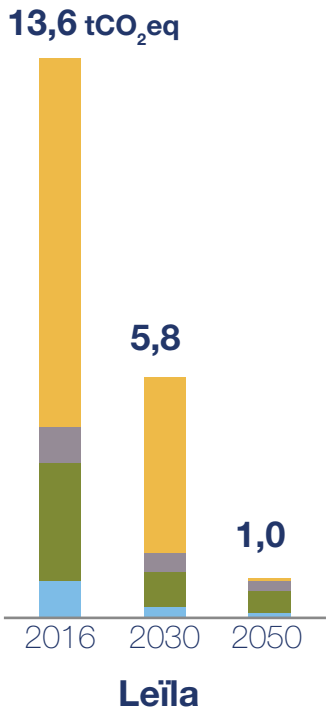
Leila and Julien follow trends, they adapt to changing lifestyles.

In 2016, Leila and Julien work hard, but they play hard too, they are hyperactive.

Leila works in advertising. She met Julien at the opening of a fashionable new bar that they had both spotted on Instagram. He is very much into modern and digital technology. He also manages a team of IT developers in a Big Data start-up. She is an expert multichannel communication in the agency. At just 28, she is the one who pitches to the customers, and they are impressed by her drive. She talks quickly, she sparkles. She loves decorating and new restaurants, she has become known for her cooking tweets and her bar reviews. She has a killer wit, and they are constantly having a dig at each other. Life is intense in Paris, they are always in a hurry, they jump on their scooter, and at the weekend, it's party time! There are plenty of weekends away with friends: Barcelona, Ibiza, Berlin, London…The great thing about these city breaks is that they practically pay for themselves when they rent out their apartment on Airbnb.

THE PRAGMATISTS

Pragmatists can belong to any social class and any age group. They occupy the middle ground, and embody the weak underbelly of the Parisian population. Basically, they do not feel concerned by climate issues, but they are not hostile to them. They consider that it is not up to them to bring about change if the system in which they are living does not participate. Their values are materialistic and hedonistic.



THEIR VALUES

Leila and Julien don't let things worry them. They are always on the go at the office, and they earn enough to be able to enjoy life. They see how the lives of their friends change after children come along, and they appreciate their life as a hedonistic couple. Everything that matters to them can be counted: How much time to get to the office? How much for this restaurant? What reductions on this private sale? The value of things depends on what others have to say about them on social networks. For the news, 20 minutes while having a smoke before going up the office and alerts on their phones from the BFMTV rolling news channel is quite enough.

THEIR ACTIVITIES

Leila and Julien fill their lives with their consumer lifestyle. Special offers, private sales, inaugurations, cocktails, cheap flights: these are what set the pace for them. They are very much in tune with the latest trends and technological innovation, and have decided that their next scooter will probably be electric. The closure of the embankment expressways? They had quite a laugh about it. "The embankments are yours? We'll take the bus!" Otherwise, with their scooter this doesn't affect them much and they loved the Indian summer aperitifs, drawing the summer out into October.

THEIR FEARS AND VULNERABILITIES

Leila comes from a large family and she would like to have children, but she's not really sure if Julien is ready.

At work, the atmosphere is sometimes tense: "obviously, we don't have the same job security as civil servants". "Retirement? Not even in our dreams, that's not for us!" Carpe diem, it's also a way of not having to worry about all the depressing news that we hear.

SOCIOLOGICAL FOCUS

Leila and Julien embody mass consumption in the digital revolution era: they follow the codes of their time. They are addicted to consumption and speed. Their life is syncopated. It consists of sudden accelerations then decelerations that are just as sudden. They are hyper-connected and live at 200 miles an hour in a world of both real and virtual images. Leila and Julien are technophiles.

Leila and Julien recount the narrative of their lives as if they were a **brand** (self-marketing and personal branding) that they are promoting on social networks. Other people are primarily seen in terms of an **audience** that must be captured by this effort of self-narrative. After his infertility diagnosis, Julien became addicted to **monitoring** tools which he uses to monitor and **control** the world. The quantified self (watches and scales, etc., connected up to measure his heart rate, his weight, his sleep, etc.) demonstrates his search for physical performance where aesthetics and a narcissistic relationship to the self are combined.

This technique gives them a feeling of being hyper-present in the world with the gift of ubiquity. Time seems to have no hold over them. It seems that nothing is an obstacle to their desires... Julien's infertility is a brutal reminder of human materiality and the fragility of our bodies. It reminds us of the existence of relationships that set each person in a long time frame which passes through them and extends beyond them.

THEIR LIFE TRAJECTORY

Leila and Julien are doing well in their professional lives. They are well liked because they have good feeling for consumer trends, and they are in sync with the majority of Parisians. They take on more responsibility and when they reach 35 they both head up teams of 10-15 people.

In contrast, married life is very unstable: they try to have children, and seek advice on fertility treatments. In 2028, Julien is shocked to learn that he is infertile. IVF is out of the question for him, he fought against assisted reproduction in 2016 and is unwilling to go back on his principles.

	2016	2050
Age profession	Advertising agent IT project manager (28 and 32 years old)	Idem Team leaders (62 and 66 years old)
Children	No	Non
	Average	High
	Tenant 45m² - 9th district Individual gas heating	Homeowner 60m² - 9th district CPCU – Paris district heating
Short distance travel	Petrol scooters	Petrol scooters
Long distance travel	Train Plane	High speed train + car rental
Food	Meat-eating	Demitarian diet
Consumer goods	Consumerist technophile	Arts & crafts, signed objects

CHANGE IN THEIR ACCOMMODATION

In 2016, they were renting in the Faubourg Montmartre but eventually this became exhausting as it was too noisy and large numbers of petrol-fuelled cars were still on the roads. It's difficult to buy in Paris, even for managers who are well-paid and living in a couple. There's always the issue of finding the deposit to put down on a home.

Eventually they sign up for an apartment that will be ready in 2026. They got a discount because they were buying the last plot. They never really considered the question of heating, but they feel reassured: air conditioning is installed systematically. Summers in Paris are hot and apartment buildings built at the turn of the century are like ovens with their large bay windows. But they feel they are a long way out: the 13th district, looking out over the ring road is not really where they want to be. Thanks to the transformation into an urban boulevard, their apartment will increase in value. It's worth sticking it out and waiting patiently.

In 2039, they finally move into the apartment of their dreams: a 60 m2 garden apartment in the 9th district at the end of a paved courtyard. This Haussmann-style building has undergone a major rehabilitation. As far as the neighbourhood is concerned, they are coming back to their first love. And now they are clear about their criteria: passive house, maximum insulation, solar shades, several openings to facilitate the circulation of air, etc.

CHANGE IN THEIR TRANSPORT

In their everyday lives, Leila and Julien are addicted to their scooters. Their offices are in Boulogne. Taking the Metro is out of the question and certainly not the bus. As for bikes, there's a risk that they will be stolen!

In 2020, they switch to City-Scoot's self-service electric scooters and appreciate on-demand transport services (more flexible than the bus).
Both have a contract that includes two days of teleworking: Leila's telecentre is just 10 minutes away on foot, Julien prefers to work at home.

For travelling, Leila and Julien have a frequent traveller card paid for them (benefit in kind obtained by Leila for herself and her partner, as part of her company's mobility package). High speed train + car rental, they are a well-travelled couple.

They often go away on romantic weekends in Europe. New trendy destinations are opening up, such as Bergamo, Liège, Cologne, etc. It's amazing what you can see in easy reach of Paris thanks to the high-speed train and EuroCities guides! Thanks to festivities in the night trains, rail travel to Vienna or Naples has resumed. Otherwise, they spend the weekend in Paris. Along with the car-free days and

weekends, there is always an unmissable festival or event somewhere! What they like best is the zero-waste white banquet.

Trips to the other side of the world are becoming increasingly rare. Leila has the latest equipment in virtual communication solutions. Now there's no need to dash to the other side of the world for a trade fair or a meeting: she can do almost everything from headquarters.

CHANGE IN THEIR DIET

They discover restaurants that are "good for the climate", offering tasty low-carbon cooking and they try out super cool little restaurants. Leila and Julien love eating outside on the terrace. Since the authorisation for restaurant terraces to occupy the public domain has included an eco-condition, restaurateurs have converted en masse to sustainable food.

When Julien discovers he is infertile, he tries to find out why. He had been exposed to orange clouds of pesticides sprayed close to his parents' house when he was a teenager. Julien then becomes hyper-vigilant, he downloads applications and buys gadgets that show the composition of industrially processed foods. He is shocked to find so many chemicals and becomes a "terroir" nerd; he and Leila become real foodies, aesthetes of the courgette, specialists in marinated artichoke, unbeatable in natural wine. In 2043, they become vegetarians.

CHANGE IN THEIR WASTE MANAGEMENT

In 2016, sorting through packaging is definitely a chore and "the bins are overflowing!" Leila and Julien never shop at the market. They prefer to order on Internet and have things delivered. The electric shuttle drops off their goods at the local logistics centre. Then a delivery person on an electric bike takes over as far as their building. Nowadays, most packaging is returnable. Leila and Julien hand it to the delivery person who brings their next order.

CHANGE IN THEIR LEISURE

"Work hard, play hard!" For Leila and Julien, there's no time to lose. The week could consist of an evening at home watching box sets with dinner on a tray, a cinema, a restaurant to be discovered, an evening having drinks, a concert. At the weekend, they go into Paris or somewhere outside the city. On Sunday evening, they chill in front of the TV. Leila and Julien are "early adopters" of current technology. They have even improved their charger bags for tablets, cameras with stabilisers, Smartphones and consoles. "City breaks" provide a real breath of fresh air. You can feel this energy in the upcoming European cities, it gives them a lift and Julien and Leila are addicted to Vuitton guides.
Their leisure time is linked more and more to gastronomy. Julien and Leila take cookery courses with great chefs. They caught this bug after visiting the farm at the chateau hotel of the Gardener Prince. The thing is, it takes time. At first it was one gastro-weekend every few months with the chance to try out new models of electric car. At home, using the latest juice extractor, they host blind tastings with friends. Their cocktails are renowned.

CHANGE IN THEIR VALUES

Leila and Julien are consumers, Parisian life always has something new to offer and they take full advantage of this. They have gradually become more principled and more restrained. But it's what is available and trends that have changed. Recycled, low carbon ethical products have become very fashionable in their social circle. So they have changed, but without really changing.

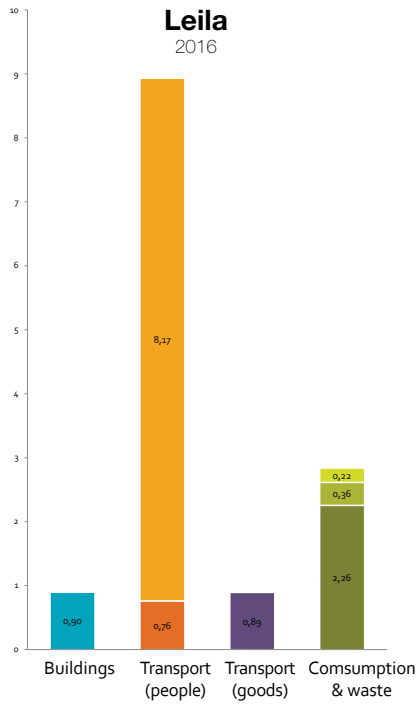
LEILA AND JULIEN ARE AT THE TOP OF THEIR GAME ON 26 JANUARY 2050, RELAXING, AT 2,000 METRES ALTITUDE.

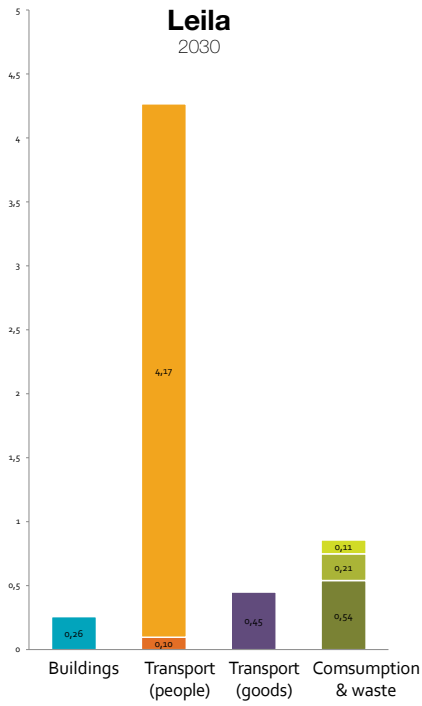
Leila and Julien are at the peak of their careers, at 62 and 66.

They say that they still have 10 active years ahead of them, but in a more relaxed mode. It's easier now they delegate to the teams who work for them (and in any case, many of them are outside Paris). They have become foodies and do the rounds of the good restaurants in France. They telework three days a week, which enables them to make the best use of these trips outside Paris.

On 26 January, they leave Paris to spend five days at the Bras & Fils Spa, at 2,000 m altitude. They are delighted to be able to work with a breath-taking view and enjoyable meals. The immersive videoconferencing room is very comfortable and during this time their own apartment is rented out.

07h30	Leila has scheduled an olfactory wake-up call, to prepare herself for the tastes in store during the day.	**Accommodation:** 80m² apartment, class A+
08h45	Julien has ordered the automatic station shuttle which will take them right to Lyon railway station. Convenient, no parking!	**Everyday transport:** Electric scooter + automatic electric shuttles
09h30	Leila and Julien are comfortably installed in the Orchestra train: these former Corail train cars have been refitted for use in off-peak hours, they have a private sitting room with a screen and work surface. For 6 to 8 hours you have peace and quiet with the landscape passing before your eyes.	**Work:** Self-employed professionals, heavy consumers of digital communication, teams are geographically fragmented.
13h15	Leila and Julien enjoy their bento boxes prepared by Yann Allébio. This service is inspired by Indian wallahs, but with dishes by great chefs.	**Food:** High quality food, vegetarian.
15h30	Arrival in the valley. Julien has booked the luggage robot which takes them to the shuttle chartered by Michel Bras. They appreciate this special moment, with panoramic windows and comfortable seats.	**Governance:** Multimodal travel, alternating public transport, automatic shuttle and private services.
19h30	Return to the chalet after a short healthy walk on the hiking trail. It's a long time since there was snow in January, they love the clear sky and this view over the valleys. The meal will be served in 30 minutes.	**Long distance transport:** The seasonality of travel has changed along with the climate: no more skiing, but hiking trails in the mountains. Virtual visits rather than flights.


Leila
2016
10
9
8
7
6
5
4
3
2
1
0
0,90
8,17
0,76
0,89
0,22
0,36
2,26
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Leila
2030
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
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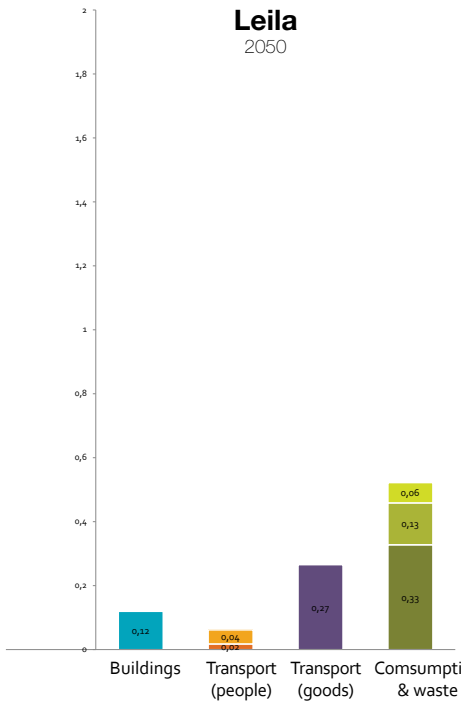
0,11
0,21
0,54
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Leila
2050
2
1,8
1,6
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0,8
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0,4
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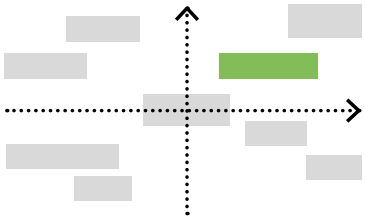
0,12
0,04
0,02
0,27
0,06
0,13
0,33
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The "North-east" quadrant, families whose activities are aligned with their values; they are the leaders of the transition, and are fairly committed (the supporter), or fairly proselytical (the activists).

THE SUPPORTERS



Emilie
Aged 34

Manuel
Aged 39

Emma
Aged 2

Emilie and Manuel are young civil servants, motivated by the general interest.

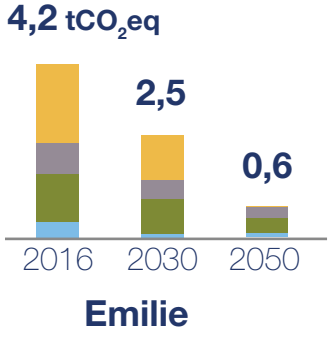
Emilie teaches economics and management at the Jean Zay High School in Aulnay-sous-Bois. Manuel works in the 13th district at the Paris Water Control and Command Centre. They live in official accommodation in Rue Monge, in the 5th district, in a small home provided by the City of Paris. They have a little girl aged two. Emma is the focal point of their lives. Emilie and Manuel took turns in taking six months' parental leave to be with her as she was growing up. Before she was born, they spent days searching out furniture without glue, non-toxic paint, clothes made from organic cotton, etc. The cat Kid & Cat had to pack up and go to make room for the little lady. Emilie and Manuel truly love Paris. They can't imagine living anywhere else. They have a real passion for the Seine and the Paris canals. Manuel hums a well-known song in the shower, *"The Seine is lucky. It has no worries. It just flows along and takes it easy..."* (La Seine a de la chance. Elle ne se fait pas de souci. Elle se la coule douce...) (water courtesy of the Paris water service).

Dynamics of change

The search for coherence between their actions and their values is a powerful driving force for change.

THE SUPPORTER

The supporter can belong to any social class and any age group. They participate in the dissemination of new practices and the construction of new social norms. Their values are based on the person and the body: food, well-being, health, spirituality, etc. They have individual and discrete practices which take the form of individualised collective action (boycott, "buy-cott", etc.). They differ from the activists in their values and commitment.



Emilie

THEIR VALUES

Emilie and Manuel chose their careers out of conviction. Manuel knows that he is working "for a good cause". He monitors levels of pesticide residues and nitrates. He is worried by the explosion in endocrine disruptors and he closely monitors the work of NGOs that are fighting for stricter standards.
Emilie is right in saying that it is through a better knowledge of the economy that tomorrow's citizens will be better able to protect themselves from the negative externalities caused by the most polluting industries. They defend strong public action, which protects citizens' interests.

THEIR ACTIVITIES

Emilie and Manuel are committed consumers who practise boycotting and "buycotting" in a discrete and quiet way, without placing any particular political value on their commitment. They may nevertheless have fossil energy-intensive practices. While they do not deny the urgency of the climate change issue and the need to limit their carbon emissions, the energy question seems not to worry them very much. They are mindful of their well-being, and feel they can take holidays in faraway places.

THEIR FEARS AND VULNERABILITIES

The impact of air pollution is becoming increasingly important in the lives of Emilie and Manuel. They were very distressed when their daughter was diagnosed with acute bronchiolitis, related partly to pollution.

Health and cleanliness have become almost an obsession. Concern for themselves and the need for security have led them to withdraw into themselves and look for a form of communal identity. Family gatherings are not always peaceful, especially when talk turns to cars or agriculture.

SOCIOLOGICAL FOCUS

Emilie and Manuel are active citizens. They embody the sense of public service, and the general interest. They adhere to the aims of public action, and in particular to the goal of carbon neutrality.

Through their professions, Emilie and Manuel are able to look into the question of **water** in urban areas. Reclaiming the river and the embankments reshapes the way the city is used. It encourages the development of a recreational and seaside relationship with the urban space. It examines body language in the public space and its relationship with the **body**.

These personality types are aware of the body and its relationship with the environment. The city is composed of a multitude of climate micro-spheres, all of which are envelopes (clothing / inside our car / inside our home) enabling us to publicise our relationship with the world. The city itself is a climate **sphere** or bubble.[2] These characters encourage us to reflect on the air (and the quality of the air) as an environment and as an envelope.

[2] P. Sloterdijk, Ecumes. Sphères III, Mare, Sell Editeurs, 2005

THE LIFE TRAJECTORY OF EMILIE AND MANUEL

Emilie and Manuel are becoming increasingly aware of more issues, in addition to the questions of health/well-being that preoccupied them initially. First, they change their diet, then their car is scrapped. The trigger is Emma, their daughter.

Aged 9, she publishes a video that has more than 4 million views, in which she challenges adults who pollute and prevent her breathing.

	2016	2050
Age - profession	Teacher (34 years old) Civil servant, City of Paris (39 years old)	Retired 68 years old 73 years old
Children	Emma 2 years old	Emma 36 years old
	Average	Average
	Official accommodation 56m² - 5th district CPCU – Paris district heating	Idem (renovation A++)
Short distance travel	Public transport	Bicycle + electric delivery tricycle
Long distance travel	Train Plane	High speed train + car rental
Food	Demitarian	Vegan

CHANGE IN THEIR ACCOMMODATION

The renovation of the building in Paris was no small matter. The 5th district, considered to be a prime location, did not benefit from any priority programmes and the occupants ended up co-financing a solar power plant in Beauce to speed up the system. Notably, they invested via the Paris Fund for Green Investment and as a result the City agreed to match their investment. The condominium syndicate selected the service provider for the Energy Performance Contract, and finalised the financial package.

Emma found it difficult to find accommodation when she became a student. This difficulty fostered a feeling of downgrading, of impoverishment, which has been a driving force behind her political activism.

CHANGE IN THEIR TRANSPORT

For travelling around Paris, Emilie and Manuel have rediscovered the bus since the birth of Emma and they rail against the stairs in the Metro.

Reluctantly, in 2016 they decide to buy a second-hand town car. They never thought they needed a car, but now, with Emma...

But they do say that this air pollution is a real problem, especially when Emma develops such a serious cough. In **2020**, they finally decide to sell this car thanks to the Paris Car Defeasance Fund: their vehicle will be partially reused after simplifying and changing the engine. At least the old banger won't pollute as much, not here nor elsewhere (they were shocked to find out about the trafficking of diesel cars in Africa).

As civil servants working for the City of Paris, the couple are priority candidates for benefitting from the advantages of the Paris Administration Mobility Plan.

They register on several shared mobility sites, giving them the choice of different options. The apartment building in which they live has acquired some electric vehicles for car-sharing between the residents.

In **2030**, for the first time, they manage to go for an entire year without filling up at the petrol pump. This is an important moment. They are committed to Paris 2030, feeling that collective mobilisation could change things. Emma is very proud of this at her high school, feeling that she is one of the pioneers.

From **2040**, they can no longer afford to fly as the price of fossil fuel has increased so much.

Emilie and Manuel enjoy the music festival in Fez, Morocco. They choose a train + boat package leaving from Sète. This

route is longer, but it's delightful to take these large ferry-boats equipped with an enormous sail and, in addition, in this way they reduce their consumption. When they retire, they will test out some more distant destinations, once again by ferry-sailing boat.

CHANGE IN THEIR DIET

Emilie and Manuel have been considering their eating habits since 2013. It goes without saying that they drink tap water. In 2026, they inherit a little money and decide to invest in the programme to support the conversion of farms in Ile-de France to organic production by means of the Fund for Green Investment. They choose a "farm of the future" located in a catchment area accessible by train + bike. They love shopping at the organic market and they are very keen on the little "Toutenvrac" grocery store which has just opened at the end of the street (with support from the SEMAEST- mixed economy company). Emilie and Manuel eat at their workplace canteens, "there is one meat-free day every week. It's great, it means that we can add credit to our carbon eco-reward card!" Everything is organic and local, since the City and the Ministry for Education adopted the responsible purchasing charter. During the week, they rarely go out in the evening. They eat together after putting Emma to bed. In September 2019, they got to know a nice girl at the Smmmile vegan pop festival organised in La Villette for music-lovers, confirmed vegans and devotees of the slow life…She reassured them about their idea to take the plunge, and Emilie and Manuel have been vegetarians since 2025.

CHANGE IN THEIR WASTE MANAGEMENT

On the way home from school, Emma challenged her parents to a "zero waste" campaign. The compost collective in their building, it's down to her. The creation of the mini glass recycling centre in the ground floor shop, that's also down to her. And then others have joined in too. A local recycling centre was set up in their neighbourhood (thanks to the local Climate Centre where Emma did several work placements during her High School years. She will become "climate ambassador" in their apartment building). At the same time, the City of Paris, which owns the building, has begun a waste audit the apartment building and is closely monitoring waste production in this test condominium. They were given advice and even visited the new sorting centre out on the old ring road. This process will create ripples, and now the co-owners in the surrounding buildings, who are also interested in reducing their household waste tax, will follow suit.

CHANGE IN THEIR LEISURE

As soon as the weather turns fine, Emilie, Manuel and Emma go to the banks of the Seine to lie in the sun after a picnic. Sometimes they get as far as Port des Celestins where an open-air leisure pool was created by the river in 2024. They stay there for hours. Lying on a deck chair, relaxed and happy, with one eye on Emma, and the other on their e-book, they take the time to enjoy life.

Sometimes, for a change, they take the waterbus to André Citroën Park opposite the Fossil Fuel Civilisation Museum (on the right bank). Swimming is now allowed in the Seine, the Bassin de la Villette and the Daumesnil Lake. The embankments are thronged with walkers, joggers and swimmers as soon as the first rays of sun appear. There's a river café atmosphere from May onwards. The banks of the Seine have become a hot spot for knowledge and participative democracy: this is where the idea of the Climate Centres was born, and new means of conflict resolution were devised, to facilitate the adoption of measures to reduce greenhouse gas emissions.

Many Parisians now spend their holidays in Ile-de-France. "Staycations" have become very fashionable because of energy prices and climate and political uncertainties. They can swim, walk and visit attractions. The City of Paris supports green tourism in partnership with the surrounding municipalities. Very early in the morning or late at night you can see barges heavily laden with goods or materials to supply Paris. "We love each other like that, the Seine and I…" (*«On s'aime comme ça la Seine et moi...»*).

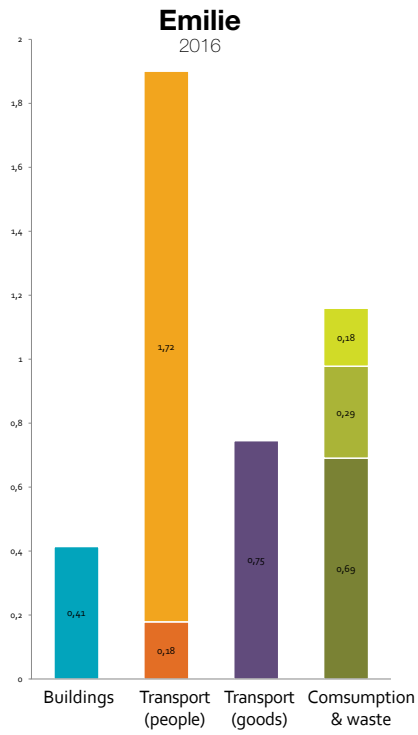
CHANGE IN THEIR VALUES

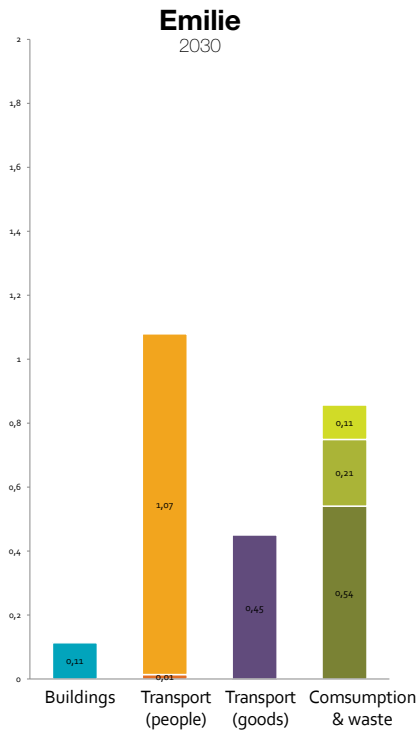
Emilie and Manuel have been well aware for many years of issues related to food and health. This awareness was to become even more acute with their daughter's respiratory problems. The body is a sensor, providing information on the quality of our environment. Emilie and Manuel have an egocentric approach to environmental issues, and a very strong awareness of the protective and regulatory role that public authorities must play. It is their daughter Emma who, through her activism, will enable her parents to include a more collective dimension in this awareness.

EMILIE STROLLS ALONG THE BANKS OF THE SEINE ON 17 FEBRUARY 2050.

Emilie and Manuel have retired after careers in the public sector. They benefit from a free time contract (which has taken over from pensions since 2030), they do not have a lot to live on and they are used to making compromises. They realise that they have little room for manoeuvre. They try to help their daughter as best they can, mainly by looking after Victoire, their granddaughter.

09h00	Emilie and Manuel get up late. Emma and Gabriel have asked them to look after Victoire, their granddaughter, for a few days.	**Accommodation:** 56m² apartment in a building renovated via an Energy Performance Contract.
10h00	Victoire has fallen asleep in the side-car. Emilie and Manuel take the opportunity to attend a citizens' forum in "duplex" communication (as they used to say in the 20 century) with San Francisco, on food and animal rights. Similar initiatives have been organised in around thirty other towns in France. The discussion is followed by an electronic vote.	**Everyday transport:** Electric-assisted bike and public transport.
10h30		**Leisure :** Emilie and Manuel benefit from a free time contract which enables them to work a few hours a week to pass on their knowledge and top up their pensions. They are active participants in the citizens' assemblies, held in the Climate Centres or on the banks of the Seine.
12h30	Emilie and Manuel have lunch at the forum. A vegan banquet has been organised by the group behind the debate.	**Food:** The produce is sourced locally. It has been cooked by a back-to-work association.
15h00	On the way home, Emma and Manuel stop at the Toutenvrac grocery store and the organic produce store at the end of their street to buy a few things.	**Consumption:** Large-scale retail outlets have disappeared. Consumers now shop online (with home delivery), or in the local shops, of which there are many. The AMAP (community-supported farming) model has extended into all areas of production.
20h00	Emilie and Manuel would like to take a trip to Italy next year. They haven't taken a plane for years: too expensive for their modest income! They should have collected enough points on their carbon card to be able pay for this trip by train. They spend the evening looking at offers by different companies.	**Long distance transport:** The increase in the price of fossil energy has led to the reinvention of the cruise train.


Emilie
2016
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
0,41
1,72
0,18
0,75
0,18
0,29
0,69
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Emilie
2030
2
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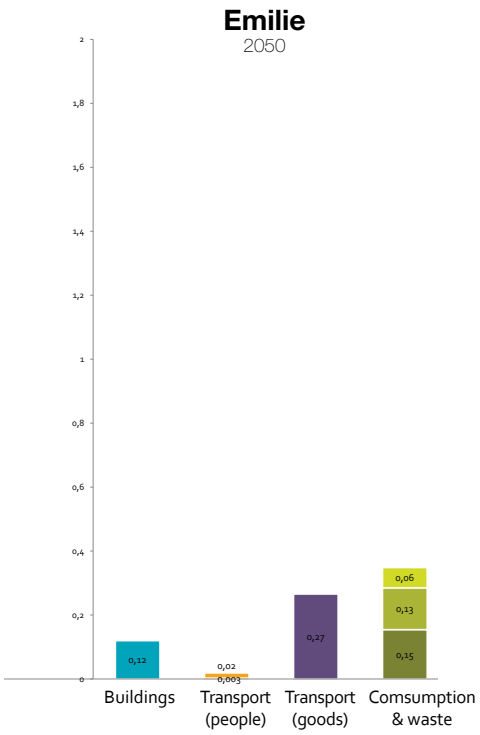
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Emilie
2050
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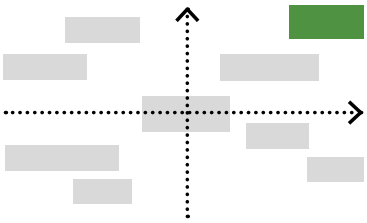
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The "North-east" quadrant, families whose practices are aligned with their values; they are leaders of the transition, and are fairly committed (the supporter), or fairly proselytical (the activists).

THE ACTIVISTS



Camille
Aged 22

Dynamique de changement

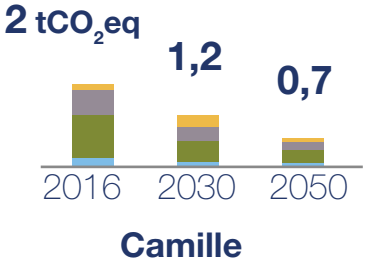
Camille is convinced of the merits of her actions. She is tireless.

Camille knows that she will change the world.

Camille has eyes that shine. Six years ago, in September 2010, feeling very nervous, she left her native Normandy, to study architecture at La Villette.
Today she no longer has the same fears. She is full of energy. She has made friends in Paris and with them she has learned about community commitment and struggles within collectives. She is involved in every battle, for the planet, for migrants, for the development of permaculture, for animal well-being, etc. Her profession is her passion, and she intends to put it to good use in working towards her ideals. She wants to change society. In the future, she promises to design housing that is really understated and super cool, with biosourced materials. She's fed up with all this concrete, all these cars...

THE ACTIVISTS

Activists can belong to any social class and any age group. They are "innovators" or "early adopters". They participate in the dissemination of new practices and the construction of new social norms. They experiment with alternative practices or lifestyles (degrowth, voluntary simplicity, freeganism, etc.) in collectives. They can play the part of opinion leaders to bring in others. For activists, citizen action, expressed in a civic, associative or voluntary framework, is a means of expression, a tool "to do their bit", like the hummingbird.



Camille

HER VALUES

Camille casts a critical eye over this society of ours which is moving faster and faster and is losing sight of mankind and the planet in its craziness.[1] She advocates a return to slowness, a more peaceful pace of life which leaves time for sharing and friendliness.[2] "We're screwing up the planet... it really is too bad!" She wants her life to have some meaning, she wants to take the time to think, to give, to look, to love, to create... She wants to make a commitment on behalf of others. "To do nothing is to be a little guilty! If you do nothing you mustn't come crying afterwards!" she says with great conviction.

HER ACTIVITIES

She has joined various NGOs or collectives that advocate frugality, voluntary decluttering and degrowth. On a daily basis, Camille consciously leads a life that is joyful and frugal. "Happiness is not to be found in consumption and ownership but in the intensity of social relationships",[3] she says in a rather didactic tone. She shares "a rather seedy apartment" in the 12th district not far from Porte de Bagnolet. "The Casbah" (this is what they call the house) is a shared house with a mix of tenants, poorly insulated, where they put the world to rights to the sound of oriental music.

DRIVING FORCE

The driving force is her rebellion and her spirit of responsibility. She is inspired by the legend of the hummingbird, which, although it is so very small, still plays his part in fighting a fire that overwhelms him. She accepts power struggles and civil disobedience as a legitimate means to change the world.

HER FEARS AND VULNERABILITIES

Camille expects the effects of climate change to be catastrophic. She is very much affected by the terrorist attacks in 2015, she was having a drink just next to the Bataclan and saw everything. She feels insecure. At the same time, she is worried about backlash from Muslims and does not agree with the political decisions of some leaders.

[1] Harmut Rosa, Accélération. Une critique sociale du temps, La découverte. Paris, 2010.
[2] Pierre Sansot, Du bon usage de la lenteur, Rivages, Paris, 2000.
[3] Tim Jackson, Prospérité sans croissance. La transition vers une économie durable, De Boeck, Brussels, 2011

SOCIOLOGICAL FOCUS

Through her work, Camille is able to consider the question of architecture and town planning. Concerning architecture and town planning: the focus is on the Paris / suburbs relationship. The ring road provides an opportunity to examine the notion of borders and limits. The city gateways, former urban barriers, are destined to become the squares of Greater Paris.

Unlike the old gateways, which open and close to block the way, the square brings people together and helps construct a group. Camille is trying to get past these borders. In her actions and her work, she questions the territories and scale of the city (travelling to Normandy). Through meeting Adnan, she questions this notion of borders (social-cultural-religious). Camille's interest in biosourced materials suggests once again this notion of border. Industrial technical materials and equipment focus media attention on our relationship with the world and try to deny the external climate. She is looking to a meteorological architecture (Philippe Rahm) which respects the cycle of the seasons.

The legend of the humming bird, Pierre Rabhi

One day, according to the legend, there was a huge forest fire. All the animals were terrified, appalled, and watched the disaster helplessly. All alone, the little hummingbird was busy, fetching a few drops of water with his beak to throw them on the flames. After a while, the armadillo, annoyed by this ridiculous and useless agitation, said to him, "Hummingbird! Are you mad? It's not with those drops of water that you are going to put out the fire!"
And the hummingbird replied, "I know, but I'm doing my bit."

http://www.colibris-lemouvement.org/colibris/la-legende-du-colibri

CAMILLE'S LIFE TRAJECTORY

Camille's life reflects her values: struggles to support new architecture, a desire to shake up the system and open doors, open borders. In this way, architecture can be put to use for those who need it most, especially refugees. This is how Camille fell in love with Adnan, a Syrian refugee, whom she met through her research into temporary housing. They are involved in a parents' collective which is renovating their daughter's school. Camille and Adnan are activists, they take up challenges, one after another: local activism to provide more space for bikes, renovation of their shared property by a community-led association, renovation of Camille's parents' house in Carentan, involving various associations ... Adnan and Camille met Nadia (ostrich family) and with her they founded the association which prefigures the International Climate City. They decided to act together to have more impact.

	2016	2050
Age occupation	Student (22 years old)	Architect (56 years old)
Children	No	Souria 30 years old
	Low	Average
	Joint tenant Large shared apartment 16m² - 12th district Dual residence	Tenant InterGenerational house 12th district Dual residence
Short distance travel	Bike + Public transport	Electric-assisted bike + public transport
Long distance travel	Car-sharing Train	Car-sharing Train
Diet	Demitarian	Vegetarian
Consumption goods	Decluttering enthusiast	Decluttering enthusiast

CHANGE IN HER HOUSING

She persuades her School of Architecture to accept a study report based on an experiment in building nomad micro-shelters using materials recovered from a large site carrying out thermal rehabilitation of Parisian housing. As a result, she gets her first job with "Encore Heureux". At the agency, she is able to apply her vision to a major project: designing the Olympic Village for Paris 2024 which will cover part of the river banks and the Parisian road network.

She is active in the "Porte de Bagnolet without cars" collective. What if the former gateways (portes) became the new squares in Greater Paris? What if we do away with the Parisian city walls definitively by eliminating the ring road? The dream she had as a student comes true in 2026 when the ring road is reclassified as an urban boulevard.

In 2038, the reconversion of the ring road takes on a different scale. It is a prize-winner in the Al Gore ZAC (Zone for Concerted Development) programme, over one of the old motorway interchanges, and includes housing, third places for teleworking and co-working and a large recycling centre for the area.

Throughout her career, Camille has favoured biosourced products, wood, unbaked clay, straw, enabling her to transform her housing into a veritable carbon sink. It took all her passion (and countless evenings) to convince the co-owners in her building to add an extra storey to finance part of the energy work in the building. This experiment was successful, and she has repeated it in many apartment buildings. Thanks to all these orders, she is able to restore her family home in the Cotentin in 2030.

In 2038, she is the architect for the InterGenerational House project backed by a philanthropist in the 7th district of Paris, Nadia. She likes the project so much that she decides to move in there with Adnan. In 2041, she speaks at a conference at the Sorbonne on "Humanities and Climate" and announces that a place is needed that will reflect the influence of the City of Paris, commensurate with the challenge of these sweltering years: the International Climate City. The first stone is laid in 2045.

CHANGE IN HER TRANSPORT

In her everyday life: Camille has never had a car, she doesn't even have a driving license, so we see how interested she is in cars! She goes everywhere by bicycle. She has an old bike that she has dragged around for years. At least no one has been tempted to steal it! Also, with the introduction of successive Active Mobility in the City plans, it's still easier and more pleasant to travel this way. She adopts the SOHO (Smart Office Home office) concept which enables her to work at home while still maintaining a certain barrier between work and family life. In the framework of the

Parisian Plan for Teleworking and Telepresence, the City of Paris persuaded her employer to let her work from home for 3 days a week. Camille carries out her few professional trips in an ecological way: car-pooling, car-sharing, inter-modality, etc. A new application allows her to compare all combinations at a glance. It's really very practical. With the new single card for the City of Paris it's even easier: no need to sign up for each system separately and you pay for each journey you make.

For getting out of Paris, at least once a month she goes to her family house in Carentan. She takes the Paris-Cherbourg slow train from Saint-Lazare station. Passenger trains have been completely redesigned. They are more comfortable and more spacious and they are now equipped to be able to carry fresh produce. Apart from her trips to Normandy, Camille does not travel much outside Greater Paris.

CHANGE IN HER DIET

Camille has been a vegetarian since 2020. First she was a demitarian then took meat out of her diet completely. She realised what the true carbon footprint of her diet was: she had her suspicions, but not to that extent! Now she only eats locally sourced seasonal produce. She is a member of a community-supported farming scheme, grows vegetables with her friends in the garden they share close to where she lives, and she belongs to a grocery cooperative. She admits that two or three times a year she allows herself to deviate: kibbeh prepared by her bloke. They are delicious, she really enjoys them... and the meat is supplied by their friend Max, a producer located one hour outside Paris. She invests her meagre savings in the Paris Fund for Green Investment to promote the conversion of agriculture in Ile-de-France to organic production.

CHANGE IN HER WASTE MANAGEMENT

She throws away virtually nothing. She remembers the lessons from her grandmother who taught her how to use up leftovers, and her years of freeganism when she collected food from the markets as they were packing up. "Before my daughter was born, I used to grab whatever I could find to eat, it was Baghdad in my stomach!" she says with a broad smile. Since then she is careful what she eats. She learned to cook at the Climate Centre in her neighbourhood and has passed on her knowledge to her friends and to members of the neighbourhood association with whom she eats several times a week.

CHANGE IN HER LEISURE

Camille and Adnan are creators, they are daring. Building on their success with the temporary Olympic Village, in 2025, with the former ActLab team, they create the Engineering Company, whose logo includes the wings of the Génie de la Bastille statue. If the military can have their wings, why not Paris?

They dream of a travelling city, which is rolled out like a camp to change the look of the city, and to invite Parisians to experience another world.
The Engineering Company draws considerable attention when they organise the memorable Banquet for the 100,000, where 100,000 Parisians are fed with food that would otherwise have been thrown away.

The Engineering Company wins the contract to coordinate popular initiatives for events in Paris during car-free weekends. Some members of the association devise repair and creative transformation workshops, portable amphitheatres, collection points for used oil and fuel cells, others set up sewing workshops, food trucks, etc.

CHANGE IN HER VALUES

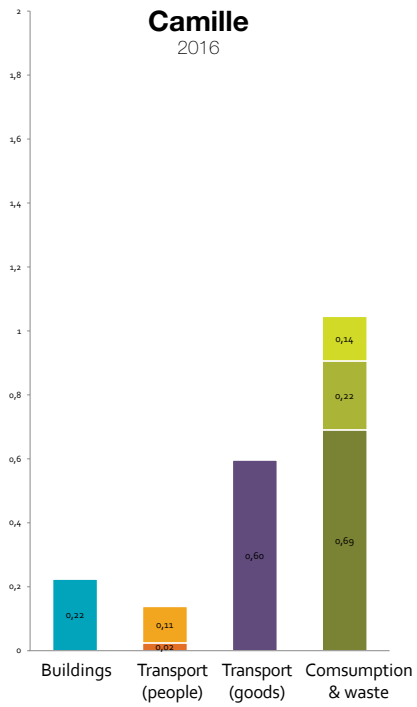
Camille's lifestyle may have seemed marginal and alternative in 2016, as the values she holds are so much at odds with the consumerist and production-driven model inherited from the past, but these values will gradually filter through into the rest of society. The City of Paris plays a key role in the dissemination of these practices and these alternative values by promoting the creation of special places. These everyday hackers who want to re-enchant the city are regarded by the Parisian community as creative innovators who must be given the means to experiment with new lifestyles. These alternative places are in fact laboratories where these innovators tinker with the everyday to produce something social. The weak signals from the 2000s have in fact given birth to much wider social movements which have contributed to changing social norms and the emergence of an ecologically responsible society.[4] Camille participates in creating different places (repair cafés, International Climate City, etc.), all of which will be spaces for encounters and for disseminating new practices. **Camille is an opinion leader, and through her actions she contributes to directing the lives of others.**

[4] *Modes de vie et empreinte carbone. Prospective des modes de vie en France à l'horizon 2050 et empreinte carbone,* CLIP n°21, December 2012.

CAMILLE IS RADIANT ON THIS DAY OF THE JUNE SOLSTICE 2050, SHE MAKES THINGS HAPPEN IN A BIG WAY.

Camille is 56 and her energy is boundless. She has developed a very strong friendship with Nadia and they have decided to move in to an InterGenerational House. This type of housing, a distant development of the Montreuil "Babayagas", reflects their values and enables them to live peacefully. Camille and Adnan organise the varied programme of conferences (life-lab sessions) in the tool library of the InterGenerational House. Camille is once again a keen militant activist: there is still so much to do and to understand, so many people to work with to find solutions given the increasing scarcity of materials. The International Climate City is a success and is renewing the image of Paris.

06h00	Camille gets up to celebrate the solstice with Adnan. They have invited a group of musicians for an early morning concert in the entrance hall of the InterGenerational House.	**Accommodation:** 1930s renovated investment property: biosourced insulation, low-tech fluid management system, no thermoblock.
08h00	Camille has promised to meet her daughter for a chicory in Al Gore Square, at the heart of the ZAC of the same name. She goes by bike. She has taken out an "active life" insurance policy and she feels on top form.	**Everyday transport:** Bike, without electrical assistance.
09h30	Camille has a lot to do: she runs the InterGenerational House. She has to manage the medical teams, check the programme of events, organise food supplies, ensure that the project has a high media and digital profile...	**Work:** Hybrid job, extension of the self-employed system, which she supplements by donating activity of general interest (50% insurance, 50% Paris municipality)
12h20	Camille sits down to eat. She meets up with Nadia, Adnan and the seven musicians from this morning in a restaurant with a "Good for the Climate" quality label. The meal is rich in local plant protein. It's more practical for the restaurant owner now that "low carbon" delivery is so easy to find! River then electric shuttle. No loss of load and no handling thanks to the Distri-Seine distribution system.	**Food:** Vegetarian diet, producers under contract.
15h00	Replacing the kitchen furniture: Camille has published her specifications in a reverse auction and offers various payment models. Her specifications stipulate priority given to re-employment and local labour.	**Consumption:** A very simple lifestyle in terms of materials but very rich in social interactions. Exchanges centralised in a "time bank".
19h30	Train to Carentan to continue the solstice a little longer. Adnan has a surprise for her when they arrive: a Yoga session at dusk with the founders of the InterGenerational House foundation.	**Long distance transport:** Inter-regional night trains (it's cooler at night)


Camille
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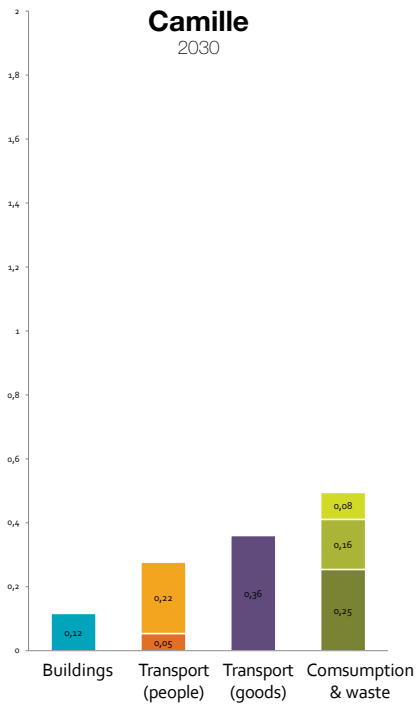
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Camille
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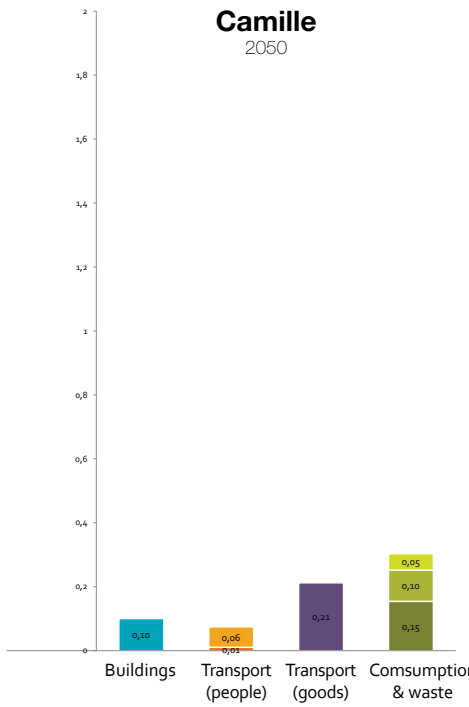
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Camille
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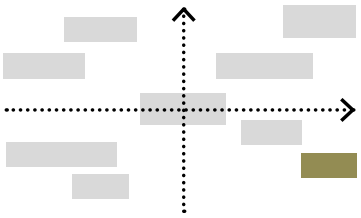
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The "South-east" quadrant, families who emit little carbon, by default rather than by conviction, or families who may even aspire to more carbon use but do not have the means (the modest).
These families may also adopt a strategy that values and acknowledges their skills, their know-how (the refugees).

THE REFUGEES



Adnan
Aged 23

Dynamics of change

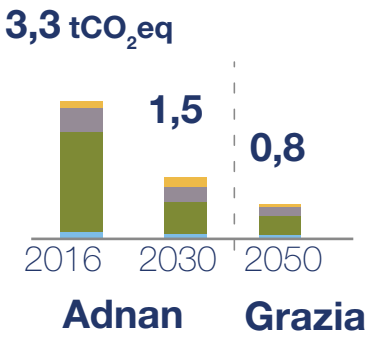
Adnan in 2016, then Grazia in 2050, have in common their urgent need to be active, they are looking for a way to fit in here in Paris.

Adnan fled Aleppo and arrived in Paris.

He crossed the border into Turkey, aiming to reach the seaside resort of Bodrum and then the Greek island of Kos. Exhausted and gaunt, Adnan first set foot on European soil on a beach bathed in sunshine amongst western tourists who were astonished by the presence of these shadowy figures that had escaped the war. One beautiful September morning, he arrived in Paris by train. For a few weeks, he lived with some fellow countrymen in a tent near Stalingrad station before finding lodgings in a humanitarian centre, then in a centre for asylum seekers. It was there that he was to meet Camille with whom he now shares his life and his dreams of a better world.

THE REFUGEES

Refugees are young men for the most part, sometimes highly qualified. Their intention is to change "family" in the course of their trajectory. Their activities are simple and virtuous by necessity (financial constraints) but they have aspirations to consume. Consumption and owning a property are still the markers of distinction and upward mobility. A change in the constraints that affect refugees may cause a rebound effect. They can be distinguished from the modest by their migratory route and their origins.



HIS VALUES

Adnan is distinctive by his duality. First, he fled the desertified countryside where he lived, then Aleppo as it was being bombed. He was torn between his emotion at realising he was in Europe, and safe, and that of knowing that his country was destroyed. He felt that he was both strong and weak: strong because he had faced the worst hardships, weak in front of a hostile world where he is seeking his place. This journey made him realise his capacity for resilience and above all revealed to him the value of solidarity and generosity.

Adnan does not reject the consumer society. On the contrary, he is fascinated by the abundance of goods on the supermarket shelves, by the wealth in the windows of the luxury stores, by the elegance of the customers. Adnan had seen abundance in the Aleppo souks but here everything is so different. He would like to buy everything, to possess everything. He loves to stroll through the shops in the rich neighbourhoods, but he leaves with his mind full of these objects that he will never possess. Game over. He has to face the rain, get back to the reception centre, and dream of another life.

HIS ACTIVITIES

Adnan is fleeing a world disrupted by war. He is fleeing a city devastated by bombs. He is taking the road to exile in order to build his future elsewhere. His life as a refugee consists of long meanderings punctuated by transit camps, reception centres, makeshift huts... at the outskirts of the city. He is living off the last of his savings and the generosity of associations that support migrants and distribute food and clothing. He has nothing left at all when he arrives in Paris.

Adnan attended the French Lycée in Aleppo before studying at the School of Agronomy in Damascus. His good knowledge of French, English and Arabic enabled him to find a small job as a translator for the City when he arrived in Paris.

HIS FEARS AND HIS VULNERABILIITIES

For a long time, Adnan has lived in fear of expulsion. Sometimes he wakes up covered in sweat, after a bad dream that haunts him: he imagines doing the journey in reverse, step by step, all the way back to Aleppo. It will take years to dispel his fears and the trauma of the war. For Adnan, life is a long march and a struggle for freedom. But sometimes his eyes cloud over, nostalgia takes hold, he thinks once again of his family who are still there in Aleppo, Hama or Damascus.

SOCIOLOGICAL FOCUS

Through his own situation, Adnan questions the **notion** of migration and the idea of nation. Adnan represents the figure of the foreigner in exile searching for a form of Eldorado. He adheres to the **national narrative**, product of the French Revolution. Paris is a paradise. But there is a discrepancy between the national narrative or **Parisian storytelling** and the brutal reality of everyday life.

Adnan's story is a tale that exposes this encounter between the imaginary and the real. The tourist is the reverse of the refugee in that he clings to the manufactured image of the tourist city.

The camp made up of tents and huts is a reminder of the ephemeral. It refers to the transitional situation of the migrant who inhabits non-places and the margins of the city. It is a reminder of the "zone" that grew up outside the old fortifications. It questions relations between the sedentary and the nomad populations. It contrasts the low-tech makeshift housing with the high-tech in the smart city.

Adnan is also the embodiment of **hope** and the **changing view**: after the journey he has completed, Adnan wants to make himself useful, he wants to show that refugees are not only a burden for the countries that take them in, but that they bring in new blood, ideas and skills.

ADNAN'S LIFE TRAJECTORY

Adnan meets Camille through a migrant support association where he works as a translator. This meeting turns his life upside down. Camille puts him up for a while in her shared accommodation before sharing her life with him. In 2024, Camille gives birth to a little girl, Souria. Adnan takes up Camille's struggles. Together, they manage the project to create an International Climate City, a contemporary version of the International University City. In this way, Adnan gradually joins the family of activists.

Other refugees take his place. In 2050, the worsening effects of climate change affect populations much closer to Paris: the South of France, Italy, Spain, Greece, Croatia... and the refugee who arrives in 2050 (Grazia) comes from Puglia in Italy. The phase when the first refugees were rejected is now dying down, as the flood of new arrivals forces Parisians to see the reality of climate-induced migrations.

	Adnan 2016	**Grazia 2050**
Age profession	Syrian refugee (22 years old)	Italian refugee (19 years old)
Children	No	No
	Very low (donations)	Low (reception contract)
	Tent / Hostel 15m² - 18th district	9m², International Climate City
Short distance travel	Walking	Walking, shared electric bicycle
Long distance travel	Hitch-hiking Car-sharing	Solidarity trains (daytime)
Food	Omnivorous	Omnivorous

CHANGE IN HIS ACCOMMODATION

Adnan lived for a few days in a migrant reception centre in the 18th district, on former wasteland belonging to the SNCF. Next he was sent to an asylum-seekers' centre where he stayed while his application was considered. He spent almost two years in a small, empty and charmless room, waiting for the decision of the commission dealing with his application. A month after he obtained the status of asylum seeker, the people living in the Casbah opened their doors to him. After this, Adnan's accommodation trajectory is the same as Camille's.

The Casbah is a late 19th century building where about forty tenants live together as a community. They share a laundry room, a playroom for the children and a large kitchen. The inhabitants of the Casbah co-opt newcomers and take in migrants on a regular basis, keeping a few rooms free for them in exchange for helping out with the maintenance of the building or the garden.

Adnan is helping with the renovation work on his in-laws' house in the Manche department where he and his little family take up residence in the summer months.

Adnan believes that one solution for welcoming refugees is "woofing": "people lend a hand in the garden or with house renovations in exchange for a bed and a meal".

CHANGE IN HIS TRANSPORT

When he lived in Aleppo, Adnan did not have a car or a driving licence. Like most Aleppians, he got around the congested city streets by bus or yellow taxi. He was a pedestrian in Aleppo, and he is a pedestrian in Paris too. For him, walking is still a way of life and is still the cheapest by far! In the Metro tunnels he feels claustrophobic. And also, with the new developments in the City of Paris and fewer cars, the streets are really much quieter and more pleasant than before. He also appreciates the feeling of freedom he has when cycling. Eventually he fixed up an old bike in the repair workshop run by some friends of Camille. This is much more convenient when he needs to get to work or come back with shopping from his favourite Syrian shop near the Porte de la Chapelle.

Now that they have Souria, he has added a children's bike trailer. Adnan has moved closer to Theo's way of thinking with local electric garages: he supports the idea that mobility should be lightweight, easy to repair, modular, adaptable and low-tech.

In 2040, Adnan feels that Camille is tired after completing the ZAC and he suggests they go to Iran for six months for her to discover the earthen architecture and the wind towers used for air-conditioning in traditional houses.

The train allows them to meet people and see the landscape. Travelling has gradually regained its virtues of initiation and intercultural discovery.

CHANGE IN HIS DIET

Camille has never really converted Adnan to the joys of vegetarian culture. Adnan is still very much attached to the flavours of his childhood. Kibbeh, tzatziki, shawarma, hummus, fattoush, etc. along with a glass of leben or cardamom coffee. Meals are primarily a time of conviviality shared with residents of the Casbah or the InterGenerational House who happen to be there on that day in the communal kitchen. They always set aside a plate for people in need.

CHANGE IN HIS WASTE MANAGEMENT

Adnan throws practically nothing away. During the war years, during his exile, he learned the importance and the value of the most trivial objects. He hoards things obsessively. Camille, who is more into decluttering, finds this habit of his extremely annoying.

CHANGE IN HIS LEISURE

As a former student of agronomy, Adnan is passionate about gardening. He has put a lot of work into the communal garden at the Casbah where he has introduced some vegetables and herbs that were new to the residents. He has put in some beehives, which he tends lovingly. For him, the garden is a place of revitalisation and meditation. He spends hours watching the plants and insects. He has put a low table and a sofa in the corner of the garden, turning it into a living room where he gets together with friends around a glass of tea. In winter, everyone takes refuge in the toolshed. The residents of the InterGenerational House quickly adopted Adnan's garden, where good humour is cultivated just as much as vegetables.

CHANGE IN HIS VALUES

Adnan has never really experienced the consumer society that he dreamed of when he first arrived in Paris. His life, like that of Camille, has remained simple and modest. First, it was out of necessity and inevitability that he adopted this moderate lifestyle. He would willingly have enjoyed this wealth to the full if it had been possible. He would have revelled in this excess of goods to satisfy his thirst, his hunger, his desire and his dreams that had been repressed for so long.

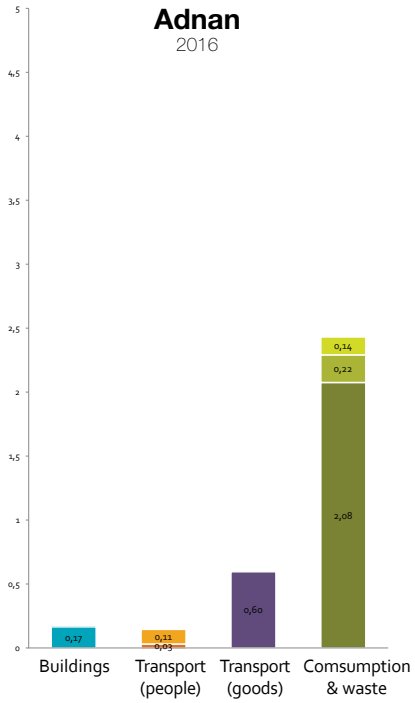
Meeting Camille, becoming part of a community, and his commitment to serving others have gradually turned him away from his dreams of consumerism. He has learned to give meaning to frugality which he saw as a constraint initially, and so the image of an Eldorado of plenty has gradually faded. Today, his Eldorado consists of his gardens which he cultivates with patience and passion.

Along with his commitment to the Engineering Company, Adnan also wants to build solutions, to find answers to coping with the unpredictable and irregular influx of refugees. He is mobilising his networks so that Paris will launch an international competition, which will draw in student geeks from the four corners of the globe.

GRAZIA LEFT PUGLIA IN A HURRY ON 25 JULY 2050, THE DROUGHT HAS BURNED EVERYTHING.

The phase when the first refugees were rejected is now dying down, as the flood of new arrivals forces Parisians to see the reality of climate-induced migrations. The migration culture is now an integral part of social, cultural and political life. Paris is one of the transport hubs for climate refugees, and also a source of manpower for the city. Just like the town of Grande Synthe in the Nord department, Paris is developing a hospitality economy, adapting its tourist facilities and its employment sectors.

04h30	As she does every morning, Grazia awakes at 4:30. Her body seems to be programmed to get the most out of the freshness of the dawn. But Paris isn't Bari. The heat is less stifling.	**Accommodation:** 9m² room in the **International Climate City.** The centre was built 10 years ago. Walls are more than 80cm thick with narrow windows to keep the inside of the building cool.
05h00	Grazia takes the RER then a self-service bike to get to Gonesse (47 min). She crosses a city that is preparing to open its shops and public services (now, in summer, this is based on the sun to avoid the hottest times of day).	**Everyday transport:** Walking + shared electric-assisted bike.
11h00	Grazia begins her midday break. She has found seasonal work in the **permaculture farm** at Gonesse, one of the first to open and recreate the ring of market gardens.	**Employment:** Seasonal market garden work in permaculture.
12h00	Grazia prepares a salad with the tomatoes she has just picked, the taste reminds her of her childhood, before the droughts killed the tomato crops in Puglia.	**Food:** Vegetarian and local diet, the cheapest there is.
15h30	In summer, it is too hot to work outside in the afternoons. Grazia transforms part of the previous day's unsold produce so that nothing is wasted: coulis, preserves... She can keep everything she produces in the afternoons.	**Governance:** Fragmented working hours, some trade is non-market (especially unsold or surplus produce).
19h30	Grazia is tired from her day. She has a six-month reception contract, but she can feel that time is passing quickly and she will soon have to give up her room.	**Long distance transport:** Grazia lives frugally, she cannot burden herself with things and she does not have much free time: her entire future is based on her own initiative, the people she meets.


Adnan
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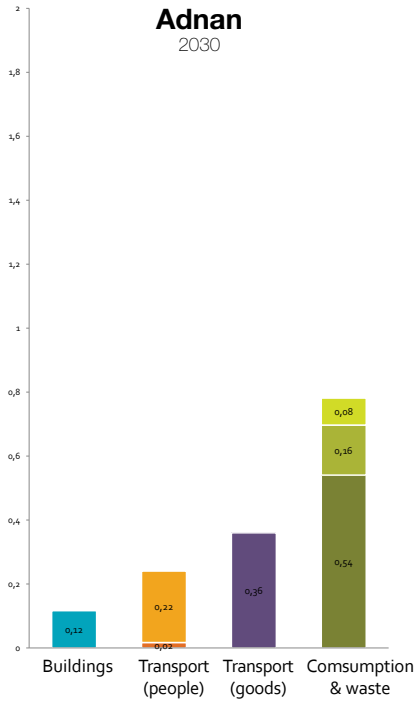
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Adnan
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Buildings
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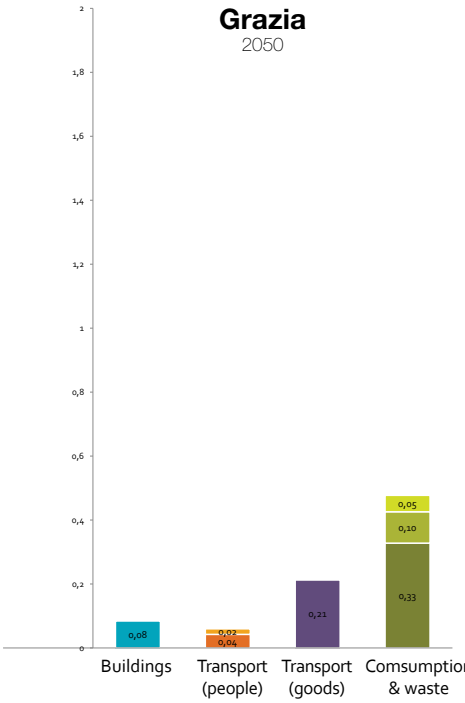
Comsumption & waste


Grazia
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Buildings
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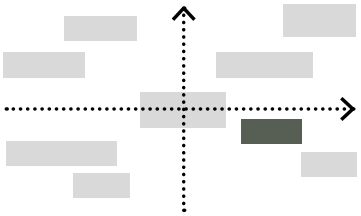
Transport (goods)
Comsumption & waste



The "South-east" quadrant, families who emit little carbon, by default rather than by conviction, or families who may even aspire to more carbon use but do not have the means (the modest).
These families may also adopt a strategy that values and acknowledges their skills, their know-how (the refugees).

THE MODESTS



Thierry
Aged 50

Dynamics of change

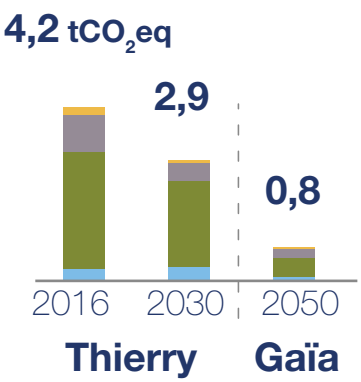
The social and solidarity economy, supported by public action, allows Thierry and then Gaïa to apply their know-how and their resourcefulness.

Thierry's morale is very low.

Two years ago, he was fired from his job. He was a mechanic in a small garage in Aubervilliers where he fixed up old cars. Thierry finds unemployment difficult to bear. His trade is his passion. He loves valves, pistons, double-body carburettors, grease and the smell of petrol...Tinkering, taking out an engine, threading a cylinder head, reboring a valve guide...that's his entire life. He does a little undeclared work, but he is not very comfortable with these new cars stuffed with electronics. He feels a bit out of his depth!

THE MODEST

The modest can belong to any age group. They experience the feeling of downgrading which affects the working and middle classes who have not been able to purchase their own property. Life is seen as becoming harder and harder (children's schooling, transport, job insecurity). They all have a feeling of failure and powerlessness and do not recognise themselves in any political discourse. The activities of the modest are simple and virtuous, out of necessity, but they aspire to be consumers. Consumption and property are still the markers of distinction and upward mobility. A change in the constraints that affect them may cause a rebound effect.



HIS VALUES

Thierry leads a simple and virtuous life out of necessity. His meagre financial resources force him to count his money and monitor his budget on a day-to-day basis. He doesn't complain about his situation, "We were never really rolling in money at home". His parents were on low incomes. He himself has experienced job insecurity and done odd jobs: "You just have to make do", he says, philosophically. Thierry has learned to "be careful".
Yet Thierry dreams only of holidays in the sun, beautiful cars, a home cinema, etc. he bets on the horses and plays scratch cards in the hope that one day he will hit the jackpot. Ah, if that happens...No more going without! He'll go to Vegas and drive a 1967 Ford Mustang.
Thierry is on the fringes of the consumer society, but he aspires to only one thing, he wants to consume like everyone else. For him, consuming is a factor of social distinction. By consuming, he can affirm a certain degree of social success. Thierry is not one for bling, he doesn't want to show off, he doesn't like flashy things, but still, a nice radiator grille, that could be really good...

HIS ACTIVITIES

To cope with the situation, he has put in place a strategy to really do away with waste. He does not systematically flush the toilet, he prefers to wash at the sink, he hardly ever heats his apartment but takes advantage of the generosity of his neighbours. He shops in the hard discount stores, takes advantage of the sales, reductions, special offers, unsold products...He hunts out second-hand bargains online...He repairs small household electrical goods to give them a new lease of life. He works on the black market occasionally...

HIS FEARS AND VULNERABILITIES

He paces endlessly in his small apartment in the 15th district. The days are long and, "things are starting to get hard financially!" He feels alone and is worried about his future. He wonders how he will be able to hang on, find another job and for the moment he doesn't see a future for himself. He tries not to think about the future too much, but he snacks to pass the time and he feels that he has put on weight since he lost his job.

SOCIOLOGICAL FOCUS

Through his profession, Thierry considers a world that is gradually coming to an end: the world of cars and the petrol engine. This world of the automobile relates to a technology that could be appropriated and over which the ordinary person could still have control. Thierry is losing control over a technology that has become a black box.

This technology foreshadows the advent of electronics and digital in the world of mechanics. It is a sign of the arrival of new players (GAFA) and the emergence of a new ecosystem. But it also marks the development of the era of **automation** and **robotisation**.[5]

Losing control also means losing knowledge and know-how that can no longer be shared and passed on. Losing control means no longer being able to **contribute** to the knowledge society and the pollination of minds. Thierry is losing control of his own life. Thierry is a victim of "creative destruction" in the sense of J. Schumpeter. To escape this state of social exclusion, he practises the art of getting by in the informal networks of the **underground economy.** It is in a second phase, after 2025, that Thierry's **low-tech** know-how and simple social skills will once again be "on trend", enabling him to start up again.

[1] B. Stiegler, La société automatique. L'âge du travail, Paris : Fayard, 2015

THIERRY'S LIFE TRAJECTORY

Thierry was made redundant in 2014, and lived on unemployment benefits, social benefits and odd jobs for several years. He attended numerous training and professional insertion courses although without much conviction.
In 2016, when his benefit entitlement came to an end, he set up as a free-lance worker and was available to carry out small maintenance jobs and car park security. He ekes out a living with the RSA solidarity income and these small jobs. He continues to lend a hand here and there to be of service to his neighbours and to friends of friends.

In 2022, the City of Paris asks Thierry to manage an electric garage. In **2032**, he claims his pension rights. He has a small pension with which he lives a simple life. In **2045**, after a bad fall, Thierry gradually loses the use of his legs. He now has to use a wheelchair but does not have the means to finance the conversion required to make his home accessible. He obtains a place in a nursing home promoting solidarity. This is extremely painful for him. He has so many memories tied up in this apartment and so many objects in his basement-come-workshop. A few months later, he dies in his bed, from a massive heart attack.

	2016	2046
Age occupation	Job seeker Car mechanic (50 years old)	retired (80 years old)
Children	No	No
	Low	Low
	Social housing tenant 36m² - 15th district	Solidarity nursing home 12m² CPCU
Short distance travel	Walking and public transport	Bus + mobility assistance
Long distance travel	Car-pooling	
Diet	Meat-eating	Demitarian

CHANGE IN HIS ACCOMMODATION

Thierry lives in social housing in the 15th district. He didn't really choose this district. He took what he could find. The apartment building was completely renovated in 2018. It is insulated on the outside, and has a green wall roof terrace. There is a small vegetable garden. The window frames and doors, the radiators and the ventilation in the dwellings were changed. The old boiler was dismantled and the building was connected to the district hot water circuit, supplied by geothermal energy and the urban heat network. The renovation was carried out on the occupied site in a record time. The company that won the contract renovated the kitchen and gave the tenants the electrical appliances free of charge. The building now records a respectable 10 kgCO2-eq/m2. The communal areas and the stair wells have been redone. Thierry is happy in his small apartment close to the Metro station and shops. He appreciates having a lift to get up to the 5th floor where his apartment is located.

In his small apartment, everything is in its place... Thierry has a strict daily routine to keep his little world in order. This stability is reassuring for him. It reminds him of the garage where each tool was tidied away in its proper place after being used. These small domestic obsessions may make us smile but they probably help to keep him sane in a chaotic world where the future in uncertain.

CHANGE IN HIS TRANSPORT

Thierry loves cars, but to get about he walks and takes the bus. He always keeps an eye on the cars that he sees around him. He has never been able to afford the car of his dreams, so he reads tuning magazines and watches TV programmes. He has drawn a line under the Paris Motor Show, which he finds too sanitised: "a car should smell of grease and real leather". He can usually be found downstairs at the bottom of his building. The teenagers come to see him and to ask him to mend their scooters, he loves it and he's good at explaining things to them.

From 2020: one car-free day is organised every quarter, a new regulation tightens up the conditions for driving the most polluting vehicles, a Defeasance Fund is put in place by the City of Paris which guarantees to buy back private vehicles and recycle them. The City and other players in the social and solidarity economy help to create local electric garages with support from a territorial investment fund. These garages replace petrol engines with electric motors. Thierry is singled out for his skills in mechanics and in 2022 he is put in charge of a local electric garage in the 15th district. He takes Theo on as a labourer. He has been struck by the determination of this 19-year-old, who was introduced to him by Nabil, a young man in his apartment building.

From 2032, Thierry starts to tire quickly, his former professional life starts to take its toll and he has back pain. Theo takes over the garage. He was born lucky and is keen to do what it takes to expand this idea. Thierry has the satisfaction of knowing that he has been useful, if only by passing the torch to a young person.

Thierry does not often travel outside Paris. When he does he uses car-sharing. It was from a publicity campaign by the City of Paris that he first heard of this scheme. But it was because his old friend Sébastien from Cachan had enjoyed the experience that he was encouraged to use it.

CHANGE IN HIS DIET

Thierry is an epicurean. He enjoys good food and he likes to eat well. He loves having a barbecue at the weekend with his metal-working mates in Cachan. Chipolatas, merguez sausages, spare ribs, smoked pork belly...with a glass of red wine... "now you're talking, that hits the spot!". In Thierry's opinion, vegetarians are "really just rich kids". "You can tell that they've never been hungry!" he says, with a touch of annoyance and contempt. "Organic food, meat-free days, it's all the same, it's just middle-class lefties!" he adds, carried away by his enthusiasm...

At home, he eats in front of the TV. When he can, in other words very occasionally, Thierry buys a good rib steak. Otherwise it's vacuum-packed ham, pasta with cheese, mashed potato, beef ravioli, tinned sardines...Thierry does not eat much fruit and vegetables, just pre-packed grated carrots, a small lettuce from Sébastien's garden.

His pension and supplementary income are low. From time to time he goes to the "Corner kitchen" where he sees Stephanie. The young people in this association provide dishes cooked using unsold produce at a very reasonable price.
Thierry is a person of small means, he is quick to take up the carbon eco-reward card issued by the City of Paris. Every low-carbon meal at the canteen earns him points that can be converted into local currency.

CHANGE IN HIS WASTE MANAGEMENT

Thierry throws almost nothing away. Food is precious. He doesn't waste anything.

He's quite a handyman. Out of necessity, he repairs almost anything, so when Theo's partner Léa tells him about a recycling centre in the neighbourhood, he's hooked. For once his skills can be of some use!
He has a good laugh when he sees these young people, these "egg-heads", asking him questions and taking an hour to do what he could do in ten minutes!

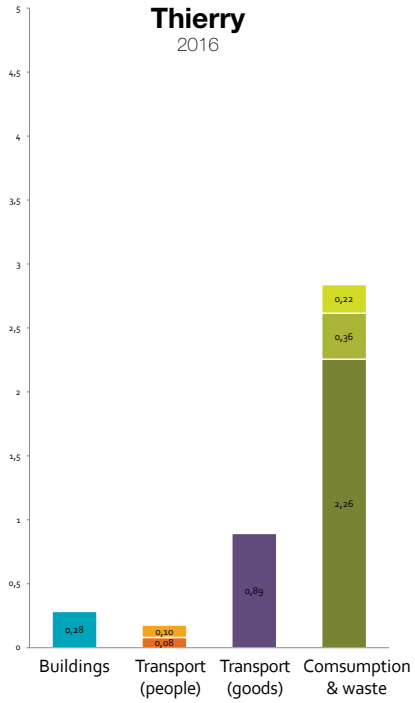
CHANGE IN HIS VALUES

Thierry goes through several phases: after the isolation and nightmare of unemployment and odd jobs, he feels he is useless, outdated, misunderstood. He turns in on himself. His local network helps him to keep on track. He doesn't let himself go, and continues to be disciplined, but he feels out of things and the excitement surrounding climate change leaves him cold. **The electric garage is a renaissance for him:** it gives him the chance to put his know-how into a project for individuals and for the common good. The garage will be a turning point in his life.

GAÏA STARTS HER SECOND YEAR AT UNIVERSITY IN PARIS ON 22 SEPTEMBER 2050, SHE LIVES ON VERY LITTLE.

The modest in 2050 are just like Gaïa (19 years old), who is starting her biomimetics studies. Gaïa belongs to the "climate change-native" generation, and she sees the old "digital natives" as innocents who believed that technology would solve all their problems. She was awarded a place at the Climate Centre: she persuaded the committee to give her one year to organise an international cooperative network of biomimeticians, with whom she wants to test some solutions inspired by local plant species for building insulation. Like thousands of young people, and not so young, she balances her activities between paid work and time devoted to projects of general interest. Long gone are the days of fixed-term contracts and steady employment!

07h30	As she does every morning, Gaïa finds it hard to wake up in her modest 16m² room where she has lived for the last year. She has a quick bowl of cereal then goes to the workshop.	**Accommodation:** 16m² room at the Climate Centre.
08h15	Coordination meeting with the Asian network; focus on aeraulics; the video meeting is supplemented by a 3D simulator for a dynamic visualisation of the projects.	**Long distance transport:** Some professional exchanges can take place online, collaborative tools are much improved.
09h30	Gaïa attends a citizen science session (which is part of her university course) in her local neighbourhood. Her tutor has trained her in holacracy techniques and helped her set her objectives. These hours count towards her "general interest" credit and she is able to test her laboratory work in the field.	**Work:** Collaboration is at the heart of professions and is an essential criterion for company performance.
12h15	Gaïa mans the food truck at the Climate Centre. Between 14:00 and 15:00 she will cook what she doesn't sell.	**Food:** Food stalls offer "zero waste" food: the containers are edible.
15h30	Gaïa has four hours in the laboratory. Her goal is to produce a first turbine which can be installed in the stairwell at the Climate Centre.	**Production:** Production combines algorithms and low-tech machines.
19h30	Gaïa returns to her room, and prepares a few "tutorials" to share some of her tips on producing aeraulic machines. She hosts a community of programmers-geeks that she has called, "Hands off my bot".	**Leisure:** Like Theo, Gaïa is an intuitive handywoman who experiments and defies tradition.


Thierry
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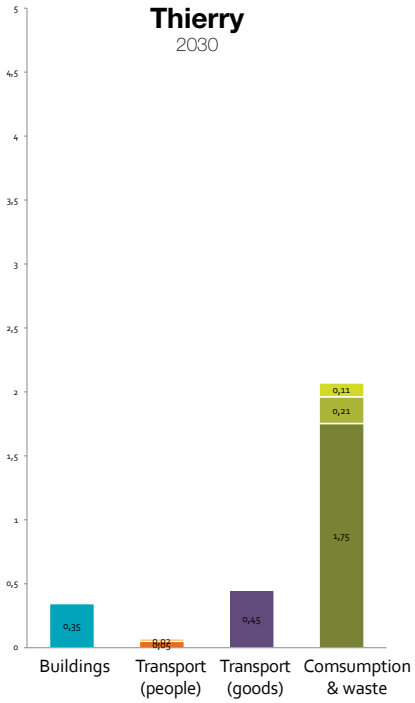
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Thierry
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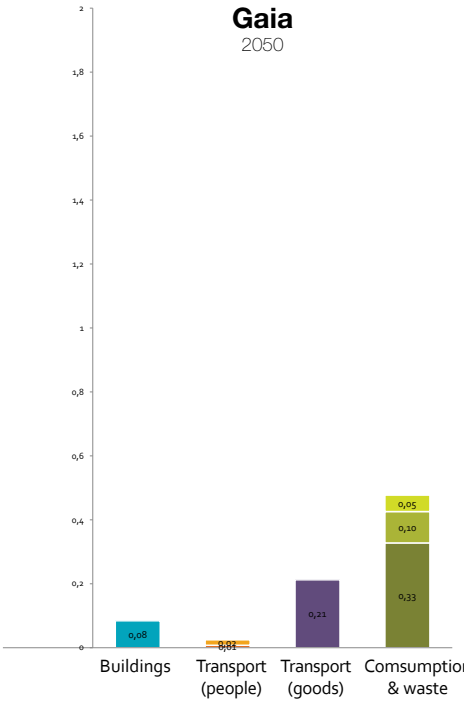
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Gaia
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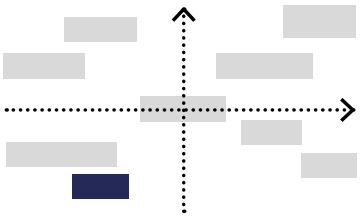
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The "South-west" quadrant, families who emit a large amount of carbon, and who do not adhere to the idea of carbon neutrality. These families will not be receptive to rational argument (the ostriches), or will even be in opposition to the strategy (the hostile); external factors (climate, social, economic, political, etc.) may intervene and cause them to change, whether they like it or not.

THE OPPONENTS



Madame Olga
Aged 75

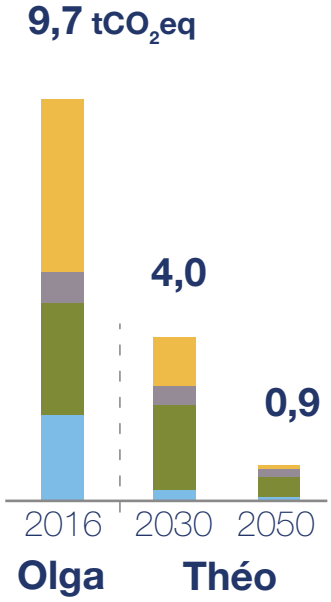
Dynamics of change

Olga and Theo are searching for their place in this world of change, how can they defend their values?

Mrs Olga mobilises the entire neighbourhood, she wants to save small retail businesses.

She ran the bookshop at the Villiers Metro station. She watched as generations of pupils from the Fénelon Sainte Marie School (Monceau site) passed by her door, and she would advise them throughout their school career. Her secret pleasure was the Wednesday shopping trip: the beautiful car that would park in front of her shop window, the mother who got out with her children and the conversations that ensued between the rows of books. Her favourite novel is Au Bonheur des Dames by Zola!

This world now seems to have gone. Since mothers started going out to work, nannies replaced them, or worse, teenagers who didn't even say hello and who kept their headphones in their ears. When she wanted to sell up, it was a lingerie chain that offered the best price. She initially refused, shocked at the idea that her books should give way to such things. But then, when nothing else came along, she resolved to accept. She always crosses the street when she passes by her former bookshop.



THE OPPONENT

The opponent can belong to any age group. They express a feeling of aggression (challenging a way of life and values) and anxiety. These points of reference are the foundation of their identity and must be protected against those who want to call them into question. To counter this feeling, they practice a form of passive resistance which takes the form of a withdrawal into themselves. This resistance may be heightened: challenging climate issues and questioning the legitimacy of the State and local authorities to intervene in our private lives, which leads to a more active form of resistance.

This hostility on principle does not mean that all types of behaviour are negative in terms of climate change. The spirit of change is found in other areas (social, identity, etc.)

HER VALUES

Olga is one of these French people who get up early, who count their pennies, who were in business at the time of the "Glorious Thirty" years of economic growth and in the 1980s: we must free the entrepreneurial spirit, make shops accessible to customers in a hurry. Loyal to figures of authority and symbols of her identity, Olga defends the idea of a France that is eternal and great: it was here that the Enlightenment was born, it was here that the Salons made Paris famous throughout Europe, it is here that we award the Goncourt prize, here we know how to uphold the traditions of wit and culture, we have the largest number of cinemas per inhabitant. Today, these values have been beaten down on all sides, injured, bruised, attacked and violated.

HER ACTIVITIES

Olga is a widow. Her husband, a former accountant for a company trading in domestic heating oil, died in 2015. She did not get a very good deal when she sold her bookshop: she was unable to get the proper value for the business and had to sell a large part of the stock at a loss. Her husband left her income from an insurance policy which enables her to have a decent standard of living, but in moderation. Three times a year she visits her friend Jacqueline in Nice. Olga likes listening to choral music in the churches in Vexin, and she listens to classical music in the traffic jams on her way back home.

HER FEARS AND VULNERABILITIES

Olga knew Paris when it was vibrant, DS automobiles with their badges, the Banque de France, close by, solid and prestigious. She is out of her depth in this world where the latest edition of Rousseau is published on a barbaric electronic device whose name she can't pronounce. Paris seems to be bogged down in a permanent traffic jam, trade suffers, the large chains are prospering, but they are signing the death warrant of small independent shops, her livelihood.

SOCIOLOGICAL FOCUS

Olga (retired shopkeeper) is very much like the characters in Zola's *Au Bonheur des Dames.* She is living through a double revolution: the transformation of business and the transformation of the city. Business as she knew it gradually disappeared under the dual influence of the digital economy and the sharing economy.

But it is also the city and the relationship with the public space that has been transformed. The city now has a sensory experience and emotional vibrations to offer, which are constantly renewed. Olga does not understand all these changes. The hostility she demonstrates can also be put down to this incomprehension.

OLGA'S LIFE TRAJECTORY

Olga, formerly a shopkeeper, remains convinced that the survival of small businesses depends on accessibility and car parking. She is therefore a militant activist in pro-car networks and is very active at public meetings. As she feels that she will not derive benefit for very long from energy saving, she does not want to incur the increase in charges related to the thermal renovation of the building where she is co-owner and she is setting procedures in motion against the co-property (renovation too expensive). Olga is looking for new forms of sociability and has discovered enjoyment in passing on her classical culture to the refugees in Ozanam House in the Batignolles district. She dies during a heatwave in 2030.

	2016	2050
Age occupation	Retired (77 years old)	Died in 2030
Children	No	
	Average	
	Died in 2030	
Short distance travel	Public transport	
Long distance travel	Plane	
Diet	Meat-eating	

CHANGE IN HER ACCOMMODATION

Olga lives in Rue Legendre, very close to her old bookshop. She likes this neighbourhood, the Rue de Lévis with its skilled craftsmen, and lovers of flavours and good food, and good quality produce. Her 60m² apartment is very clean and well-kept. Her bedroom on the 1st floor looks out onto a courtyard, and the shelf with her Pléiade collection has pride of place in her living room. She does not often have guests for dinner, but she complains about the neighbours overhead who don't take their shoes off.

Olga has gas heating and with the curtains drawn it's cosy in winter (below 24°C and she feels her legs hurting). She is used to the noise of the traffic and doesn't see why the joint owners should insist on double glazing. She voted against the insulation work at the last General Meeting of the joint owners in 2020 and she filed a lawsuit against the Syndicate in 2022, as she suspected they were in cahoots with the entrepreneur. Olga does not feel concerned about energy savings, which will take 20 years to pay off. "The charges on the other hand, we know when we're going to pay them!" she explained, furious to think that she's been fleeced by the young couples on the 4th and 5th floors. Olga pays the energy transition tax, calculated according to the size of the dwelling (more than 45m² for a single person).

CHANGE IN HER TRANSPORT

For Olga, the car is the symbol of economic growth, of this triumphant industry that has embellished Paris, mainly thanks to her hero, Pompidou, a cultivated visionary who transformed the city.

Olga sold her car when her husband died. She has adapted and walks everywhere in her neighbourhood. She feels claustrophobic in the Metro. You'll never see her on a bicycle, it's not suitable for a woman like her. Jacqueline tells her that she will eventually settle in Nice. During the 2010s, they see each other more and more frequently. Although Olga's means are more and more scarce, with the plane, "you can get to Nice for the price of a taxi ride!"

As a pedestrian, she sympathises with the poor car-drivers stuck in traffic jams. Olga starts up a petition and does the rounds of the shopkeepers in the neighbourhood to ask them to hand them out. In the Rue de Lévis, which is already pedestrianised and always attractive, they are less receptive than in the Rue Legendre. But she is not daunted.

She doesn't believe in so-called "traffic evaporation". She is a member of the reading panels for several daily papers, and she is in demand by several radio stations and rolling news channels who have spotted an "ideal customer": the respectable grandmother who stirs up trouble! In 2026, she is the figurehead to mobilise her association against changes to the ring road.

CHANGE IN HER DIET

Olga likes to gather her friends together for literary afternoons in the gothic room at the Polish restaurant in her street. On a day-to-day basis, Olga enjoys a good piece of meat and even buys herself little treats: a marrow bone, semi-cooked foie gras, a steak aged for 40 days...On principle, she never eats strawberries in winter. But this is not out of ecological convictions, just a family habit.

CHANGE IN HER WASTE MANAGEMENT

Olga is very organised, she buys just what she needs from day to day. Everything is very fresh, she never throws anything away! She was born in 1939. The post-war years were very difficult. At home and at school she learned to cook, to sew and to darn clothes to give to the poor.

CHANGE IN HER LEISURE

Olga likes reading, walking, going to exhibitions. She has bought the *Officiel des Spectacles* cultural guide since she was 18, in 1956. Olga is a living memory of cultural Paris, of those times when Paris was set alight by Malraux or against the Opéra Bastille.

She organises readings of classical texts and talking time at Ozanam House for people in difficulty, especially refugees. She is surprised to realise that “these people are suffering, they need lightness and gentleness”.

At the weekend, when the weather is good, she goes on retreat in Ile-de-France with her friends from Ozanam House. They take the train to Rambouillet or Fontainebleau, and an electric mini-bus comes to collect them at the station to take them to their guest house.

Summers are more and more uncomfortable in her apartment. The case with the Syndicate has soured relations in the building considerably and her neighbours refuse to speak to her. One August evening in 2030, suffering from the heat, Olga gets up in the middle of the night to open a window. She doesn’t put on the light, she trips and breaks her hip. She can’t get up. The telephone is still in her bedroom. Three days later, Jacqueline is worried that she has not had any news. She makes enquiries. Eventually, they break down the door. Olga is severely dehydrated and is admitted to the emergency room at Lariboisière hospital. She dies of a heart attack two days later.

CHANGE IN HER VALUES

Olga is losing her bearings. Her values no longer count for anything, the world that is appearing before her eyes seems to her to be aberrant, degraded, or even degrading. In particular, she is worried about these small businesses that are disappearing and which she holds so dear.

Olga refutes the arguments in favour of a change of behaviour, becoming more virtuous. She does not believe in the possibility of improvement, especially in a context of terrorism and values that are falling apart. She feels that the demise of the cars she remembers from her youth, this symbol of speed and vitality, also signifies her own end, and she rejects this “New Era” just as vehemently.

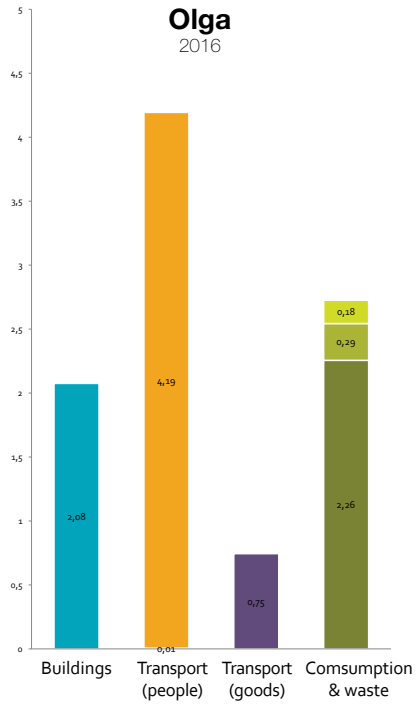
She feels overwhelmed by constraints on every side: her heating, her travel in Paris, the frequency of her visits to Nice...everything is becoming difficult for her, and she is fighting against what she considers to be a deterioration in Parisian life.

She recovers some moments from her former life when she shares her passion for classical texts, and she is surprised by the friendships that she forms with the refugees at Ozanam House.

THEO IS BROODING ON 28 DECEMBER 2050, HE IS ANGRY AT OLD PEOPLE LIKE OLGA, WHO HAVE SLOWED CLIMATE MOBILISATION.

Theo cannot stomach the judicial decision that prevents him from seeing his children. He tells himself that the comfortable years spent with Léa were no more than a bitter interlude for him, entrepreneur without a safety net. He hoped that the end of the fossil fuel era would result in a more just society, but he sees that his brother-in-law Nicolas continues to do well for himself: his carbon footprint is 100 times greater than the average Parisian's! He finds the programmes against climate change unfair and he gets involved in civil disobedience and civic disruption, a new form of hostility.

07h30	Theo wakes up with a start, he slept badly. Will he be able to pay his employees at the end of the month? The payment problems have not disappeared, despite the blockchain. Cash reserves are small.	**Accommodation:** Theo has taken over his mother's lease, since she left for Moncley: 44m², a bedroom for the children, a living room.
08h15	No holidays for Theo. He has to supervise work at the garage. He goes to work by bubble bike.	**Everyday transport:** Bubble bike, a profiled system to optimise muscle strength and protect from the rain.
09h30	The customers want to get away for the New Year celebrations. He has to finish his work quickly on two cars that were designed in 2016 and recycled in 2030. After changing the engines, he gets down to reducing their weight. Their carbon impact will thus be considerably reduced with no need to build a new vehicle.	**National mobility:** Vehicles have geo-positioning, and their energy consumption is weighted according to weight and power of the vehicle.
12h15	Theo cheerfully greets the bicycle delivery man who brings his lunch. He eats a carton of salad, alone in his office.	**Food:** Theo doesn't cook much, he has his meals delivered and is pleased that the delivery man comes back to collect the containers in the afternoon.
15h30	Between two repairs, he studies the code for the best-selling GPS-carbon beacon. He wants to hack into the weighting rules, which he thinks are too restrained. His great success would be to multiply the ratio by one thousand for the highest 1% of energy consumers. In that case, the weighting would have some meaning, he thinks!	**National mobility:** Vehicles have geo-positioning, and their energy consumption is weighted according to weight and power of the vehicle.
19h30	Theo puts together a prototype signal jammer which he decides to test on Nicolas' car: he wants to prevent the car from connecting with the insurance base, to prevent it from starting...	**Leisure :** Theo is a handyman, a Gyro Gearloose who uses all his ingenuity for his political vision as "climate vigilante".


Olga
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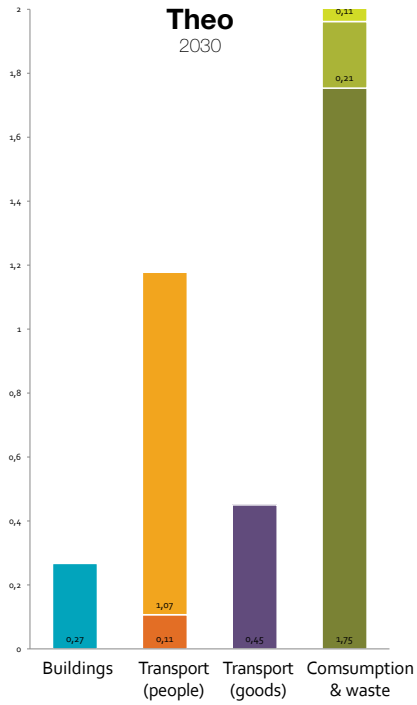
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Theo
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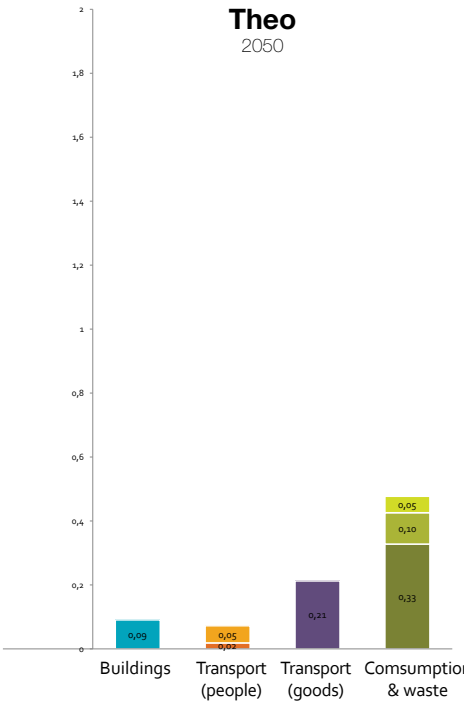
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Theo
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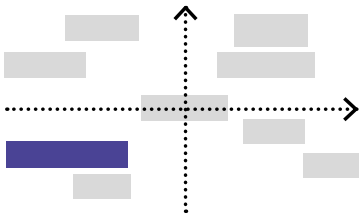
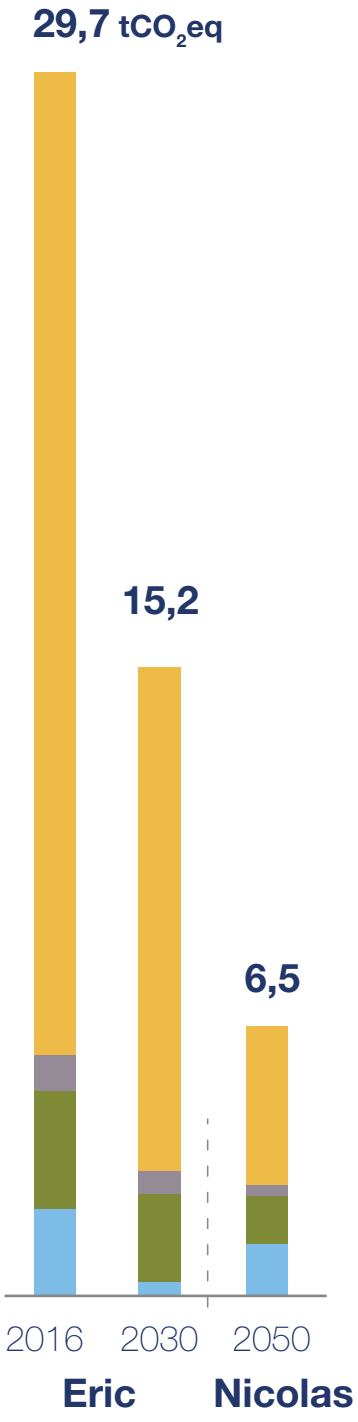
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The 'South West' quadrant, families who emit a lot of carbon, and who do not subscribe to the idea of carbon neutrality. These families will not be receptive to a rational message (the ostriches), and will even oppose the strategy (the opponents); external factors (climatic, social, economic, political) may become evident and cause them to change, whether they like it or not.

Dynamics of change

The ostriches do adapt to the new reality, but 15 years late.



THE OSTRICHES



Eric
Age 53

Nadia
Age 53

Nicolas
Age 21

Léa
Age 19

Eric and Nadia belong to the upper middle-class, at the heart of the system.

He heads an asset management company, she is a prominent journalist: editorial writer on a daily newspaper, commentator on a TV channel.
Eric's wealthy clientele, which in particular includes the big grain-growing families, has diversified thanks to the financialisation and automation of their industry and to the explosion of tax havens. In this way, he has become a member of a free trade club, which includes industrialists, journalists and parliamentarians. This is one of the networks of influence that he maintains, and regularly organises dinners at their home. Without betraying the confidences exchanged there, Nadia has a humorous dig at these male gatherings in her columns, widely reported on social networks. Nicolas and Léa, their children, are two young adults who are blossoming in this privileged, benevolent cocoon, he is a student (future banker), she is taking a Political Science Institute foundation course, destined for the prestigious *Grandes Ecoles* and international careers.

THE OSTRICHES

Ostriches may belong to all age groups. They are relatively comfortably off. They have practices that emit high levels of carbon and they do not subscribe to the values inherent in ecological transition which challenge their feeling of control, their world and their lifestyle. They practice a form of passive resistance, avoidance or denial. But the ostriches are opportunists who can adapt if their interests are threatened.

THEIR VALUES

Eric and Nadia embody that French spirit which combines tradition, wealth and elegance. Their family lineage gives them a feeling of power, of having a destiny. In return, they carry the responsibility of continuing the work of preceding generations, that of the giants of the petrol and steel industries. They hold up individual freedom of action as an intangible principle: 'the entrepreneurial spirit must not be stifled!' Faced with the lingering crisis, Eric and Nadia are persuaded of the inefficacy of public action, 'there must therefore be less state involvement and trust must be placed in the private sector'.

THEIR PRACTICES

Nothing changes in their world, they do not perceive the immediacy of the threat and therefore experience a feeling of privilege and security in their daily lives. This involves not talking about issues which are perceived as having the capacity to disrupt their financial interests. They consolidate their view of the world by sharing their social life with others in their situation, and wish to actively protect this world. They have wide professional influence, which they maintain discreetly but skilfully: Nadia advises company bosses in personal branding and e-reputation, while Eric is one of these 'night visitors' who advise the captains of industry and politicians.

Eric and Nadia are very mobile, both in their professional lives and their social lives. Their seasons are patterned by travel; the Cayman Islands for the New Year (Eric has some 'offshore' customers), Val d'Isère for February, Marrakesh for golf in May, long weekends in Corsica in July and a big exotic trip in August. The house in the country is 2 hours away by car.

THEIR FEARS AND THEIR VULNERABILITIES

They have a global view of the world, they recognise the extent of economic globalisation and that the economy depends on key resources such as petrol, gas and carbon. The BRICS and the developing countries are markets of the future, so free trade must prosper: access to key resources is at stake and global competition is stiff. They fear that COP21 will weaken the modest recovery that is on the way, and in particular they fear that European industries will relocate to Africa or Asia if Europe adopts standards that are too restrictive. Conversely, TAFTA and CETA, which should provide better protection for the large industrial groups from state intervention, must be successfully put in place.

SOCIOLOGICAL FOCUS

Nadia and Eric adopt a position of denial when confronted with events that they cannot control (climate change) which require collective action. They put their heads in the sand and eliminate the disruptive messages associated with the effects of climate change from their reading, from their life, which allows them to maintain their tunnel vision and to consolidate their lifestyle.

While their world is teetering, they are looking for a new equilibrium, new values. For Nadia, this involves introspection and a spiritual quest, for Eric and Nicolas, this involves the changes to financial standards and they adapt to new growth sectors. Léa tries to reconcile these tensions and to reduce them. Nicolas keep his blinkers on, he continues not to evaluate the question of climate refugees, of equal effort: if he can manage it, why can't others?

THEIR LIFE TRAJECTORY

Despite appearances, this couple does not get on and there are tensions firstly between Eric and Nadia, then between Léa and Nicolas. After the Panama Papers affair, Nadia forms links with associations that are fighting for greater transparency in business. This commitment exacerbates discord between the couple, who finally divorce.
For his part, Eric alters none of his habits: no changes to his transport, food, and travel practices. However, as a shrewd investor, he has become aware of the risk of 'stranded assets' and he has invested in green regional funds.
Léa is deeply affected by her parent's disagreements, and leaves her family to form a couple with Theo (the employee of her father's mechanic). As for Nicolas, he is the embodiment of his father's values and becomes a green developer thanks to the substantial bonuses he has received as an investment banker in London.

	2016	2050
Age profession	Journalist Asset manager (53)	Retired (Nadia) 87 Died 2038 (Eric)
Children	Nicolas 21 Léa 19	Nicolas 55 Léa 53
	Very high	Very high
	Owner 256m2 7th district Gas Two homes	Intergenerational house
Short distance travel	Cars + taxi	Transport on demand
Long distance travel	Cars Aeroplane	TGV and rental
Food	Carnivore	Vegetarian
Consumer goods	High-tech equipment	

CHANGE IN THEIR HOUSING

Faced with repeated heat waves, Eric decided to have air conditioning installed in the 256m² family apartment on rue Saint-Thomas d'Aquin in the 7th district. This is largely to answer Nadia, who says to him increasingly often that he is 'sucking the air out of her'. The neighbours protested at first about the noise from the external unit of the air conditioning system, installed on the courtyard façade, but he feels more comfortable like that, and so what if air conditioning is an ecological aberration, he can get away with it.

Following the divorce in 2024, Eric spends more and more time abroad, and abandons the apartment. It's Nicolas who organises memorable soirées there when he returns from London (where he works for an American bank). Léa does not like her brother's friends, she finds them vulgar and out of control.
Looking for new values, Nadia temporarily moves into a loft in the 6th district, where she organises meetings with mindfulness specialists, and runs yoga sessions. In 2038, she decides to create an intergenerational house in anticipation of her old age. This house-sharing project, developed and funded by its residents, is intended to be a meeting place for locals and inhabitants of the district. The house will host different generations and some businesses and services. She wants this house to be a place for discussion and sharing on the subject of wellbeing and climate. Camille, a friend of Léa's, will be its architect. Nicolas takes over the family apartment and moves in with Inès in 2028. Eric has chosen to limit his time in Paris, he buys a 100m2 apartment overlooking the Seine, at Quai Conti. Léa has broken with the family, she has set up house with Theo above the garage they have fitted out in the 15th district. Subsequently she buys Monique and Jacques' apartment, in Sully-Morland.

CHANGE IN THEIR TRANSPORT

The family follows two distinct pathways. Eric drives a luxury car. There is nothing like the Porsche Cayenne for going to Val d'Isère, while it is a pleasure to drive an E-Type to travel to Trie for the weekend. Eric loves driving. He has found an excellent mechanic in the 15th district, Thierry, who takes loving care of it. 'A true artist, a vanishing breed'. Eric and Nicolas travel by aeroplane in the same way that Léa takes the Metro: several times a week. But the hardening of his company's CSR policy enforced by the City of Paris obliges him to reduce the number of flights he takes of less than 2,000 km.
Nadia takes many trips to Tibet and travels to India for spiritual retreats, where she learns transcendental meditation. She keeps a record of her trips in a little Moleskin notebook. In Paris, Nadia adores her little sports car, a souvenir of her years with Eric, and her career as a journalist. In the end, she regretfully gets rid of it. She finds the new offer of shared taxis and transport on demand so agreeable that she resolves to take it up.

Léa works on the crowdfunding strategy launched by a player in social and solidarity economy to boost the development of garage projects for electric cars.

Nicolas finds his sister totally bizarre. He is indignant at what he sees as impediments to his mobility and refuses to abandon his vintage cars. In 2040, it is his own children that convince him to adapt. For them, this attachment to cars fuelled by petrol is completely out of date. Furthermore, owning a car: it's an old man's thing!

CHANGES IN THEIR DIET

Eric eats well with his customers, he now carries a lot of weight, as much in business as on the scales.

Nadia stands together with her journalist colleagues who are publishing shock investigations of agri-food practices. She feels that her husband's business is not there for no reason.

Nadia tells Eric that she is asking for divorce during a meat feast: she cannot endorse the change in her husband's values.

She feels attracted by simple gestures and aesthetic preparations. She feels better when she reconnects her body to the rhythm of the seasons: she becomes an enthusiast of the "Good for the Climate" restaurants.

CHANGES IN THEIR WASTE MANAGEMENT

Eric has never concerned himself with bins. He is served at table and when he goes into the kitchen for breakfast everything is clean. Léa has written a dissertation on the circular economy at the Political Science Institute: she tries to introduce selective sorting at home. Without success! She rails against her brother who makes fun of her, and tries to prove to her that the incinerator digests all this very efficiently.

CHANGE IN THEIR LEISURE

In 2016, the family is having a ball! It is a family tradition to celebrate the New Year in the tropics. Eric has to supervise a part of his business in the Cayman Islands, he takes advantage of this to bring his family together and go game fishing on a yacht belonging to one of his biggest customers. So his leisure activities are not really dissociated from his professional life; seminars in the palm groves of Marrakesh, holidays in Corsica with Golf Club shareholders, investor roadshows in New York. All this stops for Nadia with divorce in 2024.

As a pragmatic investor, Eric has diversified his portfolio of activities. He has become aware of the risk of stranded assets and has invested in renewable energy funds and in green regional funds especially that of the City of Paris which has an excellent rating. Obligated by Article 173 of the Energy Transition Law, he begins by measuring the carbon impact of his portfolios, he expands the transition in 2030 on the birth of his first grandson. However, he continues to speculate on the end of petrol. He is then targeted by eco-hackers in 2038 who burn out the autopilot of his luxury car. Eric is killed in the high-speed accident. The event is reported in the media.

Nicolas takes on his father's business following his death. It is a dreadful shock for him, and at this time he becomes closer to his mother. He decides to invest in green real estate, particularly by taking inspiration from the bio-sourced strategy recommended to him by Camille, his mother's architect.

Léa emerges from these family tensions tried and tested. She finally leaves Theo in 2045 and brings up their two children (born in 2033 and 2035) alone. After psychoanalysis, she becomes a psychotherapist, specialising in the treatment of climate-related neuroses.

CHANGE IN THEIR VALUES

This family tells the story of a world that is gradually reconstructing itself. The seeds of change are both internal and external.

The characters of Nadia and Léa play a central role. They are both those that contribute to the breakup of the family, and those which contribute to its re-establishment on new foundations. Nadia rises up against the downward moral spiral of the business world, she wants to uphold a tradition and think of future generations.

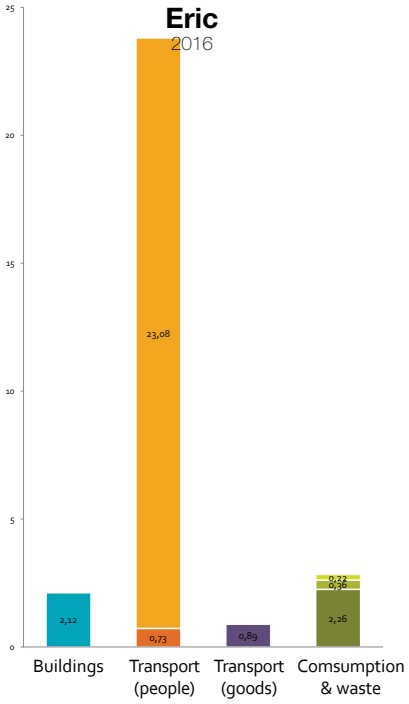
Eric, who grew up with the impression of doing God's work in the manner of the stars of finance, will not survive these changes.

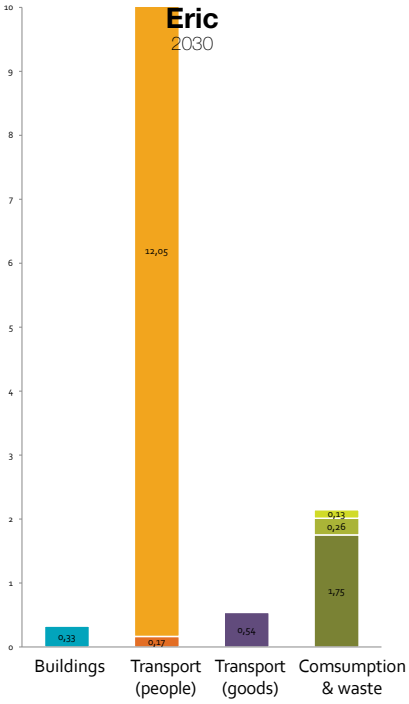
But the seeds of change are also external because these characters are subject to pressure from a changing world which imposes itself on them. At the end of her trajectory, Nadia no longer belongs to the family of ostriches. Her proximity to Camille links her to the 'militants' group. As for Léa, she joins the Privileged group.

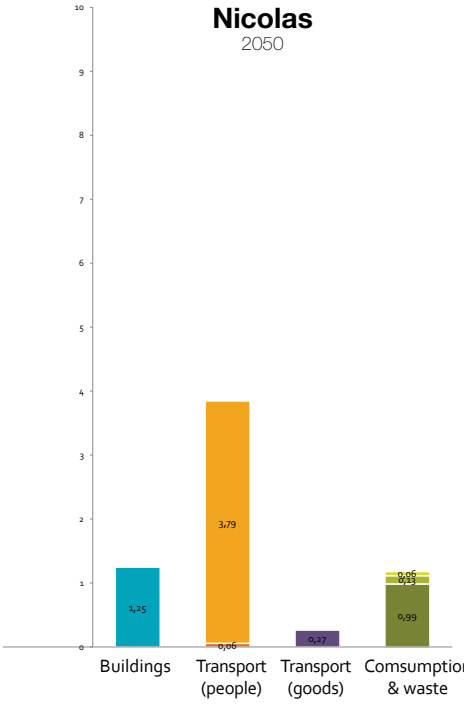
ON NOVEMBER 1ST 2050, NICOLAS SALUTES THE MEMORY OF HIS LATE FATHER

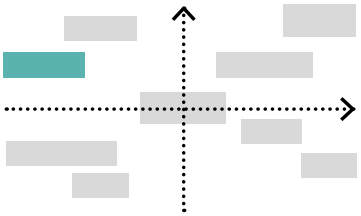
Eric's brutal death generated questions for each member of this broken family. Nadia even wanted to 'make peace with this world of yesterday' and build a solidarity project as part of the intergenerational house. Nicolas and his wife Inès are still on bad terms with Léa, but they take part in these memorial gatherings.
Nicolas knows he owes much to Nadia, who allows him to sort out the family business by successfully transitioning to green real estate and bio-sourced renovation. He was involved in funding the Fossil Fuel Civilisation Museum, in memory of his father.

08h00	The breakfast table is already laid with cereals, everyone serves themselves in their own time.	**Housing:** Renovated family housing (A++)
09h00	Nadia is no longer very robust, she now needs her exoskeleton to go to the park with her grandchildren. She maintains her independence and exercises her muscles.	**Daily transport:** Electric cars and three-wheeled carrier cycles for each member of the family + exoskeleton for Nadia.
10h30	Ceremony of remembrance and reading of texts in memory of Eric.	**Work:** The ethical rating of investments has become a central issue in their value.
13h00	Great autumn feast, preparations based on old squashes, apples and quince from the orchard. Tasting of the first cider of the year.	**Food:** A vegetarian diet, rare varieties (under a preservation-biodiversity contract)
15h00	Scoping meeting for the first fundraising by the Friends of the Fossil Fuel Civilisation Museum. Inès is angry with Léa, who would like equivalent support for the International Climate City.	**Governance:** The arbitration between reduction, adaptation and welcoming climate refugees is at the centre of debates
20h00	Return to Paris. Nadia has booked a people carrier with 12 places.	**Long distance transport:** Simplified, lighter, modular vehicles.


Eric
2016
25
20
15
10
5
0
2,12
0,73
23,08
0,89
0,22
0,36
2,26
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Eric
2030
10
9
8
7
6
5
4
3
2
1
0
0,33
0,17
12,05
0,54
0,13
0,26
1,75
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Nicolas
2050
10
9
8
7
6
5
4
3
2
1
0
1,25
0,06
3,79
0,27
0,05
0,13
0,99
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The North-West quadrant, families whose practices rely heavily on carbon, despite their awareness of, and subscription to, the objective of neutrality. These are families that are likely to commit, but who need help (the disadvantaged) or who have not yet made a start (the privileged).

THE PRIVILEGED



Monique
Age 65

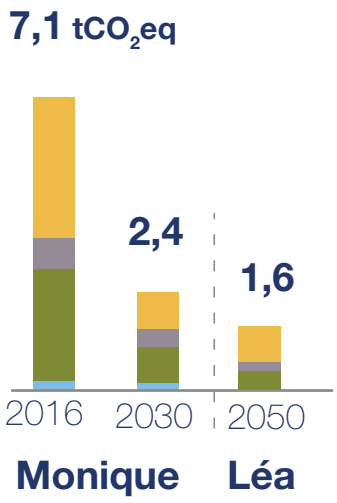
Jacques
Age 68

Dynamics of change

Climate change directly affects the lifestyle of the privileged, who gradually adjust their habits.

Monique retires after a good career in the nuclear industry, Jacques retired 3 years earlier.

These former senior professionals are delighted with this new phase of their life. They have made pension contributions since the age of 24, and they feel in good health. They are living the good life! To mark the occasion, Jacques has replaced their car. He wanted a comfortable saloon for their travel in France, from festivals to exhibitions, stopping off to sample some gastronomy. Jacques supervised the renovation works on a Provencal farmhouse bought 10 years ago and enjoys this new pattern of living in two houses. Monique tells herself it's the time to acquire shares in a Burgundy wine domain: this is a promising gourmet stopover point on the road to Provence! Having free time in Paris is fantastic, they take advantage of all the positive aspects, the museums, visits to heritage sites, restaurants, and the traffic jams are forgotten. Their terrace on the 8th floor, landscaped by a big name, is the envy of their friends, and pleases everyone.



THE PRIVILEGED

The privileged have significant financial resources. This relative affluence can be explained by age (creation of assets). They adhere intellectually to the values of ecological transition, but the absence of financial constraints leads them to consumption practices (aeroplane) that are the source of a significant discrepancy between values and actual practice. To reduce this cognitive dissonance, they try to compensate on other items or to become involved in voluntary compensation measures.

THEIR VALUES

Monique and Jacques are aware of the news. They read *Le Monde* and *Télérama*. They listen to France Inter, and since COP21, they have seen Demain, the film by Cyril Dion and Mélanie Laurent. They see climate change as a serious but distant threat. It is a complex subject which goes over their heads.
Jacques was 20 in 1968 and he is still marked by the reform of medical studies and the end of the privileges of the profession. Monique spent her career at COGEMA then at EDF, driven by the enthusiasm for nuclear energy in the 70s and 80s.

THEIR PRACTICES

Monique and Jacques are comfortably off and travel often, particularly by plane, as their children are grown-up but live a long way away. Stéphane is a post-doc student in Boston and Marie has settled in Nantes. Their children have good careers. Monique and Jacques are not yet grandparents, so they take advantage of their Provencal farmhouse and go there as often as possible. They sort their waste but have not insulated the loft (the co-owners association was against it). Former EDF employee Monique has had the gas boiler replaced by electric heating, and has had air-conditioning installed in the bedroom.

THEIR FEARS AND VULNERABILITIES

Monique and Jacques are worried about the rising tensions in France. They do not feel at ease with the security announcements, which they perceive as destructive of freedom, even if they are aware of the terrorist threat.

SOCIOLOGICAL FOCUS

Monique and Jacques are different from the other characters by their place of residence: an apartment with a terrace on the top floor of a building in Rue Morland.

From this terrace, they overlook Paris. This vantage point reveals the **poetry** of the roofs of Paris, which are visible from the roof top and the belvedere.

This urban landscape evokes the relationship with the **vertical** and shows the silent battle between the advocates of green roofs and those of roof solar panels.

Talking of roofs is a way to mention the horizon, the Parisian sky, the air pollution and the light pollution. But this vantage point overlooking Paris is also a reason to mention how some Parisians distance themselves from issues of climate change.

They gaze at the city. They are not caught up in the tensions of everyday life. Their (geographic and social) position allows them not to mix with people and therefore to avoid the prevailing difficulties.

THEIR LIFE TRAJECTORY

Monique and Jacques thought they could enjoy a peaceful and comfortable retirement. They indulge themselves and travel a lot, in Provence, in the mountains, abroad (particularly to visit Stéphane).
These trips expose them to the effects of climate change. In 2017, they have to cancel the trip offered by Monique's colleagues for her retirement. The bungalow was destroyed by a tropical storm. They notice that snow no longer falls at their friends' house in Valmorel, and that their holidays are ruined.
They do some research into the subject and develop a greater awareness of climate issues, but this is an intellectualised awareness: they feel that it is closing in on them, but they do not take it too seriously…

After a failure of the grape harvest in 2024, they decided to act and modify their eating habits, then they join a mobility centre and reduce the distance and frequency of their journeys. Their Provencal farmhouse narrowly escapes the fires of the terrible **heatwave of 2031.** Jacques dies of a stroke in **2033**. Monique sells the apartment for a life annuity to Léa, Eric and Nadia's daughter, before dying in **2038**.

	2016	2050
Age occupation	Retired (65 and 68)	Died 2033 (Jacques) Died 2038 (Monique)
Children	No	
	High	
	Owner 90 m2 – 4th district	
Short distance travel	Car	
Long distance travel	Car Aeroplane	
Diet	Omnivore	

CHANGE IN THEIR HOUSING

Monique congratulates herself on having had air-conditioning installed in their bedroom, but she finds it is really hot in the living room from June onwards. Jacques and Monique decide to fund a thermal study of their building themselves, since the co-owners association does not want anything to do with it. They are perceived as the privileged ones from the 8th floor: they have the most beautiful apartment, 90 m² with a terrace, so their insulation is seen as being their problem.

In 2024, their power of conviction finally wins over the neighbours! The co-owners' association apply to the "Let's Ecorenovate Paris" programme launched by the Paris City Council. Monique and Jacques tell themselves that they have time and decide to take part in the "Positive Energy Family Challenge" to assess their personal carbon footprint and become climate advisors for their building. They can thus take advantage of an improved rate for the renovation of the co-owned property. When the works are finished, Monique and Jacques live in a positive-energy building. In summer, the large photovoltaic farm installed on the roof produces more energy than the residents consume and the remainder is sold to the neighbours!

CHANGES IN THEIR TRANSPORT

In 2016, Jacques surprises Monique by picking her up from her leaving do in their new saloon. Monique and Jacques are delighted at the prospect of a quiet, comfortable life. The farmhouse is 6 hours away by road.

In Paris, however, the car gets stuck in the traffic jams. At least they are comfortably seated as they sit in the Rue de Rivoli.

In 2026, Jacques complains about the ban on driving the most polluting cars and the associated restriction on their power and weight. His car is still in perfect condition, how will he go to Provence? He decides to keep it in a garage next to the station at Aix-en-Provence. They take out a high-speed train season ticket.

To make up for it, Monique buys two electrically-assisted bikes as a Christmas present in 2021. The Parisian central purchasing unit has enabled prices to be reduced. The successive Active Mobility Plans have also made travelling by soft modes of transport much more pleasant and feasible for a non-adventurer like her! She has heard talk of rides along the Ourcq Canal and tells herself that they could go as far as Claye Souilly and back following the waterway from the Port de l'Arsenal.

In 2028, Monique feels that Jack is faltering. She sets themselves goals for their daily walk: her cardiologist has recommended at least 6,000 steps per day and to aim for

10,000 steps a day. They appreciate these walks in Paris. They are close to the centre and can reach the Louvre quickly.

They adore Asia. They went to Vietnam in 1992. They find that these countries are changing very quickly. In the 2020s, the concrete jungle of the Philippines and plastic pollution on the beaches in Malaysia put them off. The time difference increasingly tires them. They limit their flights to the minimum: one visit to Stéphane a year. In 2030, Stéphane tells them he is returning to Paris. At this point they decide they will not fly any more.

CHANGES IN THEIR FOOD

Monique and Jacques are discerning gourmets. Jacques joined a Burgundy Wine Brotherhood and loves how red meat and Burgundy complement each other. He wonders whether he will one day be able to deprive himself of such a pleasure.

Jacques is passionate about oenology, and by extension, about the work on the vines. He discovers that the dates of the harvests have changed enormously in the 21st century. The cellar master tells him about climate events that complicate the winemaking process. After two consecutive poor harvests (-50% in 2022, -70% in 2023), **the harvest of 2024 is totally lost.**

It is a shock for Jacques who tells himself that if wine is the victim of the effects of climate change, then he must do something about it quickly. Monique agrees and suggests starting by reducing their meat consumption. They were made aware of this last time they spent a day at the EDF Retirees Association. In fact, the company has become a major player in the Paris 2050 movement. And then speaking of the impact of food, that allows energy changes to be made! He didn't think he could give up meat successfully, but the group effect worked in favour of demitarianism. The Sully Morland Organic Market has become their hideout. How fresh these products are, delivered by barge first thing in the morning, right to their doorstep!

CHANGES IN THEIR WASTE MANAGEMENT

Monique and Jacques have difficulty managing their refrigerator. They are constantly travelling, and are sometimes too tired to cook when they get back. So, regretfully, they throw food away (around 30% of their fresh products). They think there must be an alternative: perhaps an on-demand delivery service? A 'give-box' in which they can deposit their fresh products which will not last until they return?

CHANGE IN THEIR LEISURE

Monique and Jacques approach their retirement as epicureans. Their free time relies heavily on carbon in the early days of their retirement: plane trips, constant journeys to Provence and back, as well as to their daughter's house in Nantes (they are always loaded down with presents, olive oil and figs).

Jacques, a former radiologist, is passionate about the new technologies that have revolutionised his profession. He keeps track of digital innovations and loves being the first to acquire them: virtual reality helmet, augmented GPS, even the latest real-time carbon counter fascinated him! Every day he consults his air quality meter to provide feedback to the AirParif citizens network he joined recently. He is pleased to see that things are changing, that people are becoming more aware.
The virtual visit of the roofs of Paris on their terrace is not to be missed. He loves this app that allows him to choose the ambience; green, solar or elevation. The simulation tool, developed as part of the Paris municipal consultation of 2026, fills him with enthusiasm.

CHANGES IN THEIR VALUES

The values of Monique and Jacque change little. It is their practices in particular that change: their retirement does not unfold exactly as planned, and they have to adjust their behaviour, especially as regards mobility.

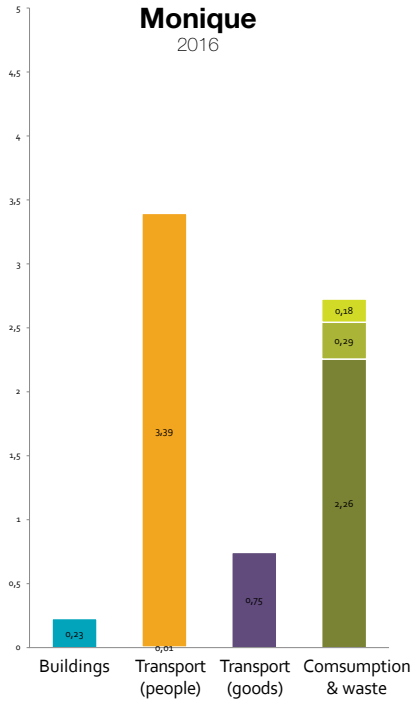
This change they experience is accompanied by the satisfaction of being able to take things in hand: the insulation of their roof, the abandoning of long distance travel in favour of new closer destinations do not feel like a burden, but opportunities to live in a different way.

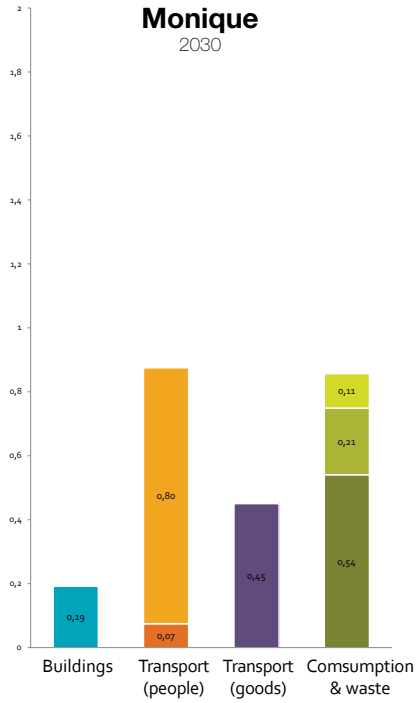
Their references also change: they are sensitive to messages from their children, especially Stéphane who followed an academic career in Boston and warns them of the risks to biodiversity associated with climate change. The fact of being able to reconcile their practices with their values is a source of relief. But the acceleration of climate change around 2030 is a source of stress for Jacques.

LEA WELCOMES HER PATIENTS IN MONIQUE'S OLD APARTMENT, ON MAY 3 2050

Léa opened her psychotherapy practice 3 years ago. She playfully named it A-LEA Climatique. Most of her clients are people who have had to leave their region or country of origin because it was subject to violent climate events. She chose to set herself up in her huge apartment in Rue Morland with a clear view of Paris.

07h30	The electric blinds in Léa's bedroom open with the first of the sun's rays. She wakes up slowly in an apartment bathed in light.	**Housing** 90m2 dwelling with a terrace in a building renovated in 2024 as part of the 'Let's Ecorenovate Paris' programme
10h00	Léa receives her first patients: a couple from the Grasse region who saw their house go up in smoke as a result of large forest fires that ravaged the region in 2049. They must learn how to grieve and rebuild themselves. Léa listens to them empathetically in order to lead them along the path to psychological resilience.	**Work:** The professions promoting psychological resilience have largely developed in recent years. Many charlatans are exploiting the demand!
13h30	Léa eats on the go, stretched out on a deckchair on the terrace of her apartment. She drinks a glass of Breton wine. She closes her eyes and sleeps for a few minutes.	**Food:** Global warming has slowly changed the cultivation distribution map. The vines have almost disappeared from the South of France. Quimper competes with Bordeaux: an excellent white wine!
20h00	Léa prepares for a long plane journey with her children (Paul and Virginie) to Baffin Island, in the far north of Canada. She can do this thanks to her parents' wealth, but knows that the carbon cost is exorbitant. She wants to benefit from this trip by perfecting the cognitive dissonance management techniques she teaches to her patients. Léa pays top price for the trip: premium service for material comfort, maximum offsetting for moral comfort. Before making the purchase, her insurer warns here that her annual climate premium will triple. Never mind, she will sell the shares in the Marrakesh Riad she received from her late father.	**Long distance transport** Aeroplanes have not changed much since 2016, there are still many kerosene-fuelled old crates built between 2010-2020 in circulation. The aeronautics industry has engaged in lobbying for a long time, and the carbon cost is now fully passed on in the ticket price, but States have not succeeded in adopting a common tax system, so it is the insurance companies that apply a climate premium to air passengers, which restricts this mode of transport to the richest individuals.


Monique
2016
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
0,23
0,01
3,39
0,75
2,26
0,29
0,18
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Monique
2030
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
0,19
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0,80
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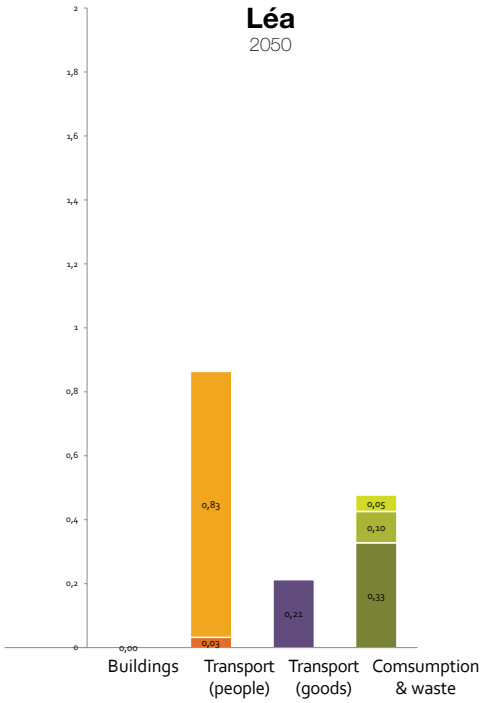
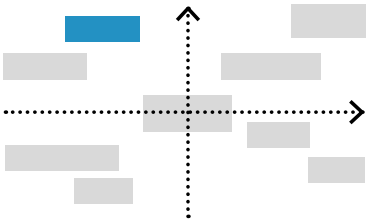
0,21
0,11
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Léa
2050
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
0,00
0,03
0,83
0,21
0,33
0,10
0,05
Buildings
Transport (people)
Transport (goods)
Comsumption & waste



The 'North-West' quadrant, families whose practices rely heavily on carbon despite their awareness and acceptance of the objective of neutrality. These are families that are likely to commit, but who need help (the disadvantaged) or have not yet made a start (the privileged).

THE DISADVANTAGED



Stéphanie
Age 41

Théo
Age 13

Dynamics of change

The optimisation of resources (transport, housing) allows Stephanie to free up time for the activities she values (principally food-related).

Stephanie spends her life running.

Running after the passing time. Running after the dreams she no longer has. Running in the cold and the night to get to Saint-Denis Hospital where she works staggered hours as a care assistant. Running again to take Theo (her 13-year-old son) to football. Always running… Her life is a daily Olympic event. On her days off, she collapses exhausted on the sofa in her little apartment in Porte de Choisy. Stephanie has just one dream: to leave Paris to go south. The south, the south…She repeats the words like a mantra, like a promise of happiness. Images from postcards fill her mind…She falls asleep to the sound of cicadas. Tomorrow is another day.

THE DISADVANTAGED

The disadvantaged may belong to all age groups. They have modest incomes and are very exposed to life's vagaries and accidents. They are not in full control of their existence. They subscribe to the values of ecological transition, but they are clearly behind in terms of practices (old cars, housing with no insulation). They are subject to significant financial constraints which determine their lifestyle. This discrepancy creates a form of cognitive dissonance.

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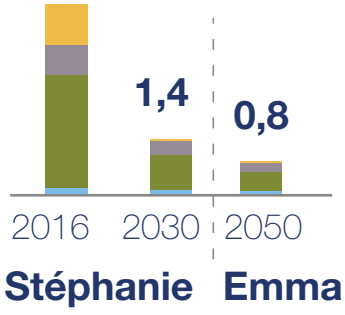


HER VALUES

Stephanie is very conscious of questions relating to climate change. She is convinced of the necessity of changing our lifestyles to save the planet. She is aware of the fragility of ecosystems and of the need to initiate actions in support of the preservation of biodiversity. She places a high value on her health and that of Theo. From a very young age, she learned to limit food waste, sort her waste, eat seasonal products, turn off equipment on stand-by and heat her apartment to 19°C, etc.

HER PRACTICES

Stephanie is convinced of all this, but her daily life constantly catches up with her, reminding her cruelly of the constraints she has to deal with. Life makes no concessions. Stephanie has had to buy an old Peugeot to get herself to work: "it's not the best, but it doesn't generate too much pollution. In fact, with…. I don't have a lot of choice" she says, pursing her lips resignedly. "We don't live in a perfect world. I would like to do the right thing but I need to be given the means. Otherwise it's too easy to point the finger at people". It is the same with food, in spite her focus on health, she deals with the most urgent needs. Some tinned food, a frozen meal, a piece of cheese or a yoghurt does the job. She would like to buy fresh products from the market and take the time to cook, but when she comes home from work, the fridge is almost empty and Theo grumbles because there is nothing to eat… Now that's going to make everybody happy! This discrepancy between her values and practices generates stress and tension in her. A note of frustration and bitterness can be detected in her words. To reduce this tension and justify her lifestyle, she puts her own values into perspective. Later, Theo will explicitly turn his back on these values…He has seen his mother, he has seen Thierry, his boss, toil for years. He understands climate issues, but he denounces the method, which he thinks too tentative.

HER FEARS AND VULNERABILITIES

Stephanie feels weak. She is afraid of losing her job, of not getting there, of falling ill, that Theo will be fall into bad company in the neighbourhood, that her old car will let her down in the middle of winter, etc. Stephanie feels she never has time for anything. She feels the years slipping by and sees the first signs of age appearing in her face. Stephanie avoids asking herself too many questions that she will not be able to answer.

SOCIOLOGICAL FOCUS

Through her profession, Stephanie notices the **hours** the city keeps and the **desynchronisation** of social time. Urban activity is gradually extending into the night. The night-time and dawn are no longer reserved for night owls, they are also the time of workers who reboot the city day after day and run the urban services.

Stephanie's profession shows the fragmentation of work and social time. Stephanie is not in control of her diary which resembles a patchwork of activities of which she tries to make sense. She is under constant tension to maintain a fragile balance between her multiple lives that ceaselessly threaten to disintegrate. She exhausts herself in this mad race against time. The Alzheimer's disease she suffers from also evokes the relationship with time.

STEPHANIE'S LIFE TRAJECTORY

Stephanie has worked at Saint-Denis Hospital as a care assistant since 2014. Through the APHP Company Mobility Plan initiatives, in 2025 she finds an equivalent job at the **Pitié-Salpêtrière Hospital** closer to her home. The "big data social" programme which matches social housing data with commuting needs has identified Stephanie as a priority individual. This programme is part of a more general approach that tries to bring jobs and the workplace closer together. In particular, financial assistance is offered for relocation. Theo studies for a Vocational Baccalaureate in Vehicle Maintenance at the Orly Industrial Training Centre. In 2022, Thierry takes Theo on as a workman. He takes over Thierry's garage in **2032**. In 2028, Theo meets Léa: the daughter of a customer. They set up house together in the 15th district. In **2033** and **2035**, Léa gives birth to Paul and Virginie. The couple separate in **2045**. Stephanie works until **2044**. The legal retirement age is now 69. She no longer feels independent since she became aware of her Alzheimer's in 2045. In **2048**, Theo places his mother in the **Moncley Alzheimer's Home**, close to the high-speed train station in her native Doubs. She hardly ever comes to Paris and isolation accelerates the disease.

	2016	2050
Age profession	Care assistant (41)	Retired (75)
Enfants	Theo (13)	Theo (47)
	Low	Low
	HLM Tenant (low-cost housing) 44m2 13th district	Maison Alzheimer de Moncley
Déplacement courte distance	Car	Bus + PAM
Déplacements longue distance	Train	
Alimentation	Carnivore	Demitarian

CHANGES IN HER HOUSING

In 2016, Stephanie lives in a small 44m2 social housing flat in a high-rise in the 13th district where she has been for four years. The block was entirely renovated in 2018. Her apartment is very cosy. It is her refuge, her "eagle's nest" as she says, that gives her a view over Paris. It is a chore to go to Saint-Denis. She tries everything to find a job nearer home. Her son leaves the apartment in 2026 after meeting Léa. Stephanie had got used to this household with her rebel of a son and his constant complaints. To compensate for this absence, she regularly hosts young people who come to Paris (paying guests, PGs), in particular young people from the Moncley area in the Doubs, where she comes from. "They are nice and their small financial contribution lets me buy the best products". The PG system was developed in response to Airbnb to facilitate the hosting of students, a population that traditionally has poor housing. The building is entirely renovated in 2028 (cross-financing from the regional investment fund, CROUS and the Retirees Reserve Fund). However, in 2048, she has to leave Paris urgently: the diagnosis of Alzheimer's is confirmed. She moves into the Moncley low-cost old-people's home (EHPAD), which specialises in Alzheimer's patients.

CHANGES IN HER TRANSPORT

Daily transport:

Stephanie drags her old car around until 2025. In 2020, Theo replaces the combustion engine with an electric engine. Stephanie sells her car to a colleague when she is assigned to Pitié-Salpêtrière. Through apps and the APHP Company Mobility Plan, she regularly carpools with her colleagues to travel to Saint-Denis Hospital. After her new assignment to APHP, she acquires a bike with the City subsidies. Nevertheless, she has difficulty in changing her practices and only uses it in the summer.

Long distance transport:

In the 2010s, she sometimes took the train to Nîmes. She stayed with her brother who lived in the town centre and considered moving. But the summer of 2037 was the hottest of the century. The Nîmes region recorded a 30-day heatwave. In 2038, Stephanie prefers to spend her summer holidays in the Doubs. She travels by train as she does every year. But this time she has an absence seizure and forgets where she is going. Theo is worried. He registers her with a new automated transport-on-demand service. But Stephanie often takes the wrong shuttle and does not feel good in these driverless cars: she needs to be reassured as to the destination and no-one can answer her. Theo then registers her for the PAM service (for people with reduced mobility), to increase human contact, but she often forgets her bookings. Finally, thanks to Stephanie's connected watch, the insurance company detects abnor-

mal walking behaviour. In 2048, it prescribes an examination for Alzeimer's Disease which proves positive. She is no longer insurable as an independent person. Theo finds a place offering treatment for Alzheimer's at the Moncley EHPAD. Theo watches her go downhill rapidly. He would very much like to come to see her more often, "but the garage takes all his week-ends and then there is the cost of travel!"

CHANGES IN HER DIET

In the 2010s, Stephanie had time constraints and did not take much interest in this topic. But after 2025 and her assignment to a hospital closer to her home, she has more time. She abandons cans and frozen food to devote herself to cooking. She takes note of positive feedback from a friend on the benefits of healthy, low carbon, low-cost eating. Marie had successfully taken part in the VLS family challenge (Vegetarian, Local and Seasonal) organised by the City of Paris.

Stephanie takes advantage of her knowledge and time to cook for her Paying Guests. Partly as a result of requests from her PGs, she progressively becomes demitarian. The Pitié-Salpêtrière initiates a large awareness raising campaign for its staff to encourage them to consume less meat and follow a healthier diet. Having more time to cook, she takes full advantage of the diversity and richness of Asian cuisine. She shops in the supermarkets on the Avenue d'Ivry or in the Dalle des Olympiades.

The food products in these supermarkets are now taken firstly by boat to the Porte de Bercy; then they are transported on the ring-road cargo tram to Porte de Choisy, from where modular electric shuttles supply all the shops in the district.

CHANGES IN HER LEISURE

She works until the age of 69 to obtain the maximum pension entitlement. She knows that will not be enough, so she puts a little money aside when she can – that is not often – just in case. Thanks to the PGs, she accumulates supplementary retirement pension points.
Once Theo is settled, Stephanie "learns how to live again", she takes part in repair cafés set up in her district. She loves this mixture of oriental music and the smell of mint tea. "We talk, we laugh" she says with enthusiasm. She finds that Theo is absorbed in technical matters, and does not necessarily understand his vision of a circular car.
At all events, her friends are delighted with Theo's work, which spruces up their old bangers and turns them into electric cars that are pleasant to use. The relationship with Léa, her daughter-in-law from an upper middle-class family, is not always easy. She and Stephanie do not come from the same world: "and now there is a man between us"!

Theo's nerves are on edge: there is nothing stable in his life as an entre¬preneur and "everything can collapse like a house of cards". There is no unemployment or retirement insurance, so he works as hard as he can. He devotes himself entirely to his business, even if this means neglecting family time. He tries to compensate and showers his children and his mother with small presents; his automobile conversion business is a success. Knowing the withering comments of some of his teachers who predicted a difficult and gloomy future when sending him to the technical stream, this represents a sweet social revenge.

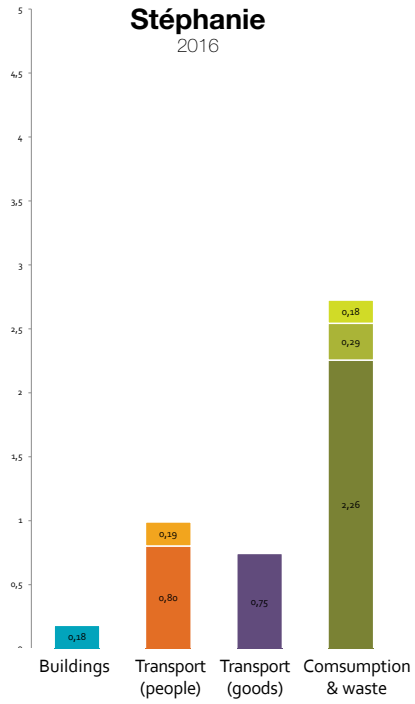
CHANGES IN HER VALUES

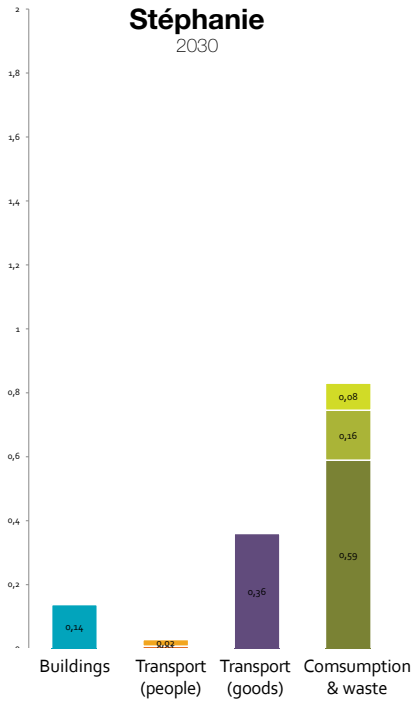
Stephanie has remained very conscious of questions relating to nature and the future of the planet. When the constraints of daily life become less onerous, Stephanie is able to match her values to her practices. Goodbye to the old polluting banger. Goodbye to poor-quality canned and frozen food. **But like her son Theo, Stephanie is still strongly subject to the vagaries of life (illness, etc.).** Theo benefits from greater material wealth and adopts the cultural codes of Léa's social circle. But he knows he is on the margins and exposed to the vagaries of life. He runs his life as a succession of power relationships. This latent anger leads to his separation from Léa. Theo is deeply affected by this. Involved in energy transition through his profession, he would like everyone to contribute and is increasingly critical of the actions put in place to achieve this, actions he considers too tentative and too inegalitarian.

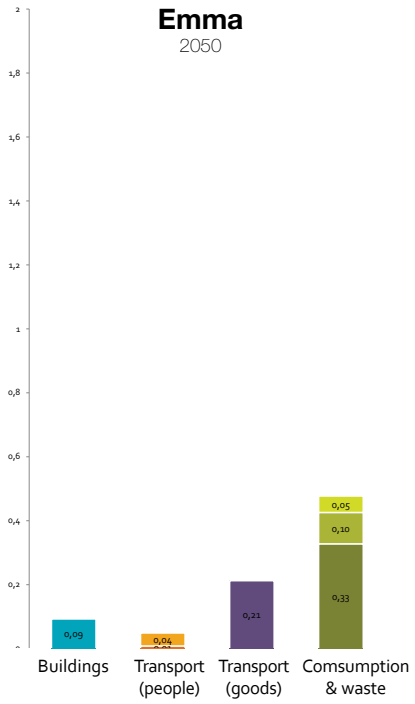
MARCH 11 2050, A CAMPAIGN DAY FOR THE WHOLE FAMILY

Emma is a candidate in the March municipal elections. She has chosen to be involved in public action after suffering acute asthma attacks as a child. Her partner Gabriel, is a language programmer and spends a lot of time caring for Victoire. Their daughter was born after four years of IVF attempts and has just celebrated her first birthday.

06h30	Emma has difficulty in getting up, she slept badly. She has to review the campaign with her team before the day begins.	**Housing:** Positive energy building of 45m2.
08h00	She gets on her three-wheeled carrier cycle, to leave Victoire at the cooperative creche. Today, Gabriel is translating for a conference and cannot look after her.	**Daily transport:** Electrically assisted bicycle and three-wheeled carrier cycle.
09h30	Emma carries out digital door-to-door canvassing in a hostile district. She plans her route in real-time, incorporating data supplied by her team of data scientists. The campaign platform is interactive and her programme is very largely crowdsourced.	**Job:** A hybrid job, an extension of the self-employed scheme, that she supplements with a public interest activity grant.
13h15	Emma has lunch with her campaign team: the meal is delivered by La Kantine, an ethical restaurant service (the era of bicycle couriers exploited and without rights of the 2010s is well and truly over). All rights are documented, and the energy inputs for the meal are synchronised on the life platform of each guest.	**Food:** Seasonal, organic, demitarian and vegetarian food. In-depth consideration of the nature of the contents (ecotoxicological studies).
15h00	Organisation of a conflict management meeting. The campaign is decided on the demonstration of problem-solving by the candidates. Panels of citizens choose the issues and test the candidates on real cases. This afternoon: the distribution of air carbon rights.	**Governance:** Citizenship forms an integral part of “active” time: time credits allow candidates and voters to prepare actively for the election, outside of their jobs.
20h15	This evening, Manuel and Emily have come to prepare dinner and take care of Victoria. Gabriel has not had the time to cook and Emma is in a meeting and will get back late: a heated debate about flight quotas!	**Long distance transport:** Air travel continues to be a thorny question: who can fly? for what cost? how many times in their lives? how to resolve these questions?


Stéphanie
2016
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0,18
0,19
0,80
0,75
0,18
0,29
2,26
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Stéphanie
2030
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0,14
0,02
0,36
0,08
0,16
0,59
Buildings
Transport (people)
Transport (goods)
Comsumption & waste


Emma
2050
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0,09
0,04
0,21
0,05
0,10
0,33
Buildings
Transport (people)
Transport (goods)
Comsumption & waste

«PARIS, AN AIR OF CHANGE» SAGA

		Protagonist's Age				
		2016	2030	2050		
		Mandate 2016-2020	Mandate 2026-2030	Mandate 2044-2050		
PRAGMATISTS	LEILA	28	42	62	LEILA	PRAGMATISTS
	JULIEN	32	46	66	JULIEN	
ACTIVISTS	CAMILLE	22	36	56	CAMILLE	ACTIVISTS
SUPPORTERS	EMILIE	34	48	68	EMILIE	SUPPORTERS
	MANUEL	39	53	73	MANUEL	
	EMMA	2	16	36	EMMA	DISADVANTAGED
				34	GABRIEL	
				1	VICTOIRE	
PRIVILEGED	MONIQUE	65	79			
	JACQUES	68	82			
DISADVANTAGED	STEPHANIE	41	55			
	THEO	13	27	47	THEO	OPPONENTS
REFUGEES	ADNAN	23	37	57	ADNAN	ACTIVISTS
				45	ESRA	REFUGEES
MODEST	THIERRY	50	64			
				19	GAIA	MODEST
OSTRICHES	NADIA	53	67	87	NADIA	ACTIVISTS
	ERIC	53	67			
	LEA	19	33	53	LEA	PRIVILEGED
				17	PAUL	SUPPORTERS
				15	VIRGINIE	
OSTRICHES	NICOLAS	21	35	55	NICOLAS	OSTRICHES
			41	61	INES	
			1	21	ERNESTINE	
				19	PHILIBERT	
OPPONENTS	OLGA	77				

OVERVIEW

SUMMARY OF THE PLOT

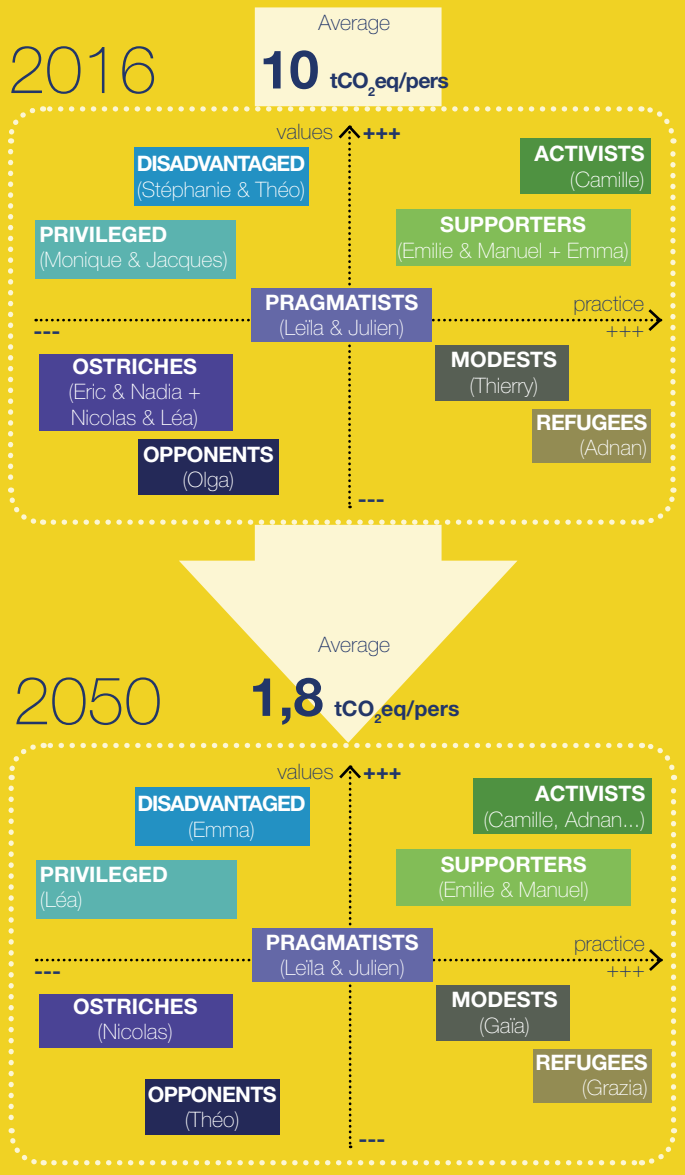
Leila and Julien remain **Pragmatists**: they adjust to the world that is changing around them.
Nicolas embodies the Ostriches, he refuses to see that the world is changing, like his father Eric who died in 2038.

Léa, Eric's daughter, becomes independent, she is **Privileged** and sets herself up in the comfortable apartment of Monique and Jacques, who die during the 2030s.
Léa leaves Theo, her father's mechanic, who has become marginalised and is now an **Opponent**: the inertia of the Ostriches shocks him and he feels very distant from the climate scepticism of Olga, who dies in 2030.

Nadia, Eric's ex-wife, has become an **Activist**, and supports an undertaking to welcome the refugees Camille and Adnan, who have started a family.
It is Grazia, a native of Puglia, who embodies the **Refugee.**

Disadvantaged by disease and limited resources, Stephanie has had to move house while Emilie and Manuel must take care, for their small pension does not allow any extravagance.
Their daughter Emma and her partner Gabriel embody the **Supporters** and their civic action.

After a **Modest** life, Thierry dies in 2045, the year when a young student arrives in Paris to share an apartment.



Which emissions?

The bar charts measure the characters' emissions. These carbon footprints are calculated using the same model as that used for Paris. The parameters are realistic and they form a representative statistical sample. When the composition of the family changes over the time period, we compare the emissions of different characters.

3.2.1/ MOBILISATION LEVERS

To achieve the objectives set for 2030 and 2050, there must be significant changes in the lifestyles of Parisians. The respective weight of the different profiles must change in favour of the more virtuous profiles located in the North-East quadrant. How can these profiles be made to change? The actions to be implemented vary according to the nature of these profiles.

We postulate that **there are already numerous initiatives in place.**

We also postulate that this programme of actions **should not resemble a list of required eco-friendly actions,** an approach which has demonstrated poor efficacy. On the contrary, we prefer an approach of empowerment which aims to provide Parisians with tools and resources.

We therefore postulate that the carbon neutrality strategy must **go further than the "mechanical" vision of Corporate Social Responsibility (CSR),** consisting in reporting and standardised commitments, but must also meet Parisians' expectations in their search for meaning.

Personae	Action levers	Levers
ACTIVISTS SUPPORTERS	Mobilise Unite	The challenge is to mobilise and unite the activists and supporters in the carbon neutrality policy right from the initial phase
DISADVANTAGED	Support	The challenge is to support those with constraints (scrapping bonus, zero-interest loans) including through offsetting/balancing measures.
PRIVILEGED	Educate Unite	The challenge is to make those who are privileged aware of this discrepancy between their values and practices. By joining the strategy, the Privileged can become aware of the impact of their actions.
OSTRICHES	Convince Constrain	The challenge is to convince the ostriches of the reality of the issues and the urgency of action, even making use of lists of (regulatory, financial) obligations to signal a break with "yesterday's world".
OPPONENTS	Reassure Support	The challenge is to reassure the opponents of their identity and help them to see themselves in a different world, in which their professions and skills will be valued.
MODEST REFUGEES	Support Educate	The challenge is to support the modest with financial incentive systems, and to educate them to avoid any rebound effect.
PRAGMATISTS	Mobilise	The challenge is to mobilise the pragmatists to allow them to go further and play the role of opinion leaders.

General levers:

These levers do not apply specifically to a sociological class, they do not depend on people's involvement with or opposition to climate questions or operational constraints. Here we give examples of their impact on a few characters. These factors are powerful levers for change.

FERTILITY	**Leila and Julien** become involved in the transition after understanding the link between their infertility as a couple and exposure to pesticides	The massive increase in infertility, especially in men, creates tensions within couples and families. It also creates introspection, which can lead to an awareness of environmental issues and their impact on health. These individuals are likely to become involved in associations ("in memory of Valentin", "never again", "eat without risk", "breathe without dying", etc.).
RESPIRATORY	**Emma** chose to get involved in public action after suffering acute asthma attacks as a child	The impact of atmospheric pollution (in particular NOx) plays an increasing part in the decisions of Parisians: some decide to move to protect their children's health. Having suffered pollution-associated respiratory problems as a child can foster involvement, mobilisation, spread by TEDx-type conferences or viral videos.
PSYCHOTHERAPY	**Léa** became a psychotherapist after seeing her parents split, (Eric the hedonist and Nadia, sensitive to animal rights).)	The cognitive dissonance between the psychological stress caused by the pressure of the climate and environmental emergency, weighs heavily on the mental health of Parisians. The consumption of anxiolytics and the proportion of professionals declaring their wish to leave Paris are alarm signals. The psychological care pathway can help Parisians to understand their neuroses and manage them better.
ANGER	**Theo** is angry, he feels powerless against a world that revolts him.	The inertia of some individuals, even the contradiction between actions and commitments, can generate indignation and even anger. This anger is currently latent in many Parisians, especially the middle classes who take the little humiliations associated with looking for housing very badly, who complain about special favours and inequalities, and who are shocked by the apparent impunity of a particular social class. Anger can be a source of radicalisation, isolation and social breakdown.
FULL AWARENESS	**Nadia** experiences an inner life which overturns her social references, she changes her life.	Meeting a multitude of aspirations and rolled out in different forms (spiritual retreats, mindfulness, meditation, personal coaching…), full awareness drives involvement, changes in practices, the breaking of social codes.
RESILIENCE	**Adnan and Grazia** develop a drive for survival as refugees. They take great strength from this capacity for resilience.	The collapse of the lifestyles of refugees drives them to leave, to wander. They confront obstacles, hostility and weariness, even indifference. They become convinced that they alone hold the keys to success, through action, inventiveness and solidarity.

EMPOWERMENT	**Camille** becomes involved with refugees, she takes up the challenges and becomes mobilised and proactive.	Actions by citizens in a civic, associative or voluntary setting are a means of expression, a tool for "doing one's bit like the hummingbird" and overcoming anxiety-producing ataraxia.
PERFORMANCE	**Nicolas** repeats the family patterns embodied by his father. He pursues a quest for possessions and materiality.	The search for performance, commercial talent, or more extreme variants such as the profit motive or greed, prolong the culture of materialism inherited from the consumer society. "Doing business" remains the driving force, and pragmatism leads to the adjustment of methods of wealth creation to the new order.
FEAR	**Olga,** a former shopkeeper, has lost her bearings and is worried about changes in society that she condemns.	The extent of the changes may be perceived as a threat, giving rise to fear and triggering withdrawal, inaction and also the search for reference points. Once they have been identified as "being afraid", these individuals can be helped by associations, local networks or even the municipal services (Paris has recruited clowns to resolve conflicts over night-time noise).
THE PARISIAN SPIRIT	**Gaïa's** project is chosen for a Climate House.	The "Génies de la Bastille" have taken possession of the new renovated square to set up the first "transition fablab" there. More broadly, it is the Parisian spirit of the artists of the Ecole de Paris, or that of Pereire and Eiffel, which breathes life into an ambition, a determination, an ambition. Paris here we come!
ESPRIT DE CORPS	**Eric** feels very connected to his alma mater, his club, his environment.	Esprit de corps coupled with peer pressure acts as a powerful regulator of individual action. The group acts as a filter, information travels fast, but it is uniform.
SOLIDARITY	**Thierry** is very close to his neighbours, he helps them out, gives them a hand. He bounces back through the social and solidarity economy.	Solidarity is a "social shock-absorber" in the face of emergencies and lack of means. It is the main basis of cooperation and managing with the situation. The social and solidarity economy, pooling and redistribution mechanisms strengthen its impact.
BIG DATA	**Stephanie** sees her everyday life improve through the matching of social housing and employer data.	The calculation and analysis capacities of Parisian databases enable systemic action and the avoidance of travel constraints, to optimise the allocation of limited resources.



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Rob Hopkins, Lecturer on permaculture, founder of the Transition Network, writer

«ICreate a different set of measurements : how to tell if the city is moving towards being more resilient, more connected, more entrepreneurial, more sustainable? Economic growth is a measure that really tells us very little. How are carbon emissions falling? How many new enterprises are being created? How much money is bring cycled locally? How much money have the people of Paris been able to invest into the economy of Paris?»

3.3/ MANAGING THE CARBON NEUTRALITY STRATEGY TIMELINE

IN A NUTSHELL

It is never the right time to take care of the climate. If everything is going well, why change? If on the other side we are in a crisis, short term priorities prevail over long term ones. We need to find the time for climate change and find permanent solutions to make a change.

3.3.1/ LET'S SET OUR CLOCKS TO "CLIMATE EMERGENCY TIME"

It is not enough to spend one hour per year on the topic, with symbols as strong as the "Earth hour", a worldwide marketing campaign to raise awareness on resource consumption for planet.

Let's consider the time challenges we have to overcome :

Short termism rules : What will I eat at the end of the week? Will my company exist in three years? Will I still alive in 34 years? Short term concerns occupy every waking hour and a 2050 time horizon may seem futile in the light of "urgent" demands. In a worse case scenario, the fatalist stance "we're all dead in the end" may have the last word and sidestep any effort to tackle the climate challenge.

Long term horizons are difficult to apprehend. 2030 may seem a distant perspective, especially for people born in the 20th Century, for whom Year 2000 was already a symbol of the distant future. However, in October 2016, we are closer to April 21st 2030 than to April 21st 2002 (a seminal date in France, when Jean-Marie Le Pen's selection for the second round of the Presidential election stunned the population). In soccer terms, we're closer to the World Cup of 2030 than to the 2002 edition.

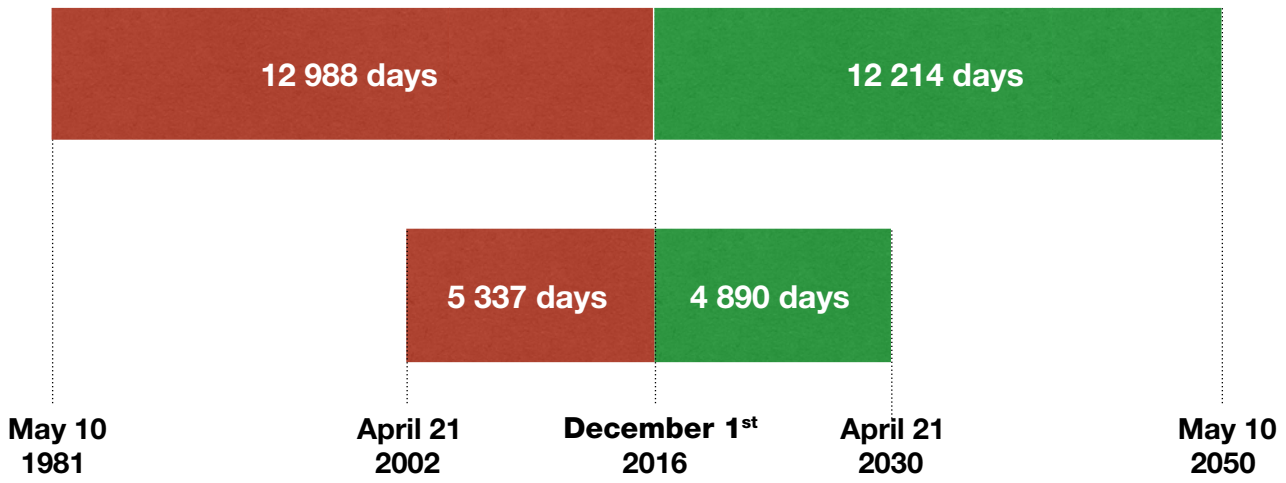
The effort must be both intense and sustained over a long period of time. To establish an action plan over a long period of time is a sort of "sprint-marathon". The exercise may be new for the vast majority of the players involved, who lack references or experiences of such long-term planning in their professional or personal life.

To face up to these challenges, we recommend to set in place a story-telling strategy, to appeal to our imagination and develop new cultural references to symbolize our objectives and timeline.

We need to learn to manage this long timeline, just as we've learned to live, love and learn in the culture of "real-time" and short-termism of the 21st Century. We need to construct "mirror milestones", to help apprehend the proximity of future dates, while keeping a link with previous ones. We need to construct marks that will enable us to appreciate the amplitude of change. The world in 1981 seems familiar, but it also belongs to another era: MacIntosh was a rain-coat, Apple mainly a fruit, and Microsoft a noun known to nerds.

On the one side, we need to highlight the "invariants", the reassuring elements that will not change with time, and that will not fundamentally be different in 2050. Paris will not be razed and rebuilt, we will not be wearing Roman togas instead of our business suits, washing machines will still have a rotary drum, and our fridges will only slightly change…

On the other side, it is reassuring to see that we can massively change the use of things we use, and change our cultural references so quickly. Taking into consideration the upheavals during the past 34 years: from the numerical revolution to the fall of the USSR, from the internationaliza-tion of our cities and culture to the upheavals of the CAC40 composition (itself an index only invented in 1987!).



3.3.2/ A POLITICAL GOVERNANCE CHALLENGE

The challenge of the strategic governance over carbon neutrality is not a mere timeline issue. It is a geographical challenge, hence political, posing the question of the articulation of the policies of the City of Paris with the policies of the “Grand Paris”, the “Metropolis”, the “Region”, even more… the “State” or “Europe”.

If only to ensure water, energy, electricity, construction material, gas or food procurement and other consumption goods, or to pilot the transport politic (local and/or international), Paris is inevitably a stakeholder in a multitude of governance networks.

A great part of the carbon neutrality strategy consists in crafting alliances

Alliances with other pioneering cities
Alliances with other cities will synchronize the adoption of complex measures or rupture innovations. Without this synchronization, Paris faces the risk of first mover disadvantage and would be punished for being the early adopter or accused of taking unilateral decisions. Hedging against a solo run by Paris, companies would threaten to relocate to more favourable business environments. Neighbour cities would complain of the burden of the consequences of measures taken by Paris.

Alliances with local stakeholders
Alliances with local ambassadors, opinion leaders will help spread the word through social hubs (cafés, restaurants, taxis…) or social networks, and therefore help touch a critical mass of engaged Parisians towards climate.

Alliances with media organisations
Media partners can help set the tone and catch the attention of the public with extended antenna time or column inches devoted to the measures, the presentation of manifestations and cultural initiatives that would allow to “live the transition”.

The signature of an ecological pact by Nicolas Hulot has become a strong mark of the presidential election in 2007, and has allowed to ensure that climate change would not disappear from the agenda after the election (although it then failed to set a target or to secure an obligation on the emissions reduction). A “2050 charter”, signed by well-known personalities and supported by a large part of Parisians, could popularize a common framework, a common and shared objective. This charter could (in the long term) act as an opposable document, able to sanction decisions taken by the “Conseil de Paris”. It could become the Paris “climate constitution”, supervised by a “council of the elders” to ensure the respect of recommendations and secure commitments referred to therein.

3.3.3/ ONLY 6 MANDATES TO ACHIEVE THE 2050 CARBON NEUTRALITY

The carbon neutrality strategy of Paris needs to articulate the climate change timeframe with a political and institutional temporality. It would be unrealistic to imagine a scenario without swings in political majorities over the next 33 years. How can we maintain our target on our carbon emission reduction objectives, regardless of the majority in place?

If interim targets aren't met, the challenge of the transition will be even tougher for the remaining mandates, which will have to implement steeper cuts in ever shorter timeframes.

This would imply to cast in stone the targets of emissions cuts for each of the upcoming municipal mandates. The political platforms of future elections would therefore focus the debate on the means to meet the targets, not the targets themselves.

This obviously raises legal, democratic, or even constitutional issues: how to define a legal status to reduce carbon emissions, and where would the cuts stand in the legal standards hierarchy?

2016-2020	2020-2026	2026-2032	2032-2038	2038-2044	2044-2050
1st mandate	2nd mandate	3rd mandate	4th mandate	5th mandate	6th mandate
Paris Agreement: Climate Plan 2017	Paris 2024	10 years of the Paris Agreement	20 years of the Paris Agreement		30 years of the Paris Agreement
Strategy launch	1st investment program	2nd investment program	3rd investment program	Massive adoption of "carbon neutrality" usages	Last reduction efforts towards carbon neutrality
Choice of compensation arrangements	1st land acquisition campaign	2nd land acquisition campaign / 1st land development programme	3rd land acquisition campaign / 2nd land development programme	4th land acquisition campaign / 3rd land development programme	5th land acquisition campaign / 4th land development programme
		2030 milestone			**2050 Carbon Neutrality**

3.3.4/ ONLY 36 EFFECTIVE MONTHS PER MANDATE OF 72 MONTHS

Every 72 months mandate follows, in investment terms and public orders, the same decision-making rhythm.

The 24 first months are necessary for the adoption of the main manifesto pledges on which a team was elected, and the subsequent readying and publication of tenders and requests for proposals, evaluation of the offers and market notification.

Some deliberations can have a rapid impact, especially measures regulating daily practices or tax schemes, which can shift investments or usages.

The next 36 months are the true “action months”, dedicated to the launch of major projects. The last 12 months at the end of the mandate are usually dedicated to wrap up projects and to the communication of the results and impact of the team in charge.

Having recalled that the carbon neutrality strategy needs to succeed in a short amount of time (33 years, hence 5 full mandates and a half), it is particularly important to anticipate objectives and means allocated to the first three infrastructure policy packages.

These «climate packages» must be defined through a transpartisan process, in order to secure their adoption by different political parties and therefore reduce the risk of delays or reversals in the case of electoral swings. This approach would also have the virtue of legitimizing actions programmed over more than one mandate.

As part of the «story-telling programme” of our strategy, we recommend to turn the development (and validation) of these climate packages into events and popular parties, so as to give these commitments a symbolic dimension, an emotional charge.

m-12 months
Programme elaboration + campaign

0-24 months	24- 36 months	36-48 months	48-60 months	60-72 months
Launch of the projects validated by elections (elaboration of specifications, public contracts...)	Implementation of the program			Synthesis of the mandate / Preparation of the works of the following mandate

ACHIEVING CARBON NEUTRALITY IN 6 M

FIRST MANDATE

① 2017-2020

Launch of the Carbon Neutrality Strategy for «Paris Changing Era».
The current mandate will accelerate reductions and prepare the required governance.

PRIORITY OBJECTIVES

Stage the strategy to communicate the ambition, the objectives and the method.
Safeguard the objectives of carbon neutrality, regardless of majorities elected from 2020 onwards.
Act as a priority on usages, carpooling, consumption, food choices, waste... Mobilize and animate a network of Climate Ambassadors.

EMBLEMATIC ACTIONS

High-impact regulations and decisions: food procurement from major Parisian entities (APHP, Town Hall, Ministries, etc.), lower maximum traffic speed, increase car-free days, launch a competition of ideas for the substitution of terraces Heating systems... Introduce the positive toll, launch of the bicycle plan.

GOVERNANCE

Synchronize decisions at the level of city networks (in particular the C40): diesel ban, mutualisation of public tenders.
Evaluate the costs, benefits and constraints of deploying a range of emblematic measures for the next mandate (investment, regulatory, carbon tax, etc.).

SECOND MANDATE

Keystone projects, major investments. The political mandate given to the team elected in March 2020 will allow it to accelerate the deployment of structural measures.

② 2020-2026

PRIORITY OBJECTIVES

Renew professional and individual mobility fleets.
Prepare the reconversion of the ring road into an urban toll.
Acquire landrights (solar roofs, agricultural land, compensation areas).
Launch long-term R&D programs (virtual tours of Paris for "no-flight" tourism).

EMBLEMATIC ACTIONS

Parisian Teleworking Plan (PTP). Create permaculture farms and inns in Ile de France (IDF). Co-Habitats Plan.
Massive renovation programme (priority given to the park built after 1947).
Large climate bond to fund massive measures (solar roofs, renovation, mobility, acquisition of land outside Paris).

GOVERNANCE

Mobilize the «climate ambassadors» proximity network.
Create new strong cultural markers, celebrate the 10 years of the Paris Agreement.
Set up the arbitrage process to deal with objections and conflicts.
Prepare the objectives of the climate package submitted to the vote in 2026.

THIRD MANDATE

Deployment, evaluation, adjustment. The «climate package» validated by the 2026 vote sets out the objectives to be achieved and the structural orientations for the mandate.

PRIORITY OBJECTIVES

Mobilize the Parisians towards the 2030 objectives.

③ 2026-2032

Allocate savings andinvestments to the Paris transition. Massively deploy the structuring initiatives initiated in 2020-2026.
Consolidate low-carbon economic industries (food, buildings, circular economy).
Launch R&D and Innovations (Climate Houses Competition, P-Prize).

EMBLEMATIC ACTIONS

Convert the ring road into an urban boulevard.
Introduce 2ºC tax incentives (bonus-malus, eco-conditionality, etc.).
Finance the removal of the most polluting vehicles from the traffic.
Adapt the tourism infrastructure (promote European partnerships and brace for a surge of climate refugees).

GOVERNANCE

Evaluate the results in 2030 and establish a remediation plan if needed.
Prepare climate refugee hosting plans.
Prepare the objectives of the climate package submitted to the vote in 2032.

MANDATES

OVERVIEW

FOURTH MANDATE

Massification of usages, removal of technological and behavioural blocks. The mandate begins with a series of corrective measures adopted as part of the «climate emergency». The mandate addresses the most complex «residual» issues.

PRIORITY OBJECTIVES

Extend mechanisms for carbon off-setting and storage.
Adjust long-distance mobility (slower, closer).
Adjust food practices (focus on «demitarians»).
Strengthen the compensation and solidarity mechanisms (Paris-Paris, Paris-Region, Paris-South).

④ 2032-2038

EMBLEMATIC ACTIONS

Stimulate the renovation of the small commercial tertiary sector (cafes, restaurants, small shops...).
Prefiguration study of the International Climate City (designed for climate refugees).
Massify the low carbon logistic scheme at regional level.

GOVERNANCE

Introduce the «carbon gap-years» for bachelors + young students.
Class actions against the biggest carbon emitters based in Paris.
Prepare the objectives of the climate package submitted to the vote in 2038.

FIFTH MANDATE

Consolidation of the dynamics of transition, management of the «rebound effect», post-2050 prefiguration.
The mandate continues to implement corrective measures and innovations designed to overcome residual bottlenecks.

PRIORITY OBJECTIVES

Upgrade the first generation of solutions (better energy efficiency, systemic contribution ...).
Safeguard carbon gains: target rebound effects.
Traffic ban for the most polluting vehicles.
Finalize the renovation of the housing park (focus on heritage buildings).
Extend co-habitation (especially intergenerational). Consolidate neighbourhood energy cooperatives.

⑤ 2038-2044

EMBLEMATIC ACTIONS

Open the Museum of the Fossil Civilization.
Extend «weekends without fossils» in Ile-de-France (1/month).

GOVERNANCE

Prepare the post-2050 project: culture, policy, scientific festivals, innovation fairs...
Prepare the objectives of the climate package submitted to the vote in 2044.

SIXTH MANDATE

The symbolic significance of the year 2050 justifies the organization of retrospectives, festivals and conferences, both in Paris and throughout the world. But the world does not stop in 2050 and the 2050 celebrations outline the post-2050 project.

PRIORITY OBJECTIVES

Celebrate! Plan parties and festivals on a par with the Year 2000 celebrations.
Consolidate and maintain the low-carbon heritage: valorise the efforts undertaken, the results achieved.
Vet residual emissions: mitigate, compensate or prohibit?

EMBLEMATIC ACTIONS

Celebrate the 30th anniversary of the Paris Agreement.
Launch new forms of mobility and long-distance collaboration.
Exhibit the work of the School of Paris (international post carbon action-research centre).

⑥ 2044-2050

Adopt «weekends without fossils» in the Paris Region (one every other weekend).

GOVERNANCE

Announce and inaugurate the project post 2050.

Jean Haëntjens
Economist, urbanist, director of Urbatopie and author

Carbon neutrality, applied to cities, is doable if we look at both side of the problem, technically and socio-politically. It is impossible to reach such an objective without a strong mobilization of all actors working in the urban field, including of course the inhabitants.

3.3.5/ 2016-2020 (1ST MANDATE) LAUNCH OF THE STRATEGY

a. Dec 2016-Dec 2017 mark a strong commitment

The first year is crucial, it is an election year, it must mobilize:

- Position the strategy, the ambition, the timetable, the means:

  - Take a stand: as a sign of a strong political courage, Paris rises up to the challenge of the COP21 and takes pride in its motto «Fluctuat nec mergitur». Paris formulates a simple, ambitious, unambiguous and determined mission statement inspired by JFK's launch of the Apollo programme: «Our nation must commit itself to landing the Man on the Moon and to bring it back to Earth safe and sound before the Of the decade «;
  - Mark a milestone, commensurate with the objective of carbon neutrality: «pedestrianisation» is a strong symbol, to be completed by other «totems»
  - Extend media air time to personalities from a wide range of backgrounds: elected representatives, finance / entrepreneurs, artists, and scientists;
  - Dedicate air / media time to explain and defend measures.

- Mobilize alliances and support and make them visible:

  - C40: align positions, coordinate announcements of backbone measures
  - Network of European Cities: Strengthen the prerogatives of an EU-wide procurement office
  - Proximity networks: increase the visibility and recognition given to pioneers, build a network of Climate ambassadors,
  - Business networks of the green economy (including green finance): speed up the processing of applications + proposals for intervention, facilitate the organization of events
  - Cultural networks, tourism and events: work on the evolution of the «Paris brand»
  - Education and NGOs networks: initiate an eco-school approach in all Parisian institutions (public, private), then in associations, sports clubs...

- Encourage the emergence of initiatives

  - Encourage the members of these pioneer networks to calculate their personal carbon footprint (and request that all City Council staff calculate their personal carbon footprint); start with declarative entries (require a pledge to declare accurate data); anonymise conclusions and share them on a database.
  - Publish pre-authorization charters (compost, vegetation spaces ...) to ease the initiatives taken by entrepreneurs or associations.
  - Publish calls for projects and performance targets for each of the 123 Paris districts (amplification of the competition "reinventing Paris").

- Story-telling of the strategy to inform and reach out to the largest audience:

  - Launch the «zero carbon generation» programme, reminding Youth that the NASA engineers who had celebrated the landing of Apollo 11 in 1969 were only 26 years old on average (and 18 years at the time of launching the programme).
  - Launch a «Paris Zero Carbone» brand (name to be found)
  - Aim for a TV series production of the script and next steps in the strategy
  - Create «Zero Carbon» tours of Paris and invite visitors to discover new usages

- Prepare projects for year 2

  - Vote significant budgets for the implementation of 2017-2020 projects, based on 2ºC tax incentives (announce "first come first served" aid programmes to encourage Parisians to act quickly, or a «bonus-malus» redistribution mechanism across Paris arrondissements based on the per capita consumption of electricity and gas)
  - Announce, prepare and initiate backbone projects (anticipate the time-lags induced by the preparation, publication and evaluation of requests for proposals or public tenders)

[1] Extrait du discours de John Fitzgerald Kennedy le 25 mai 1961 [en ligne] *http://www.futura-sciences.com/magazines/espace/infos/actu/d/astronautique-video-il-y-50-ans-president-kennedy-promettait-lune-30306/*

b. Dec 2017-March 2020: convince of the urgency to act, strongly, quickly

This sequence translates the announcements from year 1 into action, it must convince:

- Regulate and govern: set a stable, readable, fair and ambitious policy platform
  - Publish the timetable for the implementation of the main measures
  - Establish a conflict resolution structure and procedure
  - Set up a consultation structure with the neighbouring communes
  - Announce the conditionality of certain authorizations / aid, in a «win-win» logic (eg. grant favourable terraces extension rights to restaurants labelled «good for the climate»): companies who are most engaged in tackling the climate crisis should be rewarded for their efforts

- Act: implement exemplary, large-scale measures

  - Launch simple pace setting actions with a strong impact, that must embody the reality and solidity of the city's climate action. These actions inspire parties to join the programme: they are effective, they target significant parts of the emissions.
  - Implement common decisions at the level of networks of cities (C40, European and French metropolises): joint procurement office, expertise and audit group, mutualised R&D centres…
  - Leverage major international events (Olympics, World Expo, C40 congress or other major international meetings) to promote key milestones of the carbon neutral strategy; If applicable, refrain from submitting an application if the carbon footprint of the operation (especially international flights) cannot be compensated.
  - Measures are audited by an independent authority; the results of the audits are published in open data

- Finance:

  - Shift the tax base and redistribution schemes at the scale of the City of Paris, announce a gradual implementation of a bonus-malus scheme
  - Introduce a carbon tax on energy, transport
  - Issue a large «zero carbon» bond to allocate funds for implementation and investment projects
  - Foster and support sustainable local crowdfunding campaigns, launch a territorial investment fund
  - Design a defeasance fund in order to decommission stranded assets, and upcycle the collected materials

- Innovate: open the «Climate Houses»: laboratories for the youth elite committed to the climate

  - Climate houses leverage the experience of the «Grands Voisins» (St. Vincent de Paul) and open 20 «climate houses» (one per 100,000 inhabitants)
  - Climate houses are living laboratories that advance research in the field of carbon neutrality, they are centres of local animation, they are places of co-working, artistic and cultural creation, open to exchanges and international partnerships.
  - Participants are recruited on the basis of prototypes and live pitches of the candidates' projects, without condition of diploma (as for school 42 for example).
  - Selected participants commit their time to the advancement of the neutrality programme, they play a comparable role to the ESA astronauts, which justifies the allocation of funding to cover their accommodation and food (Public funding + tax credits + crowdfunding + private funds);

- Mobilize: create, train and animate the network of local ambassadors

  - Extend the core team responsible for monitoring and facilitating the strategy within the City Council,
  - Train internal teams : the target is to train 53,000 people in three years
  - Identify a climate ambassador for each neighbourhood, then each street
  - Provide these «climate ambassadors» with information resources on the flagship actions of the carbon strategy and the challenges to be tackled in the main themes, computer models and calculation tools, demonstration kits, and answer their questions via a hotline,
  - Climate ambassadors provide bi-directional mediation: they support and facilitate the implementation of the measures in their vicinity, they capture and relay feedback and recommendations from their local networks.
  - Adapt «eco-schools» methodologies to companies (SMEs of 10 persons and beyond), institutions, administrations (including in collaboration with the State and regional services)

- Publicly open the debate about «tough questions»

  - Impact assessments (real estate programmes and urban planning, high-carbon sites, major infrastructure projects, etc.)
  - Big data collection: fund the collection of large sets of data, across long periods of time (e.g. a minimum of one year to measure the evolution of traffic after the implementation of pollution restriction measures)

- Public controversies: foster debate and tackle controversies at a local level. Create and animate climate dialogue areas enabling opponents and proponents of measures to defend their respective positions; adopt governance and facilitation processes dedicated to public controversies
- Neighbourhood referendums: design mechanisms for public consultations / citizen voting to resolve issues that will not have been solved through the first level of dialogue. For a question to be submitted to the neighbourhood referendum, two alternative options, announcing the same carbon impact, must be proposed (it is not a yes / no on a single measure, but a choice between two measures).

- Reassure: the extent of change and its rhythm require facilitation and support

- Launch a «psychology and climate» challenge : a dialogue between climatologists and psychologists, aimed at developing resources / methods of psychological resilience to help Parisians cope with burnout, denial, anxiety attacks, stress...
- Mobilize religious networks, in particular in connection with the encyclical Laudato Si and the ecumenical working groups that joined up efforts during COP21
- Encourage intergenerational exchanges, especially among seniors and children, to help the elders transmit the memories, know-how and lifestyles of low-carbon times, and, where necessary, to share memories of adapting to tough times (e.g. life during war time or post-war reconstruction time).
- Develop measures with the DGEFP (state department in charge of skills and work competences) to anticipate and deal with economic skills transformations, in particular within the framework of the Provisional Management of Territorial Competences, and anticipate the need for training and retraining

- Build the «first climate package» for the 2020 elections

- The programme of action of the Second Mandate must derive its legitimacy from a popular vote: tough issues need to be raised before the vote to ensure they will be tackled in due time;
- The development of the programme will be largely collaborative and iterative: project promoters will be invited to submit their action plans for 2020-2026, they will be asked to demonstrate the impact and performance of their measures and how CO2 reduction targets will be met.
- A cross-party process will be designed to «sanctuarize» the package, to ensure that it will not be challenged in case of a political swing (e.g. public commitment / signature by all candidates)

3.3.6/ 2020-2026 (2ND MANDATE) ACCELERATION OF THE IMPLEMENTATION

a. March 2020 - December 2020 impulse a new phase

The first year of the second term must immediately draw the benefits from the mandate given by the electorate. The newly elected team immediately triggers the backbone actions of the Climate Package, including impact studies, calls for tenders, land acquisitions.

- Regulate and govern: publish ambitious, tiered targets and introduce binding measures
  - Publish the timetable for the implementation of the main measures
  - Launch tenders for structural programs (mobility, building, food)
  - Denounce the contracts binding the City Council to carbon intensive providers and modify the terms of reference to align the services with the strategy
  - Join initiatives led by citizens, companies or associations and provide legal support in order to launch class actions against big polluters and fight for a healthy air, quality water (actions inspired by urgenda in the Netherlands).
  - Modify urban planning, trade and transport regulations
  - Strengthen inter-city co-operation: co-invest in R&D tracks, pool best practices, replicate initiatives...
  - Implement the conditionality of certain authorizations / aid, in a «win-win» logic (eg. grant favourable terraces extension rights to restaurants labelled «good for the climate»): companies who are most engaged in tackling the climate crisis should be rewarded for their efforts

- Increase the number of Climate Ambassadors and broaden their sociological representativeness
  - The objective is to have identified (then trained) one ambassador per condominium, or for each commercial/public establishment with more than 50 staff.
  - Provide online collaborative digital tools to help share experiences; facilitate the organization of debates and public meetings (provision of rooms within a 10-minute walk).

b. December 2020 - August 2024 : deliver the first batch of Zero Carbon infrastructure (ZoC)

The bulk of the second mandate is devoted to the delivery of new low-carbon infrastructures, their commissioning and to the pedagogy required to facilitate their adoption. A transition management process must accompany the delivery of infrastructure, and must specifically include the means to convert jobs that may be affected by changes in usages,.

This sequence is likely to coincide with the delivery phase of the Olympics infrastructure.

- To act: to embody the change of scale and the amplification of the action
  - Launch actions that illustrate the «firepower» of Paris carbon Neutrality policy
  - Buy (or long leases) land in Paris and out of Paris and rooftop rights in Paris
  - Finance / acquire renewable energy production capacities
  - Develop low-carbon infrastructure (energy, transport, circular economy)
  - Launch a large scale transformation of surface roads and squares to reduce the space dedicated to cars
  - The audit of the emissions reduction programme is carried out by an independent entity, and its results are published in open data

- Financing: ramp up the resources allocated to the transition (scalability, debt, investment)
  - Change the tax incentives / redistribution schemes at the scale of the City of Paris: significantly increase the tax rates of the most carbon intensive usages
  - Broadening the carbon tax base for food, increasing the level of the tax, with the view of putting a true price on the most carbon intensive food items
  - Extend budgets dedicated to implementation projects and investment projects,
  - Launch a second «zero carbon» bond
  - Develop sustainable & local crowdfunding and the Territorial Investment Fund
  - Launch the defeasance fund, setup to remove the «stranded assets» from the market, enabling them to be «decommissioned» and for materials to be upcycled.

- Innovation: increase the «Climate Houses», the youth laboratories committed to the climate
  - Open 123 «climate homes» (one for each neighbourhood);
  - Open a budget line to fund and implement Innovations developed by house members (public and private partners associated to this type of early stage financing).

c. August 2024 - March 2026: consolidate the programme and prepare for the mid-term review

The aim of this second mandate is to reach out to a visible minority of «pragmatists», mobilizing well beyond the pioneering or militant circles. In particular, the mandate must mobilize Parisians on the development of the objectives of the third term.

- Mobilize: create and animate the network of climate ambassadors
  - Aim to recruit one ambassador per «building», or where relevant, one per staircase.
  - Strengthen the number, means and prerogatives of the «climate ambassadors»: they are the focal points of the strategy;

- Expand the debate on «rough issues»
  - Prior to the development of the Climate Package, address issues that have become sources of tension or threaten to slow down the pace of the emission reductions.
  - Deploy a network of climate mediators (and adopt a “train the trainers” methodology),
  - Organize a «major carbon debate», for example by setting up po-up climate desks on major (pedestrianised) roads on Sunday.

- Reassure: the extent of change and its rhythm require facilitation and support
  - Strengthen and expand measures to accompany economic change and retraining

- Invest in the Imagination and Culture of Carbon Neutrality
  - Open a «Museum of Fossil Civilization», and introduce ceremonies to mark the break with the fossil era and celebrate the entry of certain goods into the museum’s collections;
  - Boost the R&D on virtual tours of the carbon neutral city, immersive devices
  - Significantly invest in the cultural programme «A moveable feast»
  - Promote the «Ecole de Paris”, its students, research programmes and innovations (scholarships for artists, researchers, entrepreneurs)

- Build the «second climate package» to be voted on by Parisians for 2026
  - The 3rd term coincides with an important milestone in the transitional calendar and the platform of actions must aim towards this unifying objective;
  - The development of the programme will be largely collaborative and iterative

3.3.7/ 2026-2032: 2030 MILESTONE AND MID-TERM REVIEW OF THE EFFECTIVENESS OF THE STRATEGY

The third mandate is a key milestone in the carbon neutrality strategy. Most of the emission reductions must have taken place before 2030. The first four years of the mandate therefore represent an intense effort focused on the key pillars of the strategy. The last two, while continuing the effort, are devoted to the evaluation of the results obtained and, if necessary, the rapid definition of a Remediation Plan, if the results obtained are below the objectives.

One of the difficulties is to manage the acceleration of the effects of climate change during this period. An increased migratory pressure coincides with the renewal of thermal equipments, notably those of the concrete-steel-glass buildings of the beginning of the twenty-first Century (which had not initially been designed to sustain heat waves).

The share of climate change adaptation measures is a burden on the city and the Parisians on the one side, but it is also a factor of implication and commitment to the new low carbon usages.

a. March 2026 - December 2027 launch of the «sprint towards 2030»

2027 marks the 10th anniversary of the carbon neutrality strategy, and gives rise to numerous conferences, symposia, and an urban festival, celebrating the progress achieved since 2017. These celebrations are an opportunity to recall the importance of the 2030 milestone and communicate about the goals to be achieved on the sequence. In addition to this celebration, the first year of the third period must capitalize on the legitimacy given to the Climate Package by the new election. This first year is dedicated to the signature of new procurement contracts, to the adoption of backbone decisions for the remaining years of the mandate.

b. December 2027 - December 2030 deliver the 2nd batch of ZoC infrastructures

The core of the third mandate is dedicated to the deployment of new infrastructures and usages that have a significant impact on emissions. Above all, this period consolidates the low-carbon businesses initiated during the previous mandates.

The city is facing strong pressure on its finances: the tax transition is in progress, revenues from the taxation of intense carbon usages drop and are no longer sufficient to fund the investments in the transition. Taxation of low-carbon initiatives remains moderate, as this new economy is still in a consolidation phase. However, the private sector and Parisians step in to cover a greater part of the investment needs, as they increasingly perceive the profitability and sustainability of low carbon solutions / equipment / products.

c. December 2030 - March 2032: evaluate the action and adjust the strategy

The objective of this third mandate is to evaluate the performance of the carbon neutrality strategy, to communicate its results widely and to develop the objectives of the fourth mandate. The fourth mandate may have to implement corrective measures, either by intensifying previous plans or by introducing new policies, including more binding ones.

d. Managing conflicts

The third mandate concentrates difficulties: investments and therefore indebtedness are weighing on public and private finances, results are still relatively modest, the solutions implemented can be challenged or derailed. These difficulties are amplified by international tensions induced by the accelerating effects of climate change and the ensuing surge in climate migrations. The climate refugees passing through Paris represent numbers equivalent to the tourists of 2016, which profoundly alters the economics of hospitality, which remains one of economic powerhouses of Paris.

The management of conflicts is at the heart of the action of the third mandate. A silent majority of Parisians support the transition, occasionally take part in demonstrations or protests. In addition to investing in the immediate (re)mediation of local conflicts, the city initiates and supports legal action against the largest polluters, targeting the source of the problems that Paris and the Parisians have to face up to.

3.3.8/ 2032-2038: CRITICAL MASS OF USERS AND KEY TRANSITION POSTS

The fourth mandate is a phase of large-scale deployment of the solutions initiated in the previous mandates. It still represents a phase where two worlds coexist: a significant part of the usages continue to depend on carbon-based infrastructure, while the circle of Parisians engaged in the transition is now much larger than the core militants.

Scaling up no longer depends on the information or awareness levels of the public. Emissions reduction messages have now been broadcast continuously for more than 20 years. The main challenge is now how to ramp up production facilities and services on an industrial scale.

Usages that «resist» are the ones most difficult to replace, for which the last physical, legal, technological blocks must be lifted. If these usages can't feasibly be replaced, and if their necessity is ascertained, the challenge now is to tie these usages to compensation and sequestration measures. Where alternative solutions do not yet exist, this mandate must rapidly devote significant resources to R&D and the experimentation of new solutions.

a. March 2032 - December 2032: management of the corrective measures

As the results of the 2030 audits are known, a series of corrective measures must be rapidly validated at the beginning of the 4th mandate. Exception clauses make it possible to expedite the investigation of the most urgent / impacting measures (particularly relevant in the case of previous measures having faced significant delay / demonstrated little impact).

b. December 2032 - December 2036: promotion of infrastructures Zero Carbon usages

The previous two batches of low-carbon infrastructure packages are remodelling Paris and lift most of the operational obstacles to the adoption of new usages. This sequence's objectives are to foster the adoption of new usages. Investments in discovery programmes invite Parisians to try out and adopt new usages, with highly advantageous pricing for early adopters. Steep price rises are announced for late comers.

c. December 2036 - March 2038 Celebration of the 20 years of the carbon neutrality strategy and preparation of the 3rd Climate Package

2037 marks the 20th anniversary of the carbon neutral strategy, and gives rise to numerous conferences, symposia, and an urban festival, celebrating the advances achieved since 2017.

The first ZeroCarbon bachelors graduate and are celebrated. The number of «Climate Houses» increases significantly, enabling 20% of an age group to spend at least one semester in residence in a «Climate House» (a programme inspired by the Anglo-Saxon «gap year»).

3.3.9/ 2038-2044: CONSOLIDATION OF THE DYNAMICS OF THE TRANSITION, PREPARATION OF THE POST-2050 ERA

The fifth term is close to the 2050 deadline and close to the carbon neutrality goal. In terms of the supply of solutions / products, the mandate capitalizes on the research carried out during the 4th term. It is therefore devoted to the implementation of solutions designed to overcome the last major obstacles.

The 5th mandate devotes more resources to the animation of programmes already in progress and appeals to the imagination, in order to anticipate what comes after carbon neutrality. The collaborative dynamic around climate policy is one of the «classic figures» of civic and political action and has become a reality in everyday life.

a. Implementing the 5th generation of climate solutions.

The majority of these solutions are carbon usages displacements or substitutions. The dynamics of the deployment is driven by a significant evolution of the behaviour of the Pragmatics, whose practices and values are increasingly aligned with the objectives of the carbon neutrality strategy.

b. Tighter implementation of solutions.

Climate change and its consequences lead to the adoption of restrictive, binding or even coercive measures, which tackle the most carbon-intensive usages. The political mandate is not sufficient: the adoption of these tighter measures is the subject of intense debate (privacy vs. climate protection, individual freedom vs. collective harm) and is subject to a local referendum.

c. Renewal of the first climate solutions, which have become obsolete

Another part of the programme renews the equipment that was installed at the beginning of the transition strategy. In particular, the first generations of solar panels are replaced by much more efficient solar technologies. This phase of renewal leads creates new business opportunities for the dismantling of equipment and the re-use of materials.

d. Start of the planning process for the post-2050 era

Initial studies, post-2050 calls for projects are initiated during the 5th mandate. Options are evaluated by different expert panels and citizen groups. Contrasting visions emerge and give rise to exhibitions, prospective conferences and consultations of the Parisians on the main orientations.

Paris is branding its climate commitment as a «city of light», and is mobilizing an international network of experts and artists to feed the post-2050 foresight.

3.3.10/ 2044-2050: FINALIZATION OF THE TRANSITION PROGRAMME, INAUGURATION OF THE POST CARBON ERA

The 6th term leads to a very strong symbolic date. It is devoted to the finalization of the programme and the preparation of a memorable event that will mark this threshold, this benchmark point. The symbolic significance of the year 2050 justifies the organization of retrospectives, festivals and conferences, both in Paris and throughout the world. But the world does not stop in 2050 and events devoted to 2050 also look beyond 2050.

The objective of the sixth term is to plan and anticipate the next sequence. It continues preparatory work begun during the 5th term and launches the «major projects» for the post 2050 era: invitations to tender, investments and R&D.

a. 2050 Celebrations

These celebrations are similar to those of the Year 2000, or the bicentenary of the French Revolution (they can be launched in 2048, the year that will celebrate the bicentennial of the July Revolution).

b. Management of the latest projects of the strategy

At this stage, the efforts undertaken are marginal, they are not the most painful / the most complex to implement. This involves the commissioning of new tranches of solutions that are already widely known and accepted. Implementation is a matter of local pedagogy and the day-to-day management of projects.

The tighter measures decided during the 5th term are now understood, increasingly easily accepted, which facilitates their implementation. Their results are visible / analyzed and widely commented on. The evaluation of the effectiveness of the measures leads either to their alleviation or to their tightening in the context of emergency measures / climatic emergency measures.

c. Post-2050 planning

Post-2050 perspectives initiate a creative and ebullient momentum. What world do we want to invent, what do we want to do? The sixth mandate is marked by these debates, which give rise to confrontations, arbitrations and campaigns in competition with one another.



CONCLUSION

PARIS, AN AIR OF CHANGE

Paris is leaving the fossil fuel era. This is a landmark undertaking in the history of the city, like the advent of electricity in the past.

The electrification of Paris took place between 1870 and 1900 and transformed the French capital into the City of Light, gave it its underground railway, its lifts and its telecommunications system, made the "Roaring Twenties" possible and ushered in a century of rapid development. The Universal Exhibition of 1881 had an enormous global impact, with 750,000 visitors in a single year witnessing a multitude of innovations heralding a revolution in habits, lifestyles and business models. In 1889, the Eiffel Tower lit up the Paris skyline for the first time – the perfect emblem of this industrial era and this quest for progress.

This shows that it is possible to change from one era to another in less than 40 years, and it is reassuring to know that Paris has already undergone a comparable process of transformation, which allows us to believe that the extent of the changes announced in this report is not so much ambitious as rational and reasonable.

Rational, because the state of climate emergency requires us to work relentlessly and triple our greenhouse gas reduction efforts to attain neutrality by 2050.

Reasonable, because the proposed measures have practical foundations, taking account of the specificities of Parisians and their motivations, as well as their practices and their constraints.

Nevertheless, Paris will still need to carry out a rapid transformation of its buildings, its transport systems, its food and energy supplies and its waste, and these transitions will require simultaneous changes of habits, uses and infrastructures, while raising the massive question of how to finance these changes.

We should bear in mind the sheer scale of the issues at stake: firstly, the adoption of new mobility habits – carsharing, carpooling, cycling, walking and teleworking – in order to halve the car fleet and convert internal combustion-engine-powered vehicles to reduce transport-related emissions by 95%. Then there is the adoption of "flexitarian" diets – not quite as strict as vegetarianism but conforming to a "vegetarian, local and seasonal" approach. Next comes the massive renovation of the housing stock and tertiary buildings. Not forgetting the transfer of logistics flows to the River Seine. And the migration of the energy mix towards 100% renewable sources…

To succeed, we must therefore ensure that this goal of carbon neutrality is given its rightful status: as a central, essential and vital priority.

This goal must be the yardstick against which the major events – the Olympic Games and the Universal Exhibitions that have been announced – must be judged. They must be placed at the service of this project and become vectors for the promotion and adoption of new habits and uses; they must be catalysts for instigating and financing infrastructures, such as the conversion of the Paris ring road.

In addition to these events inherited from the 19th century, Paris must also invent its own landmark institutions to reflect the importance and impact of its carbon neutrality: an International Climate Complex (Cité Internationale du Climat), a Museum of the Fossil Fuel-Civilisation (Musée de la Civilisation Fossile) and Local Climate Centres (Maisons du Climat) – local laboratories in which young people can invent solutions and define how to implement them.

We must invent solutions to today's most complex problems: how to be carbon neutral while being dependent on tourism and therefore on aviation, in the knowledge that air transport is currently the biggest source of emissions? How to carry out the thermal renovation of buildings with respect for the specificities of Paris's precious architectural heritage? How to implement a carbon neutrality strategy for Paris without merely displacing the emissions to other parts of the Metropolis, France or other countries?

Above all, the mobilisation must take place on a daily basis, supported by the network of climate ambassadors, Parisians who, for the most part, are already actively engaged and young people for whom we must successfully accomplish the transition. We will need parties and celebration meals to mark car-free days and other carbon-free urban gatherings. We will need calls for projects and specifications that mark the departure from our fossil-based past. We will need eco-conditions, taxes and regulations to further develop this new economy and establish a new frame of reference for our daily lives.

We will need arable land, solar farms and wind farms, certainly in central Paris or on infrastructures converted to serve the cause of transition, but especially outside Paris. And to strike an overall balance and attain neutrality, we will need to plant forests to capture and store the residual carbon that we have been unable to reduce or offset by renewable energy production.

This programme is unlikely to unfold smoothly and without opposition; it would be naive to expect it to attract spontaneous and universal support. Attention must be paid to any objections, outbursts of anger or rage. Answers will need to be found and solutions will need to be improved, but we will need to demonstrate, explain and convince people that the neutrality goals involve us all, and that we must be united by a new political framework and a new civic pact – now and in the long term – to ensure that the trajectory being defined in 2017 can be maintained until 2050, whatever the future might bring.

The municipal majorities for the next five terms of office will doubtless be of differing persuasions. It will be our responsibility, as citizens, to make sure that they all continue these efforts and campaign to provide the best solutions for the targets that must be attained during each term of office.

The foundations of this project must be cultural, and must capture the Parisians' imagination. Dallas, the oil capital, had its own television series that epitomised the carbon era. Can Paris, as the carbon-neutral capital, launch its own series with similar success? How can Parisian artists form a new "Paris movement" representing their creations and productions while capturing the zeitgeist? Which popular figures will allow Parisians to take ownership of these messages and identify with these struggles and this quest for carbon neutrality?

Paris is basing its hopes for success on its population, its culture, its heritage, its history and its enterprises, but Paris is not alone. Paris is not a parochial village cut off from the rest of the world. **Paris has key allies to help with this transition**: as the host city of COP21 and as president of the C40 global network of cities, Paris can mobilise a very large number of cities in pursuit of these goals and this ambition.

Together, these cities can pool their purchases and orders, they can share their methods and studies and synchronise their decisions – especially the hardest ones to implement. This means that Paris might not be alone in deciding to ban diesel in 2020, it could be joined by the mayors of cities with a combined population of hundreds of millions of inhabitants, thus sending out a decisive signal to manufacturers: tomorrow's markets are being defined today and they call for cooperation between economic stakeholders, cities and citizens.

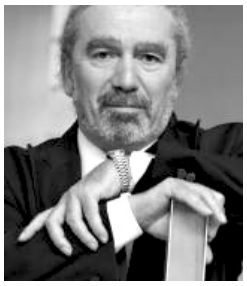
The carbon neutrality of Paris is a message of hope because it provides answers to anxiety-inducing questions, it takes up challenges with confidence and determination and it prepares for the future.



INTERVIEWS AND UTOPIAS
















CARBON NEUTRALITY ACCORDING TO EXPERTS

We have nourished our work from various contributions shared by recognized personalities and experts. We asked them two questions:
- Is a carbon neutral city possible?
- Under what conditions and on what perimeter?

We thank them and we faithfully transpose their answers here. we are deeply convinced that the transition is still possible, provided that a large-scale movement is initiated without delay.



CITY OF MELBOURNE,

Kate Vinot
Director City Strategy and Place

• Is carbon neutrality for a metropolitan area achievable?

Carbon neutrality is achievable for a metropolitan area, but it depends on the technical framework that is used, and the social, environmental and economic context, which in turn affect the complexity and time-frame to achieve this goal.
In 2003 the City of Melbourne (which covers 37,7 km² in the centre of the greater Melbourne area), made a commitment to achieve zero net emissions by 2020. This ambitious commitment covers both Council operations and the wider municipality. For the City of Melbourne, being carbon neutral means the net greenhouse gas emissions associated with a city's or organisation's activities are equal to zero[1]. This definition is consistent with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
and the Australian Government's Carbon Neutral Program.

The City of Melbourne has a legislated responsibility to "endeavour to achieve the best outcomes for the local community having regard to the long term and cumulative effects of decisions" and "to promote the social, economic and environmental viability and sustainability of the municipal district" (Local Government Act (Vic) 1989, Section 3C). We apply this approach to tackling the impact of climate change on these objectives through reducing greenhouse gas emissions and enhancing our climate resilience. Further, through their development of the Future Melbourne Plan in 2008 and the refreshed Future Melbourne Plan 2016, our community has expressed strong support for the City of Melbourne to reduce greenhouse gas emissions. This community consensus supporting urgent, ambitious, science-based emission reduction targets is further supported by the international consensus expressed by the 2015 Paris Climate Change Agreement.

The City of Melbourne achieved formal certification for the carbon neutrality of its operations in 2012 and this has been maintained for each subsequent year. Achieving carbon neutrality for the municipality requires substantial structural, economic and policy change to drive an increase in energy efficiency; rapid decarbonisation of the electricity grid, transport systems and other activities using fossil fuels; and investment in carbon offsets. Council does not have direct responsibility for these emissions, which come from a variety of private and public sector sources, so achieving the reductions requires innovation and a collaborative approach. Whether carbon neutrality can be achieved, therefore depends on many technical, social, political and economic considerations as described below in response to your second question.

• Under what conditions and with what scope?

Technical considerations
The definition of carbon neutrality used by the City of Melbourne is zero net emissions, which includes direct emission reduction through energy efficiency, renewable energy and fossil fuel substitution as well as the purchase of accredited carbon offsets equivalent to any residual emissions. In our view, carbon neutrality for the municipality is technically feasible because the technology needed to reduce energy demand, supply renewable energy, and substitute fossil fuels is available in the market today. In the short to medium term, there will be residual emissions regardless of the city's best efforts to mitigate emissions; however these can be offset via the purchase of recognised quality carbon offsets. The City of Melbourne has developed and implemented a number of acclaimed programs and initiatives aimed at reducing emissions across the municipality to assist with the goal of Zero Net Emissions by 2020. These include 1200 Buildings Program, Smart Blocks and the Melbourne Renewable Energy Project. More information on the City of Melbourne's relevant initiatives can be found here and here.

The scope and method of calculating municipal scale greenhouse gas emissions is outlined in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). This standard allows for transparency in what is measured and the assumptions made, which is an important condition for the community to have confidence in the credibility of any carbon neutral claim. The GPC is currently recognised as the most robust and comprehensive framework for measuring community emissions and is also the framework which the City of Melbourne utilises.

The Sectoral Decarbonization Approach developed by Carbon Disclosure Project (CDP), World Resources Institute (WRI), and World

[1] Zero Net Emissions by 2020, City of Melbourne (2014)

Wildlife Fund (WWF) can be used to calculate the emissions an organisation needs to reduce to meet science-based targets. The City of Melbourne recently used this method to calculate the science-based targets for the emissions from our own operations. The method takes into account the emissions intensity of the economic activity of the business or organisation. For a capital city such as Melbourne with a large proportion of retail, finance, educational and other services sector businesses this method enables a wide range of organisations to calculate their contribution to the city's emissions

• Social and political considerations

While it is difficult to measure precisely, there is a feedback loop between the City of Melbourne's commitment to setting bold, ambitious, greenhouse reduction targets and community support for this leadership. By committing to zero net emissions the City of Melbourne generated interest from other local and state governments and there are now several Australian cities with similarly ambitious targets. This has played a role in mobilising the skills, research and innovation needed to develop solutions, overcome policy barriers and identify market opportunities. This activity produced practical proposals to reduce greenhouse emissions that captured the public imagination, such as installing solar panels on public buildings and homes. In this way, the bold decision to commit to zero net emissions by 2020 itself played an important role in catalysing the necessary conditions to achieve it.

In Australia, local government does not have direct control over the vast majority of emissions sources within the municipal boundary. Therefore the delivery of emission reductions for their municipality depends on their ability to influence other government and non-government actors. In particular state and national governments have jurisdiction over energy policy including energy market regulation as well as energy efficiency standards for vehicles and buildings, and other organisations manage water, transport, waste and energy for the municipality. However local governments can demonstrate, promote and incentivise solutions and advocate for the required policy change.

For the City of Melbourne to achieve zero net emissions by 2020, the actions outlines in the Zero Net Emissions by 2020 strategy need to be accompanied by fundamental changes to our energy supply, which is subject to Australian and Victorian government policy. In June 2016, the Victorian State Government announced its commitment to a legislated target of net zero emissions by 2050 and a renewable energy target of 40 per cent by 2025. This action will support the conditions needed for the decarbonisation of Melbourne's electricity grid which will support the delivery of the City of Melbourne's carbon neutrality goals.

• Economic considerations

Over 70 per cent of emissions generated in the municipality of Melbourne are from electricity use in commercial buildings. This requires demand-side solutions to improve energy efficiency and supply-side solutions to supply electricity generated by renewable energy. For that reason we have developed programs, including financing options, to engage office workers, businesses and building owners in reducing their emissions. Local governments can also influence market conditions through purchasing policies. We collect emissions data from our major categories of supply and report the emissions generated by our supply chain. We are working to increase the number of carbon neutral goods and services, and low emission or electric vehicles that we purchase.

The market conditions needed to decarbonise Melbourne's energy supply are greatly influenced by policy settings of the state and national governments. Local government can play a role in supporting investment in business innovation, new technology, and the development of skills and training by partnering with universities and businesses in pilot projects, joint research projects, and internship programs.



Rob Hopkins
enseignant en permaculture, initiateur du mouvement des villes en transition
Transition Network, écrivain

A revolution in grassroots enterprise: reimagining the Paris economy.

Let's learn from a recent example in Belgium, when two companies changed their way of operating, and nearly 15,000 people lost their jobs. 15,000 families deeply impacted, with knock-on impacts across the economy.

My proposal for Paris is that it sees its economic future in enabling a revolution in grassroots enterprise. To return to our example of Belgium, conventional thinking would be that in order to replace the 15,000 jobs, two more companies need to be found. But what might it look like if instead the intention was to replace those jobs with 1,500 new enterprises, each employing around 10 people each?

There are many advantages to this. Such enterprises are increasing anyway. In the UK, for example, the majority of businesses now employ fewer than 10 people. Such businesses are more flexible, more connected to and responsible for local communities, more agile and nimble, more empowering, require less infrastructure, are more likely to pay their taxes, produce less waste, are more likely to collaborate with each other, and have more reason to remain in a place for longer. Rather than a handful of large businesses vying with each other to become the largest in the city or in the world, an ecosystem of smaller enterprises, often working collaboratively, could be created. Indeed in many areas of the economy it already exists.

At the moment, economic development strategies tend to be broad-brush and focused on the needs of larger businesses. To truly be in a position to address climate change, we must urgently move towards more resilient local economies.
We must also, as the European Economic and Social Committee pointed out recently, recognise that the COP21 Paris Agreement "will be implemented and brought to life by civil society, not the COP negotiators". They call for a "coalition of politics, administration and civil society".

Here are some key suggestions for how such a coalition could revolutionise the economy of Paris:

- ***Create a Paris Business Charter** : larger businesses will always play a role in the economy of Paris. But all too often, they are welcomed in with little expectation beyond their creating some jobs. A Business Charter would be clear that businesses setting up in Paris would be expected to show true corporate social responsibility and to enable and support, rather than undermine, the emerging new economy in the city.*

- ***Create a different set of measurements** : how to tell if the city is moving towards being more resilient, more connected, more entrepreneurial, more sustainable? Economic growth is a measure that really tells us very little. How are carbon emissions falling? How many new enterprises are being created? How much money is bring cycled locally? How much money have the people of Paris been able to invest into the economy of Paris?*

- ***Map where the money goes** : how much money does Paris spend on food every year? On energy? On care for the elderly? Knowing where the money goes allows the City to set some targets, and to frame the work of building a more resilient local economy as being an economic development approach. A 10% shift, for example, away from hypermarkets into local independent traders and local produce would lead to a significant amount of money remaining in the local economy, enabling the creation of new jobs, enterprises etc.*

- ***Harness the spending power of anchor institutions** : hospitals, schools, universities, the police and other public organisations spend large amounts of money annually on goods and services. Choosing to focus on supporting local businesses, or to create new co-operatives to meet the needs, would have a large impact. The Evergreen Cooperatives in Cleveland in the US have shown what an impact it makes when a hospital sources its energy, laundry services, food and other essentials from a community-owned cooperative.*

- ***Increase local democracy*** *: introduce Participatory Democracy for some public spending in the city. Invite and enable local people to work with the Council, and delegate decision-making to them, modelling devolution and giving local people more power over job creation, public spending and housing.*

- ***Maximise opportunities for local inward investment*** *: at the moment, many people have money invested in pension and other investments, which do no good for Paris, nor do they support the work that needs to happen in the city. Supporting the creation of community energy companies which invite local investment, or community-led developments which create new housing in community ownership, all offer great investment opportunities for local people. Local Entrepreneur Forums are a great model to bring people together to support their local young entrepreneurs. The Council of Paris also has a huge role to play here, in terms of where and how it invests its resources*

- ***Enable communities to own assets*** *: for communities to own land, buildings and enterprises makes a huge difference in their ability to design and create the kind of future they want. Where possible, support communities to do this, recognising that doing so often requires resources and expertise that may not be found in the community at the moment*

- ***Celebrate the new story*** *: there is a new story to be told about a more resilient, more local, low carbon Paris. A city where local food is revered, where the new young entrepreneurs who are telling a new story about the city's future are treated like heroes, where schools are reimagined as market gardens, power stations and incubators for the new economy. Where hospitals serve the best food in Paris and can tell their patients the stories about where all the ingredients in their meals were sourced. A city where every arrondissement has a story to tell about the food and drink produced there, about the economic shift underway there.*

There are many other cities around the world which are starting to take steps in the direction set out here. More local, more resilient, more democratic economies are essential if climate change is to be addressed with the urgency and at the depth the challenge demands.



Eric Vidalenc
Responsable Pôle Transition Energétique
Direction Régionale Hauts de France
Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME)

• Une métropole neutre en carbone est-elle possible ?

C'est possible à moyen terme, au plus tôt 2050, mais impossible à réaliser à l'horizon d'un ou deux mandats électifs. D'où le besoin d'inscrire des actions structurelles dans les projets d'infrastructures notamment, et dans le consensus à faire monter avec les parties prenantes du territoire pour des mesures plus comportementales ou « soft ».
C'est possible surement en occultant ou mettant de côté une part conséquente dans le Bilan Carbone d'une métropole, c'est-à-dire le trafic aérien… ou en adoptant des mesures « compensatoires » fortes en partenariat avec les acteurs et responsables de ces émissions notamment…et surement en dehors de son territoire. Les puits de carbone naturels (sols et arbres) sont bien trop faibles à l'échelle d'une agglomération pour jouer un rôle significatif dans ce sens.
Mais en tout cas, une métropole neutre en carbone avec un trafic aérien qui continue de croire, cela semble à première vue infaisable.

• À quelles conditions et sur quel périmètre ?

Introduire le concept de subsidiarité semble intéressant. L'idée étant déjà de faire localement…tout ce que l'on peut faire localement. Et d'aller chercher ou « faire le reste » à l'extérieur.
Une métropole, notamment en France aujourd'hui avec les nouvelles compétences Energie acquises avec les lois MAPTAM, NOTRE, TECV, peut agir considérable sur toutes les énergies de réseau sur son propre territoire (électricité, gaz, chaleur…).

Ensuite, il sera surement indispensable de s'appuyer sur des dynamiques extérieures qui visent justement à décarboner ces différentes vecteurs (via électricité renouvelable, hydrogène, biomasse…) via des injections qui auront largement lieux en dehors du territoire propre de la métropole. Mais la valorisation de déchets organiques peut aussi être réalisée via collecte en centre métropolitain (cf. biogaz au CVO de Lille métropole), la récupération de chaleur fatale sur eaux usées, grands équipements recevant du public, data center…sont aussi des sources locales mobilisables.

Pour aller plus loin, il faut soit contractuellement s'appuyer sur son Hinterland à travers une contractualisation à inventer, afin de construire un vrai projet de territoire avec les « marges » ou « périphéries » plus rurales. C'est l'occasion de faire que ces marges retrouvent une place dans le territoire.

Soit à travers une forme de contractualisation plus commerciale, en souscrivant des contrats avec des fournisseurs d'énergie renouvelables disposant d'installation en dehors du territoire (ex : Munich sur ses ambitions renouvelables), voire éventuellement à l'étranger, notamment dans des logiques de coopération internationale. Cela ne peut toutefois faire sens par rapport à la responsabilisation et transformation structurelle du territoire à opérer qu'une fois les potentiels locaux mobilisés…et pour des montants marginaux même si en termes purement financier il sera toujours moins couteux de compenser une tonne dans un pays émergent plutôt qu'en pays industrialisé.



GREEN CROSS France & Territoires

Nicolas Imbert
Directeur exécutif Green Cross France et Territoires

Paris se met en ordre de marche pour viser la neutralité carbone en 2050. C'est une démarche vertueuse, novatrice à l'échelle d'une mégapole, ambitieuse, et qui nécessite une métamorphose de nos comportements. La clé du succès en est triple : il s'agit d'avoir une démarche inclusive, incarnée dans la réalité, et enthousiasmante.

***Inclusive**, puisqu'il faut à la fois concevoir et mettre en oeuvre, de manière apprenante, notre alimentation, notre rapport au transport, au logement et au travail, nos sports et loisirs pour une démarche qui soit non seulement neutre en carbone, mais également qui préserve et développe la biodiversité, qui permette de mieux vivre ensemble, qui génère de la valeur économique, sociale et écologique, et qui maintienne le rayonnement de l'agglomération parisienne à un excellent niveau.*

***Incarnée dans la réalité**, car la stratégie bas-carbone ne se décrète ni se réglemente, mais se met en oeuvre à l'échelle du territoire, et que son succès est l'assemblage d'initiatives de terrains, complémentaires et concourrantes, pour la plupart issues de financement privés : développement de l'économie circulaire, circuits de production plus vertueux, partages des moyens dans une logique ou la coconstruction prend le pied sur la compétition, lutte acharnée contre le déchet et pour la valorisation du travail et de la matière. Dans ce contexte, le rôle de la puissance publique est passionnant : il s'agit, dans un contexte de rareté de l'argent mais de responsabilités sans cesse accrues pour les métropoles, non plus seulement de réglementer, surveiller et punir, mais aussi de détecter, identifier, accompagner et fertiliser, de montrer la force d'un réseau d'action fédérant les initiatives, d'utiliser la force de la transition bas-carbone comme outil de métamorphose des quartiers et des habitants.*

***Enthousiasmante**, puisque cette métamorphose ne sera effective que si elle fédère, si chacun s'y projette et perçoit son intérêt à en devenir moteur, ambassadeur et actant. En complément du rôle exemplaire de la collectivité, de l'urgence d'impulser toute initiative répondant aux enjeux d'adaptation et d'atténuation, une stratégie bas carbone réussie est aussi une stratégie qui ne laisse personne de côté, qui utilise la créativité de l'économie informelle pour en accompagner les pépites vers l'économie formelle de demain, qui construit du lien et de la fierté d'appartenance, et qui fait de la stratégie bas-carbone un levier d'efficacité économique, de rayonnement financier durable, et un socle culturel universel creuset de créativités.*

Le défi est immense - Paris a su avant et autour de la CoP21 jouer un rôle précurseur, engagé, concret et opérationnel sur la transition bas-carbone. La stratégie bas-carbone 2050 est le moment de transformer cet essai, tant dans sa définition que dans sa mise en oeuvre.



Benoît Leguet
Directeur général I4CE
Institute for Climate Economics

La neutralité carbone est un objectif souhaitable et nécessaire

Au-delà de la possibilité, une ville neutre en carbone est un objectif à atteindre pour rester dans un monde « 2°C compatible » et s'accorder avec les objectifs de l'Accord de Paris.
Ceux-ci demandent que les émissions mondiales baissent de 40 % à 70 % d'ici à 2050 et atteindre une économie quasiment neutre en carbone durant la deuxième partie du XXIème siècle. L'horizon 2050 pour la Ville de Paris est donc une avancée par rapport à ces objectifs qui montrent l'engagement d'une ville comme Paris à aller au-delà et plus vite que celui des Etats. Cette ambition s'inscrit dans la mouvance des engagements d'autres villes, reflétée lors du Sommet des Maires en marge de la COP21 en 2015. Copenhague, par exemple, souhaite également devenir neutre en carbone d'ici 2025[1].
Les questions à se poser sont donc de l'ordre de « comment y arriver » : quels sont les moments clés à ne pas manquer pour poursuivre les avancées sur cette trajectoire et quel est le rôle de chacun des acteurs de la métropole ?

Exploiter l'effet d'entraînement de la Métropole

Tous les leviers d'action ne sont pas directement aux mains des municipalités. En France par exemple, on estime que les émissions de GES issues du patrimoine et des compétences des villes ne représentent qu'entre 5 et 20 % des émissions totales de leur territoire[2]*. Les logements privés, les activités économiques ou encore les importations de produits de consommation recèlent un potentiel d'atténuation complémentaire très important.*
Le défi est alors de parvenir à entraîner dans la dynamique de réduction des émissions tous les acteurs du territoire (ménages, entreprises, associations, etc.). Pour cela, la Ville de Paris a un rôle d'information, de mobilisation, d'organisation et d'accompagnement à jouer. Il s'agit donc de poursuivre des activités telles que la plateforme Paris Action Climat qui accompagnent les entreprises et d'aller plus loin dans la mobilisation des citoyens. Elle peut également envoyer des signaux économiques forts et fournir des incitations ciblées selon ses compétences, par exemple via la fiscalité locale, ou encore l'introduction d'un prix du carbone interne dans ses décisions d'investissement – qui structurent les émissions futures - et même pour ses achats.

Partir du besoin des Parisiens et de leurs activités émettrices

Si la neutralité carbone de Paris semble indispensable avant la fin du siècle, il faut par ailleurs la rendre désirable afin de rendre acceptable l'objectif final, et son calendrier. Pour assurer le succès et l'adhésion des Parisiens à la démarche, il semblerait utile de partir des besoins quotidiens des Parisiens, sur chacun de leurs actes de la vie courante qui émettent des gaz à effet de serre : manger (ce qui inclut le transport des marchandises, la production de la nourriture, etc.) ; se loger (construction et énergie pour se chauffer) ; se déplacer ; se divertir (loisirs) ; etc. Tous les pans de l'économie sont ainsi concernés par la réduction des GES au sein de la Ville de Paris. Il s'agit donc pour la Ville d'accompagner, voire d'accélérer sur son territoire les réductions d'émission des secteurs fortement émetteurs tels que le transport et la production d'énergie. Ces secteurs sont déjà en train de s'engager dans un processus de décarbonation, avec par exemple la soumission des producteurs d'énergie au système d'échanges de quotas carbone

[1] Pour en savoir plus : http://denmark.dk/fr/vivre-ecologique/copenhague/
[2] Selon le rapport Delebarre & Dantec, 2014, http://www.assembleenationale.fr/14/evenements/mardiavenir/2014-06/MAE-rapport-2013.pdf

européen et avec la participation des acteurs du transport à l'Agenda de l'Action reconnu lors de la COP21. Ainsi a été mis en place le Paris Process on Mobility and Climate (PPMC) qui définit à la fois une feuille de route à long terme et des actions sans regret ayant un impact rapide sur la décarbonation du secteur[3].

Activer tous les leviers

Pour arriver à la neutralité carbone, il faut donc réduire au maximum les émissions actuelles et augmenter le potentiel de séquestration du territoire, c'est-à-dire développer :

- *La sobriété et l'efficacité énergétiques : rénovation des bâtiments, information aux habitants sur les comportements efficaces, etc.*
- *Les vecteurs énergétiques décarbonés : développement de l'hydrogène propre, maximiser le potentiel en géothermie du territoire, etc.*
- *Des offres de transport adaptées : espaces de télétravail, réseau express vélo pour les franciliens, poursuite de la subvention pour les vélos à assistance électrique, etc.*
- *La prise en compte du climat dans toutes les décisions publiques (ex : critères carbone dans la commande publique, choix d'investissement, prix interne du carbone, etc.)*
- *L'absorption des émissions résiduelles : par exemple, en développant la végétalisation et valoriser le patrimoine forestier existant (gestion améliorée du bois de Boulogne et de celui de Vincennes, avec une exploitation du bois et une augmentation de son potentiel de stockage de carbone)*

Enclencher une planification dynamique d'ici à 2050

Pour accompagner ces actions, la métropole peut mettre en place des régulations comme la mise en place de zones à faibles à faibles émissions (Low Emissions Zones) dont 194 zones ont été recensées dans neuf pays européens[4], selon un benchmark réalisé par l'Ademe en 2014[5]. Par exemple, le maire de Londres a annoncé en mai 2016 le doublement de la surface de la future zone à ultra-faibles émissions dans le centre-ville, avec un lancement en 2019 au lieu de 2020[6]. Il s'agira de voir, en prenant en compte les efforts fournis par les acteurs des secteurs de l'énergie et du transport, si ces actions sont sur la bonne trajectoire pour atteindre la neutralité carbone d'ici 2050. Dans cet exercice de projection, il sera crucial d'identifier quels moment clés et quelles décisions importantes à prendre qui seront déterminantes pour les réductions d'émissions associées et vérifier la résilience (capacité à faire face aux impacts du changement climatique) des mesures prises. À partir d'une cartographie précise de ces moments et décisions il est possible de poser des jalons pour une planification dynamique des actions d'aménagement, de renouvellement et de développement du territoire métropolitain cohérents avec une trajectoire neutre en carbone et adaptée.

Assurer la cohérence entre l'objectif global et les actions locales

Sur la question de la compensation, il sera pertinent de compenser les émissions résiduelles sur le territoire de la métropole, celle-ci ne pouvant sans cela être neutre, et sans reporter le problème des émissions à diminuer sur un autre territoire. Il est donc important, pour répondre à la question du périmètre, de prendre en compte celui de la Métropole du Grand Paris, y compris ses interactions avec la région, pour les émissions et les possibilités de compensation qu'il offre. Il est à noter qu'I4CE développe sur 2016-2018 un cadre de certification carbone volontaire national pour les projets agricoles et forestiers qui permettra de valoriser les réductions d'émissions au niveau national[7]. Cela pourrait être un cadre intéressant pour la Ville de Paris pour valoriser le potentiel de son territoire, également en interaction avec le territoire francilien. Ainsi une compensation des émissions résiduelles via l'achat de crédits carbone issus de projets parisiens ou franciliens agricoles ou forestiers sera possible et permettra la réalisation de l'objectif de la Métropole d'être neutre en carbone.

[3] Cf. http://www.ppmc-transport.org/ppmc-components/
[4] Autriche, République Tchèque, Danemark, Allemagne, Italie, Pays-Bas, Suède, Royaume-Uni et Portugal
[5] http://www.ademe.fr/zones-a-faibles-emissions-low-emission-zones-lez-a-travers-leurope
[6] http://www.journaldelenvironnement.net/article/qualite-de-l-air-droit-d-inventaire-a-londres,70536
[7] Pour en savoir plus : http://www.i4ce.org/go_project/projet-voluntary-carbon-land-certification-vocal/



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La question d'une possible neutralité carbone, appliquée aux villes, doit être posée à la fois sur le plan technique et sur le plan socio-politique. Il est en effet impossible d'atteindre un tel objectif sans une forte mobilisation des acteurs du jeu urbain, dont, bien sûr les habitants[1]. Cette question n'a par ailleurs d'intérêt, en terme prospectif, que si elle est associée au choix d'assurer l'essentiel des besoins en énergie par les renouvelables.

La faisabilité technique

Pour simplifier le raisonnement, nous ne prendrons en compte que les émissions liées au fonctionnement urbain - résidentiel et tertiaire, déplacements, logistique urbaine, consommations alimentaires des habitants - mais non les émissions liées à la logistique inter-urbaine ou à la production de biens industriels. Les émissions ainsi définies représentent environ 70% des émissions totales de CO_2, ce qui est déjà significatif. Elles correspondent, en France, à des consommations d'énergie finale de l'ordre de 15 000 Kwh/habitant/par an. Près de la moitié concerne le chauffage des bâtiments résidentiels et tertiaires, un tiers concerne les transports intra-urbains et le reste les usages de l'électricité[2].

Ces consommations urbaines pourraient être réduites, en partant d'une feuille blanche, d'un facteur 4 par rapport aux consommations actuelles. Concernant les consommations résidentielles et tertiaires, nous savons déjà faire des logements et des bureaux qui consomment, usages électriques inclus, moins de 50 Kwh/m²/an. Concernant la mobilité urbaine, la consommation énergétique, essentiellement d'origine fossile, pourrait être réduite de façon drastique en remplaçant l'automobile routière par un mix de transports collectifs, de modes actifs et de transports individuels légers (voitures électriques légères, 2 roues électriques, gyropodes, patinettes). À titre indicatif, une voiturette électrique peut se contenter de 0,1 Kwh/Km quand il faut 0,8 Kwh/Km à une berline routière roulant en milieu urbain.

Ces économies étant réalisées, il resterait cependant à trouver quelque 4 000 Kwh/habitant/an pour assurer les consommations urbaines avec des énergies renouvelables. Pour les besoins de chauffage, cette énergie pourrait être produite par du solaire thermique, de la cogénération biomasse et de la géothermie. Pour les autres usages, il faudra un apport direct d'électricité, qui sera principalement fourni par le solaire photovoltaïque, l'éolien et la cogénération biomasse.
La faisabilité technique d'une couverture des besoins énergétiques de la France par les seules énergies renouvelables a déjà été démontrée il y a plus de quarante ans, par le groupe de Bellevue[3]. Cette démonstration est toujours pertinente, et ce d'autant que les filières renouvelables ont vu leurs performances progresser et leurs prix relatifs chuter.
La principale question qui se pose, pour une métropole zéro carbone, c'est l'intégration des filières énergies renouvelables dans le milieu urbain ou dans son périmètre proche. Ces filières se caractérisent en effet par une faible intensité énergétique, mais avec cependant de fortes nuances. La productivité énergétique annuelle d'un m² de surface au sol est de l'ordre de 1 Kwh pour la biomasse terrestre, 30 Kwh pour l'énergie éolienne, 100 Kwh pour le photovoltaïque et 300 Kwh pour le solaire thermique (voir tableau).

Productivité énergétique d'un m² de surface au sol

	Kwh/m²/an		Base de calcul [4]
	Usages thermiques	Usage électriques ou mécaniques	1 TEP = 10 000 Kwh pour les usages thermique, 3 900 Kwh pour les usages électriques
Biomasse	1 à 4	0.4 à 1.6	1 TEP (forêt) à 4 TEP (cultures énergétiques)/ ha
Éolien		30 - 50	150 Kw/ha x 2 000 heures/an
Solaire photovoltaïque		100	1 000 Kwh/m², rendement utile 10%
Solaire thermique	300		1 000 Kwh/m², rendement utile 30%

La faible intensité énergétique des énergies renouvelables constitue donc une limite à la densité urbaine, mais cette limite reste cependant gérable dès lors que les consommations urbaines ont été préalablement réduites d'un facteur 4.
Une demande de 4 000 Kwh par habitant pourrait être assurée pour partie par des capteurs solaires (thermiques et photovoltaïques) situés directement en milieu urbain, en toiture ou en façades (soit 10 à 20 m² par habitant), et pour partie par des éoliennes et des productions végétales situées en périphérie.

Le caractère intermittent des énergies solaires et éoliennes et le coût actuel du stockage de l'électricité imposent par ailleurs d'apporter à ces deux énergies un complément qui, sauf situation particulière (ressources hydro-électriques, géothermie), viendra principalement de la biomasse (bois, déchets végétaux, cultures spécifiques).
L'équation doit alors prendre en compte la très faible intensité énergétique de la biomasse. En supposant qu'elle ne fournisse qu'1/4 des 4 000 Kwh/habitant, il faudrait déjà 1 000 m² par habitant. Ce chiffre est à rapprocher des 2 000 m² par habitant considérés comme nécessaires pour fournir une part significative de son alimentation.

[1] THEYS Jacques, *Les villes au cœur de la transition vers les sociétés post carbone*, Commissariat Général au Développement Durable, 2010
[2] Chiffres clés de l'énergie 2015, Ministère de l'environnement. Les transports urbains représentent environ les 2/3 du poste transport.
[3] Groupe de BELLEVUE – Projet Alter – Etude d'un avenir énergétique pour la France axé sur le potentiel renouvelable. Paris, Syros, 1975
[4] Voir Projet Alter, op.cit.

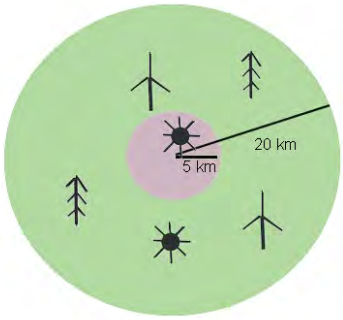
La question du périmètre

La prise en compte de ces données conduit à proposer quelques principes souhaitables pour une métropole zéro carbone.

- *Sa partie urbanisée concilie une densité minimale (permettant de faire fonctionner une mobilité économe) avec la possibilité de capter facilement l'énergie solaire et d'accorder une place significative au végétal. Le chiffre de 30 à 50 logements à l'ha, soit 7 000 à 10 000 habitants au km², fréquemment utilisé par les concepteurs d'éco-quartiers, donne une bonne indication de cette densité moyenne.*
- *Dans cette partie urbanisée, elle peut assurer une partie de ses besoins énergétiques par des capteurs solaires intégrés aux bâtiments (10% de la surface au sol).*
- *Elle doit compter sur un hinterland proche pour se procurer les compléments énergétiques nécessaires (éolien, biomasse), ainsi que les produits agricoles nécessaires à son alimentation de base.*

De tels principes sont faciles à mettre en œuvre pour une petite ville ou une ville moyenne et fonctionnent encore à l'échelle du million d'habitant. Une ville millionnaire appliquant ce schéma occuperait environ 100 km² dans sa partie urbanisée (rayon de 5,4 km si elle est monopolaire) et 2 000 km² dans sa globalité (rayon de 25 km). Il s'agit d'une configuration finalement peu éloignée de métropoles moyennes comme Lyon ou Nantes. À cette échelle, et sous réserve d'une réduction préalable des demandes d'énergie d'un facteur 4, la neutralité carbone est techniquement possible.

Schéma de principe pour une métropole « zéro carbone » de 1 Millions d'habitants
(source : Urbatopie)



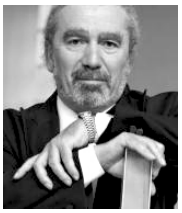
Ces principes fonctionnent beaucoup moins bien à plus grande échelle. Une mégapole monopolaire de 10 M d'habitants devrait en effet se déployer sur 1000 km² dans sa partie centrale (rayon de 17 km) mais sur 20 000 km² (rayon de 84 km) dans sa périphérie d'appui ! En somme, la nécessité pour une métropole zéro carbone de devoir s'appuyer sur hinterland rural représentant 10 à 20 fois la partie urbanisée introduit une limite d'échelle, tout du moins dans le cas d'une organisation monopolaire.

La faisabilité socio politique

La réduction de la demande d'énergie par un facteur 4, condition préalable de tout scénario zéro carbone, ne peut se concevoir sans une adhésion très forte de la population au projet et une gouvernance en capacité de piloter un difficile changement de paradigme.
Ces conditions semblent pouvoir être réunies dans des métropoles comme Göteborg ou Copenhague qui se sont fixées des objectifs zéro carbone à l'horizon 2025 ou 2030. Copenhague a démontré, par la place jouée par le vélo dans son système de mobilité (plus de 40% des déplacements) l'adhésion de la population au projet et son haut niveau de conscience écologique.
Ces conditions sont très loin d'être réunies dans l'agglomération parisienne. Ni la gouvernance métropolitaine, ni la conscience collective, ni la vision stratégique ne sont aujourd'hui à la hauteur du défi que représente la transition vers le zéro carbone.

Quel avenir pour un grand (ou petit) Paris zéro carbone ?
L'agglomération parisienne dispose donc de plusieurs handicaps pour tendre vers un avenir zéro carbone :
- Son échelle complique le fonctionnement technique d'un écosystème mettant en boucle les demandes énergétiques du cœur urbain et les ressources complémentaires (éolien, biomasse) nécessairement puisées dans la périphérie rurale.
- La mégapole souffre, par ailleurs, d'un déficit de gouvernance qui rendra difficile le « changement de paradigme » de son système urbano énergétique.
- Le bâti du cœur haussmannien pourra difficilement être isolé et alimenté de façon significative en énergie solaire (densité, caractère patrimonial).
Elle dispose en revanche de trois atouts majeurs :
- Une politique de mobilité très volontariste menée par la ville de Paris et tendant vers le « zéro carbone pour la mobilité » dans le périmètre de Paris Intra muros.
- Des ressources géothermiques qui permettraient de réduire en partie la dépendance énergétique du cœur urbain.
- Un positionnement symbolique au niveau mondial qui pourra jouer un rôle très important dans la mobilisation des acteurs. Si Paris était la première ville au monde capable de fonctionner sans voiture à carburant fossile, cela aurait certainement un effet mobilisateur considérable pour l'ensemble de la démarche « zéro carbone ».

C'est donc bien en partant de l'angle d'attaque de la mobilité qu'une stratégie zéro carbone peut et doit être engagée. Il s'agira d'ailleurs plus probablement d'une stratégie « zéro pollution », concept immédiatement compréhensible, que d'une stratégie « zéro carbone ». Ce concept reste en effet technocratique même s'il marque un progrès incontestable par rapport au très chic et très hermétique « post Kyoto » qui avait été affiché dans les réflexions sur le Grand Paris.



Jean Robert Mazaud
Architecte Urbaniste - président S'PACE & S'IAMA

Il est fréquent aujourd'hui, que l'on compare l'industrie touristique et l'industrie automobile et aéronautique. Rien d'étonnant puisqu'elles génèrent des chiffres d'affaires équivalents. La différence ne pourra que s'amplifier au profit du tourisme dans les années à venir tout simplement parce que la France est une plaque tournante au cœur d'un dispositif mondial sur le plan géographique et logistique (grâce notamment à ses infrastructures) mais aussi sur le plan historique et culturel. La capacité de notre pays à créer de la valeur d'attraction grâce à son tempérament contestataire et à son goût pour la créativité et la nouveauté en font une exception qu'il convient de reconnaître pour mieux la solliciter et l'exploiter.

Peut-on imaginer une évolution des pratiques vers un écotourisme ? Le changement de paradigme que nous impose la question environnementale impacte-t-il ce secteur et de quelle manière ? Comme n'importe quelle autre activité industrielle, le tourisme est-il susceptible de donner des gages sur des performances vertueuses ? Circuits-courts, prise de conscience et gestion des ressources, diminution des émissions de gaz à effet de serre, effets de résilience, cohérence et solidarité sociales font-ils sens lorsque l'on voyage, se déplace, pour partir à la découverte de soi et des autres ? La nature de l'offre peut-elle influencer la demande et vice-versa ? Peut-on imaginer et mettre en œuvre des formes de disruption écoresponsables ?

L'industrie de la croisière est, à ce titre, intéressante à analyser. Aucune autre activité n'a connu une telle croissance (8% annuelle en moyenne) ces vingt dernières années. Le seuil des vingt-cinq millions de passagers dans l'année est sur le point d'être atteint. Mais quantité d'idées reçues volent en éclat lorsque l'on recherche les signaux d'une disruption en marche.

Les passagers d'un paquebot sont d'une grande diversité sociale et géographique. Tous les pays sont désormais concernés par cette activité de loisir mais qui reste un mode de transport. Il est de plus en plus fréquent de voir des trajets aller en bateau puis retour en avion, voire l'inverse. (Dans ce cas le bilan carbone d'un voyage complet est nettement amélioré comparativement à un voyage exclusivement aérien).

Les activités pratiquées par les croisiéristes se répartissent entre l'intérieur et l'extérieur des navires. De nombreux opérateurs de croisières donnent la possibilité à leurs clients de passer des nuitées lors des escales dans les villes de destination des excursions (ce pourrait être Paris ou n'importe quelle ville de la vallée de la Seine à partir d'une escale dans le port du Havre).

Les ports d'Europe du Nord (cinq dans les trente mondiaux les mieux classés aujourd'hui) sont de plus en plus des destinations prisées et appréciées.

Si donc la croisière est un loisir en soi, c'est aussi pour ses adeptes un mode de déplacement- pour atteindre les sites qu'ils cherchent à découvrir, à condition que ces derniers restent dans un périmètre isochrone raisonnable (deux heures tout compris semblent être un maximum).

Le port de Copenhague au Danemark a accueilli près de 850 000 croisiéristes en 2013 et sans doute dépassé le million aujourd'hui.

Avec Paris comme attraction, il est imaginable de réaliser la même performance au Havre : un paquebot par jour dont un tiers des passagers choisit une excursion dans la capitale française. Cela nécessite des infrastructures adaptées dont on aura par la suite du mal à déterminer si le tourisme en est à l'origine ou si leur réalisation a favorisé le développement de cette industrie si convoitée.

En effet ce sont deux rames de TGV chaque jour dans chaque sens qui sont ainsi légitimées économiquement (environ 1 200 passagers). Ce sont également des équipements de rabattement de type télécabines, nécessités par la rapidité et la fluidité des liaisons navire-gare ferroviaire, qui deviennent justifiées tout en étant à disposition des habitants et de leurs entreprises (la croisière est une activité qui crée aussi des emplois dans les ports et dans leur périphérie).

S'imaginer qu'un nouveau touriste ne peut pas être vertueux environnementalement (taux d'émission de CO_2, consommation abusive des ressources, facteur de pollution, de bruit ou de congestion urbaine,) est aussi désuet que de penser que Airbnb ou Blablacar ne répondraient pas à un vrai besoin et ne seraient pas des valeurs ajoutées complémentaires dans un territoire déjà aménagé.



Matthieu Auzanneau
directeur du Shift Project, think-tank de la transition carbone, auteur d' « *Or Noir, la grande histoire du pétrole* » (La Découverte, 2015), blogueur invité de la rédaction du Monde, « Oil Man, Chroniques du début de la fin du pétrole ».

Une métropole telle que Paris sans émissions de CO_2 ? Chimère, utopie ! Oui mais voilà, le défi de l'Accord de Paris sur le climat réclame de transformer l'utopie en projet politique cohérent.

Il revient à notre génération d'inventer la ville post-carbone. Cette invention, c'est un souffle nouveau que Paris peut offrir au monde, la voie que la France et l'Europe se doivent d'ouvrir pour empêcher la ruine des conditions de vie sur Terre.

Il y a moins de deux siècles, Paris voyait naître la première révolution industrielle, celle du charbon et des hydrocarbures. L'humanité a depuis consumé près de la moitié du pétrole que la nature a pourtant mis des millions d'années à produire.

Parvenir à zéro émissions nettes de gaz à effet de serre au cours de la seconde moitié du XXIe siècle nécessite littéralement de faire émerger un monde inouï, une nouvelle révolution industrielle et sociétale. L'ampleur de l'entreprise égale tout ce que l'Europe a accompli depuis sa création. Cette entreprise est la voie de la modernité.



Régine Bréhier
Directrice Générale d'HAROPA - Port de Paris.

Comment HAROPA - Ports de Paris contribue à la Stratégie de Neutralité Carbone de la Ville de Paris à horizon 2050

Afin de répondre aux enjeux liés au réchauffement climatique et de s'orienter vers une métropole neutre en carbone, le secteur des transports est un axe prioritaire d'amélioration car il représente environ 27 % des émissions nationales de gaz à effet de serre en 2012[1].

Le transport de marchandises reste routier à près de 85%. Dans Paris, on estime que 20 % des véhicules en circulation sont dédiés au transport de marchandises, ce qui représente 1,5 million de mouvements (livraisons et enlèvements) par semaine[2].
Le développement des modes de transports « massifiés », que sont la voie d'eau et le fer, génère significativement moins d'émissions de gaz à effet de serre que la route et est particulièrement stratégique dans une région où la saturation routière est prégnante.

Pour répondre à ses enjeux Ports de Paris forme depuis 2012 avec les ports maritimes de Rouen et du Havre l'alliance HAROPA qui vise à développer des chaines logistiques à la fois performantes et écologiques à l'échelle de la Vallée de la Seine pour la desserte de l'agglomération parisienne.

Ces chaines logistiques s'appuient sur le transport fluvial et le transport ferroviaire qui constituent une alternative plus économe en CO_2 que le transport routier.

Ports de Paris est à la fois le premier port fluvial de France, le deuxième en Europe pour le trafic de marchandises (20,2 Millions de tonnes en 2015) et le premier port fluvial mondial dans le domaine du tourisme (près de 8 millions de passagers en 2015).

Le trafic fluvial en Ile-de-France concerne d'ores et déjà de nombreuses activités tournées vers la satisfaction des besoins de Paris, de ses entreprises et de ses habitants :

- *le secteur de la construction, s'agissant d'approvisionner les chantiers en matériaux et d'évacuer les déblais et déchets ;*
- *les déchets, s'agissant de les évacuer tout en permettant leur valorisation au meilleur coût ;*
- *le commerce, avec pour objectif à la fois de faciliter les flux import/export et l'émergence d'une logistique de distribution urbaine durable*
- *l'agroalimentaire avec notamment l'approvisionnement en céréales des Moulins de Paris*
- *le tourisme avec une activité de croisières fluviales dans Paris*

Le réseau de port constitué de ports maritimes, de plateformes multimodales jusqu'en première couronne et de ports urbains jusque au cœur de l'agglomération parisienne permet d'ores et déjà aux entreprises et aux chargeurs de développer des chaines logistiques réellement vertueuses et moins émettrices de carbone (cf. ppt joint).

En complément de son offre portuaire, le port de Paris s'est associé avec SOGARIS au sein de SOGARIS Paris pour participer au développement de nouvelles solutions de logistique urbaine durable. Dans ce cadre SOGARIS Paris porte actuellement la réalisation du projet de terminal ferroviaire urbain à Chapelle-International qui vise à l'utilisation du transport ferroviaire de marchandise pour approvisionner Paris.

Cette armature logistique qui se renforce répond aux besoins des grands flux logistiques et de la distribution urbaine en permettant des échanges de marchandises utilisant les moyens de transport les moins émetteurs de CO_2. Dès aujourd'hui Le transport ferroviaire et fluvial pour la longue distance, le transport routier électrique ou au gaz pour la courte distance. Demain il continuera à s'adapter et à évoluer pour toujours permettre l'utilisation des moyens de transport les plus performants et écologiques quelques soient les modes de consommation et de production qui s'imposeront en 2050.

[1] Rapport national d'inventaire au titre de la CCNUCC 2014
[2] Charte en faveur d'une logistique urbaine durable https://api-site.paris.fr/images/80326



FERMES D'AVENIR
AGROECOLOGIE & PERMACULTURE

Maxime de Rostolan
permaculteur, fondateur de Fermes d'Avenir et de BlueBees.

La permaculture est sur toutes les lèvres.
On confère à cette approche bien des vertus, mais on oublie qu'avant d'être une technique agricole, c'est surtout une philosophie globale, une méthode pour concevoir des écosystèmes humains équilibrés.
Quel autre objectif une femme ou un homme politique pourrait avoir que de transformer son territoire en un écosystème humain équilibré ?
La permaculture, qui repose sur une éthique forte, avance trois principes : prendre soin de la Terre, prendre soin des Hommes, partager équitablement les ressources.
C'est uniquement à ces conditions que nous pourrons envisager une société résiliente et un développement réellement durable.

Lorsque l'on parle de changement de paradigme, l'agriculture et l'alimentation doivent être appréhendées comme des briques essentielles, incontournables, comme le socle d'un nouveau modèle. Nous avons externalisé la fonction de production, soit à des machines, qui officient dans des environnements hors-sols et totalement contrôlés, soit aux pays étrangers. Une société ne peut pas fonctionner avec 2% d'agriculteurs et des produits qui parcourent 1 000 km en moyenne avant d'arriver dans notre assiette. Enfin si, elle peut fonctionner ainsi tant que le pétrole ne vaut rien…mais force est de constater que cet état de fait implique surtout de dérégler notre climat, d'empoisonner nos aliments à coups de pesticides (dérivés du pétrole), et de détruire les emplois locaux…

L'agriculture peut donc être appréhendée comme une des sources des problèmes de notre société, ou alors à l'inverse comme une formidable opportunité de 'réparer' notre monde, en fixant du carbone, soignant les gens, restaurant la biodiversité, et ceci au plus près des bassins de population, donc des centres urbains.

Nous avons 20 ans pour changer le modèle agricole, et la tentation de voir l'agriculture urbaine, qu'elle soit sur les toits, dans des serres ultra-modernes équipées de systèmes hydroponiques, risquerait de nous faire passer à côté des vrais leviers. Bien entendu, cultiver en ville présente de nombreux intérêts, comme la reconnexion des urbains avec la terre et les saisons ou la création de liens sociaux, mais ces projets nécessitent de tels investissements et frais de fonctionnement qu'il n'existe malheureusement pas de modèle économique.

Récupérer des terres en périphérie des villes de taille moyenne, assurer une relance par la production agricole plutôt que par le béton et les zones artisanalo-industrielles, créer des emplois péri-urbains, proposer des systèmes inspirés de la permaculture sur de grandes surfaces, voilà des pistes à creuser pour assurer l'autonomie alimentaire et la dynamique de nos territoires
La nature, source principale d'inspiration des systèmes permacoles, nous invite à diversifier les productions, à créer des synergies entres les espèces, animales et végétales, et il conviendrait de créer des fermes en polyculture-élevage, qui produiraient des fruits et légumes sur 10% de la surface et laisseraient le reste à l'élevage et la production de céréales, le tout conçu en accordant une grande place à la biodiversité, avec notamment des arbres, des haies, des refuges pour les auxiliaires…

Si en plus nous tirons le fil de la transformation, en intégrant à ce genre de fermes une cuisine et un laboratoire, nous renforçons encore la résilience économique de l'agro-système.

L'enjeu des villes de demain sera de produire de manière saine, en régénérant l'environnement, créant des emplois désirables. C'est un vaste programme, d'intérêt général, appelé à s'ancrer dans le concret et la durée. Les collectivités ou acteurs de la filière ne sont pas forcément équipés pour mener à bien cette mission, et nous avons imaginé un nouveau concept pour accompagner ce chantier : le payculteur. La première formation, organisée par Fermes d'Avenir, donne à 22 stagiaires les outils pour 'provoquer' la création de fermes sur leur territoire : de nombreux experts leur transmettent les compétences essentielles pour développer des projets alimentaires territoriaux, comme l'agronomie, bien entendu, mais également la gestion, la commercialisation, les notions juridiques, les ressources humaines, la communication, la connaissance des acteurs, la recherche de financement…

En 1940, une calorie fossile permettait de produire 2,4 calories alimentaires, il nous faut aujourd'hui 7 à 10 calories fossiles pour produire une calorie alimentaire : nous avons divisé par 25 notre efficacité énergétique pour produire de la nourriture…si nous souhaitons changer les choses, il faut repenser littéralement et profondément notre système. La permaculture propose des solutions, mais il faudra des dizaines de milliers de gens prêts à cultiver, et des milliers prêts à leur faciliter cette tâche et rendre le métier plus accessible.



Thomas Buberl
Directeur Général d'Axa

Malgré le succès de l'Accord de Paris et de la COP21, de nombreux défis restent en effet à relever pour renforcer les objectifs de contribution nationale (INDCS) d'ici 2018. Dans ce contexte, l'engagement des villes et métropoles du monde entier est un levier d'action décisif. L'objectif de faire de Paris une ville neutre en carbone d'ici 2050 est un signal politique incontestable, tant pour les acteurs de la transition climatique que pour les Parisiens qui bénéficieront de meilleures conditions de vie et de santé à long-terme. Dans cette perspective, nous percevons très positivement votre engagement au sein du réseau des C40 Cities et la dotation de la Ville de Paris au Fonds Vert pour le Climat des Nations Unies.
Alors que les deux tiers des 9 milliards d'habitants de la planète vivront dans les villes en 2050, celles-ci seront à la fois les principales sources de pollution, concentrant 70% des émissions mondiales de gaz à effet de serre, et les espaces habités les plus vulnérables face aux risques climatiques. Notre expertise d'assureur nous permet de mesurer l'ampleur des risques auxquels la population mondiale serait confrontée si l'action engagée à la suite de l'Accord de Paris n'était pas à la hauteur de cet enjeu primordial. Dans ce contexte, renforcer la résilience des métropoles constitue une des priorités majeures dans la lutte contre le changement climatique.

Nous partageons donc avec vous la conviction qu'il est urgent de mobiliser l'ensemble des acteurs de la société civile de Paris, y compris les entreprises privées et les sociétés financières, pour faire de la capitale française une place de référence de la finance verte au niveau mondial et des solutions urbaines durables.
AXA s'est engagé depuis de nombreuses années en faveur du climat en tant qu'assureur et investisseur responsable sous de très nombreuses formes. Le métier de l'assurance repose en effet sur deux piliers : d'une part, la protection des personnes et des biens, et d'autre part, l'investissement, dont la vocation est bien de rendre possible cette protection. Notre responsabilité est donc double : contribuer à atténuer le processus de changement climatique et agir efficacement pour accompagner l'adaptation des sociétés à ses conséquences.
Notre expertise en matière d'évaluation et de prévention des risques est un levier efficace dans le domaine de l'anticipation et de la réparation des catastrophes naturelles. Les données et l'expertise que nous avons développées au fil des années pourraient ainsi devenir la base de partenariats innovants pour faciliter le développement de vos propres outils de gestion du risque et des crises. Notre engagement auprès de l'Etablissement public territorial de bassin (ETPB) Seine Grands Lacs contribue déjà à cet objectif.

Notre rôle est également de soutenir les dispositifs les plus pertinents en matière de mobilisation des acteurs économiques et des populations locales face au risque climatique et face aux comportements à engager pour faciliter la transition climatique. A titre d'exemple, AXA Entreprises agit pour sensibiliser de manière continue le tissu économique francilien aux conséquences d'une crue centennale de la Seine, au-delà des grands exercices collectifs de préparation ou de la réparation de la crue exceptionnelle récente. Nos produits d'assurance eux-mêmes seront amenés à évoluer en vue de générer davantage d'incitations en faveur de l'adoption de comportements écoresponsables, en particulier en matière d'efficacité énergétique et de conduite automobile.
AXA cherche depuis plusieurs années à prendre sa part dans la recherche de solutions innovantes en matière de stratégie d'investissement durable. Notre responsabilité est en effet celle d'un investisseur institutionnel de premier ordre. Notre stratégie d'investissement est fondée sur le choix d'intégrer dans chacune de nos décisions des critères environnementaux, sociaux et de gouvernance (ESG) exigeants. Notre groupe s'est en particulier distingué par deux engagements institutionnels forts en 2015 : le choix du désinvestissement des industries intensives en charbon pour un montant de 500 millions d'euros et la décision de fixer l'objectif d'un triplement de nos investissements dans les obligations vertes, pour un montant cible de 3 milliards d'euros d'ici 2020.

Notre responsabilité est enfin de prendre des engagements internationaux ambitieux, à la fois en matière de transparence environnementale et en matière de financement de la transition écologique. AXA a notamment l'honneur d'exercer la Vice-Présidence de la Taskforce sur les risques financiers liés au changement climatique (TCFD) créée par le Conseil de Stabilité Financière sur mandat du G20. Notre groupe a également pris la décision de participer au prix international du meilleur reporting climatique, créé en juin 2016 par le Commissariat général au développement durable pour soutenir l'application de l'Article 173 de la nouvelle Loi de Transition Energétique. Nous travaillons également de manière rapprochée avec les agences des Nations Unies pour construire et financer un monde plus résilient, notamment à travers un partenariat avec le Bureau des Nations unies pour la réduction des risques de catastrophes (UNISDR).



Anne Girault
Directrice de l'Agence Parisienne du Climat

• Une métropole neutre en carbone est-elle possible ?

Une métropole neutre en carbone à l'horizon de la moitié de ce siècle, c'est l'objectif que nous devons partager, parce qu'il n'y pas d'alternatives à la transition écologique et que nous avons tous à rendre cela possible. C'est le sens du Sommet des élus locaux pour le Climat dans la déclaration de l'Hôtel de Ville de Paris, de la COP 21 et de la loi sur la transition énergétique. C'est un cap et une ambition qui servent à donner de la dynamique à l'action de tous.

La vision 2050 d'une métropole est également l'occasion de la construction d'une vision positive avec un projet qui parle aux habitants, dans leur quotidien d'aujourd'hui et qui préparent des trajectoires qui se déclinent dans nos vies et qui, étape après étape, conduisent à l'appropriation par le plus grand nombre des transformations à venir.
Le Plan Climat de Paris a toujours été précurseur et ambitieux dans la lutte contre le changement climatique. Les résultats après 10 ans de mise en œuvre sont là. La lutte contre le changement climatique est, depuis 2007, le fil conducteur de l'ensemble des politiques de la Ville. Le nouveau Plan Climat aura aussi cette ambition et rendra l'objectif possible. Les questions maintenant portent sur la trajectoire, les parcours sectoriels, les conditions sur lesquelles il est nécessaire de travailler maintenant. L'Agence Parisienne du Climat a été créé aussi pour cela et nous y prendrons notre part.

• À quelles conditions et sur quel périmètre ?

Aller vers une métropole bas carbone demande de remplir deux conditions structurantes : une condition de temporalité, commencer maintenant et une condition de méthode, en faire le fil conducteur de la transformation urbaine et de la construction métropolitaine, au cœur des agendas des décideurs et des scénarios de vie des citoyens. Les ingrédients sont là, notamment à partir du socle des résultats des dix ans de Plan Climat à Paris mais également dans l'ensemble des signaux faibles que l'on voit apparaitre dans les dernières années. La préparation des documents structurants des politiques publiques, de Paris à la Métropole, sera également l'occasion de se doter d'une nouvelle ambition à long terme et du plan d'actions opérationnelles et structurelles qu'il convient d'engager maintenant. Ce sont des opportunités qu'il faut saisir et qui feront du climat à ses différentes échelles la boussole des engagements du territoire métropolitain qui se construit. Inclusion et solidarité engagent à viser un périmètre large qui se constituera au fil du temps. Ce siècle est celui de l'ouverture, de la combinaison des échelles et des territoires. Première visée : la Métropole du Grand Paris, enjeu de la construction territoriale des toutes prochaines années dans une Région mobilisée. Progressivement d'autres espaces territoriaux pourront être liés à celui de la Métropole et offrir des espaces de mutualisation et de co-construction. C'est l'esprit dans lequel nous travaillons sur la rénovation énergétique des copropriétés et la réflexion sur les grandes questions énergie/climat dans une perspective métropolitaine et régionale. Une expérience à développer.

S'agissant des thématiques, le bâtiment en général trouvera son chemin à l'horizon de cette première moitié de siècle. Plus difficile reste la question des transports et de la mobilité en général. C'est aussi l'enjeu francilien.

Enfin il convient de consolider les conditions du passage à l'acte : l'accompagnement au changement, la mise à disposition de bibliothèques de solutions, le croisement des regards, l'apprentissage par l'écoute de l'autre et le repérage des signaux faibles et bien sur la préparation des nouveaux métiers. Et puis, certainement apprendre à compter différemment : les euros ne suffiront pas, les kWh non plus, et il sera important de compter carbone et d'avoir une vision plus précise de notre empreinte et de nos impacts pour guider les choix, de ceux des citoyens et des décideurs.

Aider à passer à l'acte maintenant, sans perdre de temps, c'est la méthode que nous avons construite en 6 ans à l'Agence Parisienne du Climat. Laboratoire de la transition, expert du quotidien, nous pensons avoir réuni un certain nombre de conditions opérationnelles pour contribuer à un nouveau cap plus ambitieux.

- *Disposer et communiquer sur des repères simples, adaptés et fiables avec une bibliothèque de solutions de bonnes pratiques disponibles dans l'ensemble des secteurs*
- *Décrypter les transformations en cours et donner un cadre de références solides, propices à l'action*
- *Valoriser et donner du sens à l'innovation et proposer des territoires d'expérimentation*
- *Renforcer le rôle des acteurs opérationnels de proximité et démontrer la capacité à innover en tenant compte des réalités*
- *Augmenter l'expertise des acteurs en assurant la transmission des informations, le décryptage des politiques, la co constructions de nouvelles démarches et outils avec savoir, compétence et créativité.*

Fort de notre expérience et de nos 90 partenaires et adhérents, la préparation du nouveau Plan Climat sera l'occasion de prendre notre place dans cette nouvelle étape.



Flore Berlingen
Directrice Zero Waste France

Notre territoire souffre d'un retard énorme en matière de tri et de réduction des déchets : deux fois moins de tri que dans l'ensemble de la France, sans parler de métropoles européennes plus performantes. L'analyse de nos poubelles montre que plus de 40% de leur contenu est constitué de recyclables, et ne devrait donc tout simplement pas s'y trouver. Face à ce constat, il est donc logique et urgent de mettre les bouchées doubles (c'est à dire mobiliser des moyens humains et logistiques) pour donner la possibilité aux habitants de réduire et trier plus facilement. Car c'est bien le seul moyen de faire progresser nos performances : il n'y a ni baguette magique, ni sens inné de l'écologie dans certaines régions. Un engagement politique fort et des choix d'investissement cohérents sont les conditions sine qua none pour débloquer la participation citoyenne. Le Plan B'OM s'inscrit dans cette dynamique positive et volontariste.

Le mouvement est en marche, à tous les niveaux. Malgré les faibles performances de tri rappelées plus haut, la quantité d'ordures ménagères résiduelles (celles qui sont envoyées en incinérateur) sur le territoire a diminué de 20% entre 2005 et 2015. Au niveau national, les textes adoptés en 2015 et 2016, dont la loi de Transition Energétique, imposent une accélération : tri obligatoire de 5 flux de déchets dans les entreprises, extension des consignes de tri à tous les plastiques d'ici 2022, tri des biodéchets pour tous les citoyens d'ici 2025… autant de déchets que l'on ne devra plus trouver dans les fours des incinérateurs et au fond des décharges.

Du côté des citoyens, le zéro déchet remporte de plus en plus de suffrages, tant le gaspillage devient insupportable à qui découvre l'urgence de préserver les ressources qui nous permettent de vivre et d'évoluer dans un environnement sain. Si 5000 personnes ont participé, à leurs frais, au Festival Zero Waste à Paris en début d'été 2016 pour apprendre à mettre en oeuvre une démarche zéro déchet, combien seraient prêtes à suivre le programme ambitieux qui leur serait proposé par une collectivité ? Quant aux réfractaires, sont-ils seulement avertis que leurs déchets envoyés à l'incinérateur contribuent directement à la pollution de leur cadre de vie ? Combien seraient prêts à finalement franchir le pas (réduire, trier) s'ils étaient au courant que le jeu en vaut la chandelle, tant pour leur santé que pour leur porte-monnaie ?

La pollution atmosphérique est en effet particulièrement problématique en Ile-de-France, où les émissions dépassent encore les seuils réglementaires pour plusieurs polluants dont le dioxyde d'azote et les particules fines. Ces polluants sont bien sûr émis en premier lieu par le trafic routier, mais les usines d'incinération y contribuent aussi !

En outre, ces usines émettent aussi d'autres types de substances toxiques (dioxines par exemple) dont on sait que ce n'est pas la dose qui fait le poison, mais l'exposition prolongée.

Un plan alternatif permettant de créer plus d'emplois
La reconstruction de l'usine d'Ivry-Paris 13 n'est pas inéluctable, au contraire : de nombreuses solutions déjà appliquées en France ou à l'étranger permettent de réduire la quantité de déchets à incinérer. Elles ont été rassemblées pour former un plan alternatif, le Plan B'OM (pour Baisse des Ordures Ménagères). Les objectifs du plan restent modestes : dans un premier temps, il s'agit simplement d'atteindre, d'ici 2023, les performances déjà atteintes aujourd'hui par les métropoles de Lyon ou Nantes ! Cette première étape permettrait déjà d' arrêter la mise en décharge et de se passer de la reconstruction de l'incinérateur, mais il ne faudrait surtout pas s'arrêter là . Les deux autres incinérateurs de l'agglomération suffiraient à traiter le reste des déchets résiduels, mais l'objectif serait alors de réduire progressivement leur capacité en allant plus loin que le Plan B'OM, c'est-à-dire vers le zéro déchet.

Le Plan B'OM comporte trois chantiers, illustrés par 12 actions concrètes. Ces chantiers et actions prioritaires ont notamment été identifiés grâce à une méthode très simple : l'analyse de la caractérisation (détail de la composition) des poubelles d'ordures ménagères résiduelles (celle qui sont incinérées ou enfouies) du territoires. Cette analyse a ainsi mis en évidence la présence anormalement élevée (par rapport à la moyenne nationale) de papier, carton, textiles, emballages recyclables dans les bacs verts où ils ne devraient pas se trouver. D'où des actions ciblant spécifiquement ces gisements. Au programme : amélioration du tri, collecte des biodéchets, développement du compostage domestique et de quartier, réduction des emballages grâce à la vente en vrac et à la consigne, etc. Autant d'activités qui permettent en outre de créer plus d'emplois car elles sont plus intensives en main d'oeuvre. Pour une même quantité de déchets traités et un budget similaire, on emploie 10 fois plus de personnes en collecte et tri des recyclables qu'en incinération des déchets. Car ce qui coûte cher, lorsque l'on utilise des technologies comme l'incinération, ce ne sont pas les emplois, c'est l'infrastructure. Plus particulièrement, la nécessité de contrôler et tenter de maîtriser la pollution induite par ces installations : l'épuration des fumées par exemple, indispensable pour limiter les rejets de polluants dans l'atmosphère, est extrêmement coûteuse.

Une opportunité historique . Ce n'est pas tous les jours que l'on doit s'exprimer sur un projet à 2 milliards d'euros, un choix industriel qui engage un territoire de près de 7 millions d'habitants pour un demi-siècle. Les 68 élus franciliens siégeant au Syctom ont devant eux une occasion rare d'engager leur territoire dans l'économie circulaire, dans la transition écologique. Plutôt que d'investir dans une infrastructure de traitement dont on sait qu'elle sera coûteuse, polluante et peu créatrice d'emplois, le Plan B'OM leur propose d'arbitrer en faveur d'actions qui permettent, en amont du traitement, de réduire et réorienter les déchets vers des filières qui font partie de l'économie circulaire.



Damien Carème
Maire de Grande Synthe, département du Nord

C'est aujourd'hui, à l'image du projet régional de troisième révolution industrielle, une «grande» transition qui est à l'œuvre à Grande Synthe. Une transition qui prend le temps de se construire avec la population, qui fait émerger l'espoir d'une vie meilleure, qui aspire au bien-être de tous et à la résilience du territoire. Une transition qui valorise et amplifie les mesures de rénovation urbaine et de transition énergétique, étendant ses champs d'intervention à l'environnement, à la santé, à l'alimentation, à la mobilité, à l'éducation, à la culture.

Cette transition ambitionne de dépasser le programme de rémédiation conduit pour répondre aux effets négatifs du modèle de développement hérité du 20e siècle. Elle va également au-delà du cadre technique d'une troisième révolution industrielle rifkinienne. C'est une transition sociétale, qui se met en scène et donne rendez-vous aux habitants et aux acteurs de la ville pour concrétiser un nouveau modèle de développement.

UTOPIAS AND VISIONS OF A FUTUR PARIS

IN A NUTSHELL

Foresight has always been fascinating. Here is a collection of more or less poetic pictures, dreaming about Paris in the future, with its new uses and technologies. Imagining 2050 is not necessarily alike.

source : grandparisfuturlab.org



Un quartier embrouillé, Albert Robida,1892



La Sortie de l'opéra en l'an 2000, Albert Robida, entre 1882 et 1902



Paris la nuit, Albert Robida, 1883



Paris futur, Place de la Bastille, auteur anonyme,1905

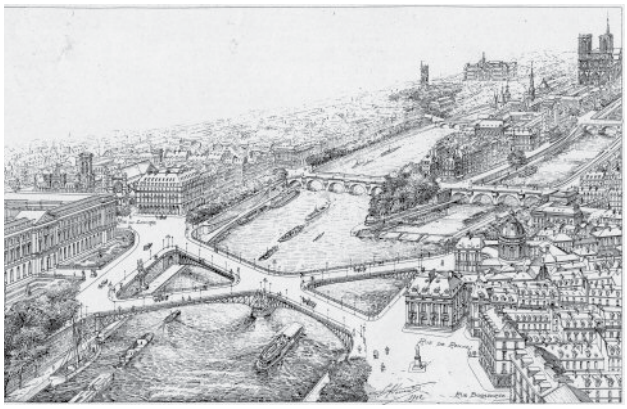


Paris futur, Avenue des Champs-Elysées, auteur anonyme,1905



Paris futur, Les Grands Boulevards, auteur anonyme,1905

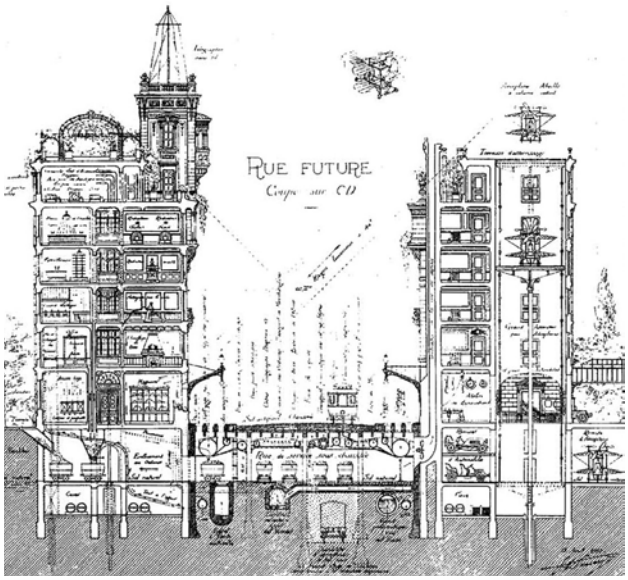
source : grandparisfuturlab.org



Le Pont X, Eugène Hénard,1903



Vue du carrefour à giration des Grands Boulevards, Eugène Hénard,1910



Rue Future, Eugène Hénard,1911



Les villes du futur, Eugène Hénard, 1911

source : www.ruederennes.com/Histoire_de_la_Rue_de_Rennes
en.wikipedia.org/wiki/Eug%C3%A8ne_H%C3%A9nard
www.germeetjam.com/collectif
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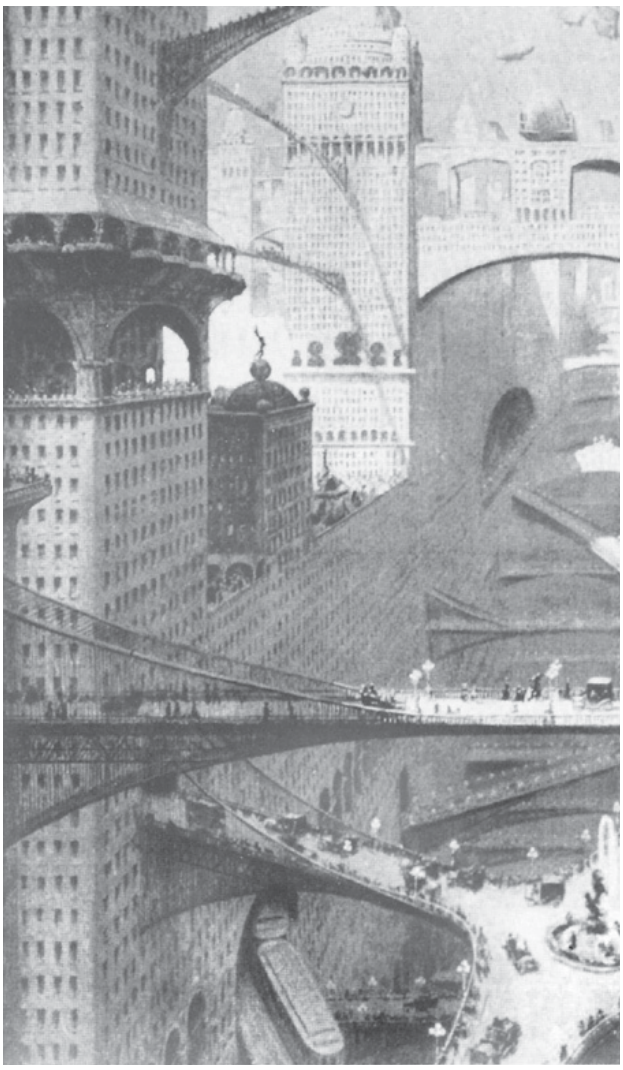
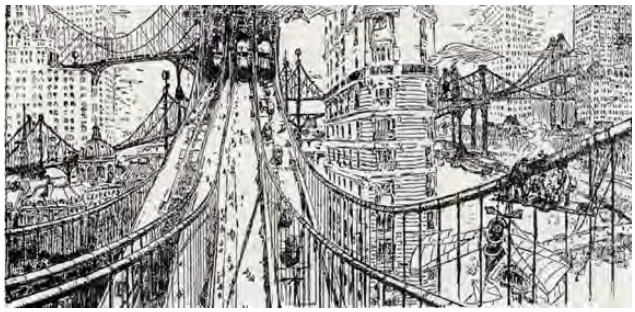


Paris futur, Roger Biron, 1910



Paris futur, Roger Biron,1910



Paris futur, Roger Biron, 1910

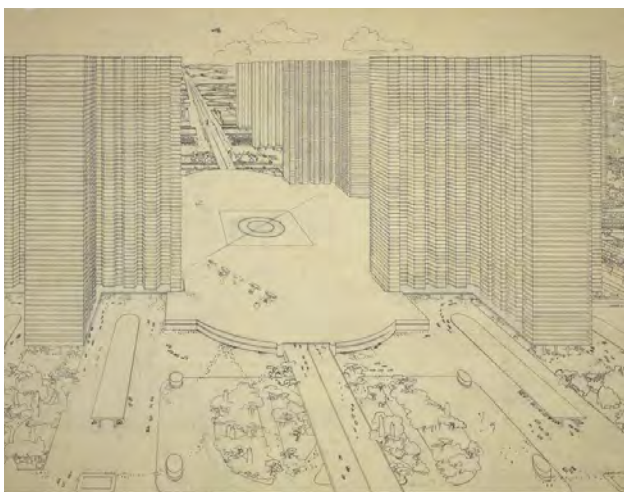
source : grandparisfuturlab.org
relationalthought.wordpress.com



Plan voisin, Le Corbusier, 1925



Plan voisin, Le Corbusier, 1925



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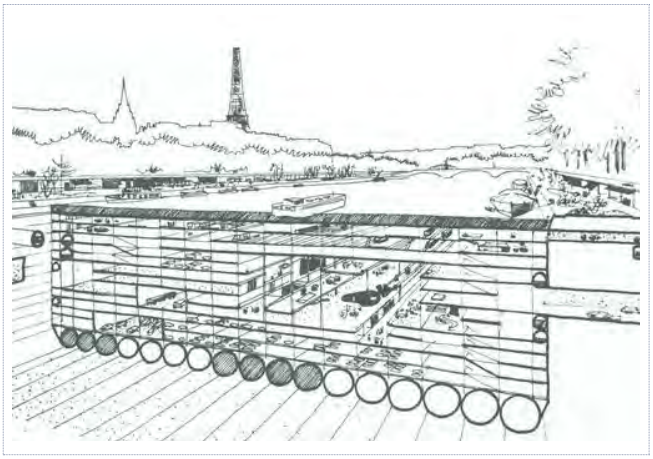

Paris sous la Seine, Paul Maymont,1962



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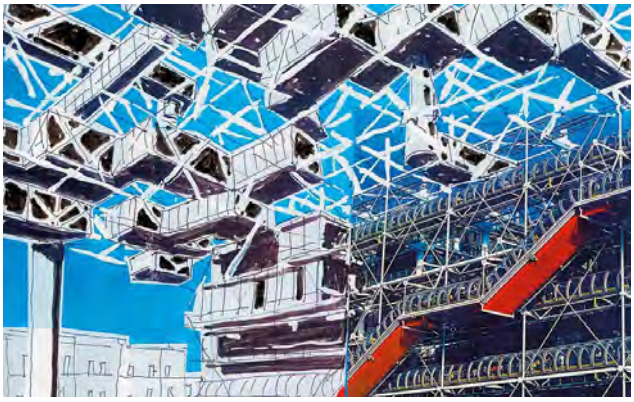

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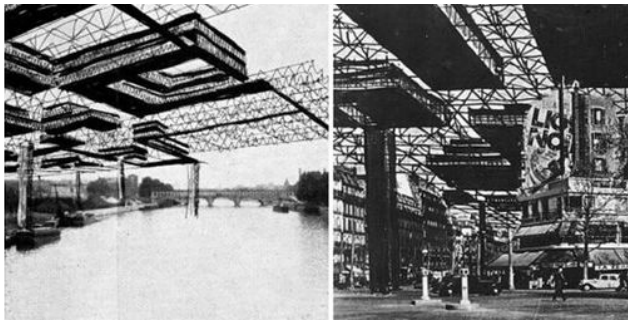

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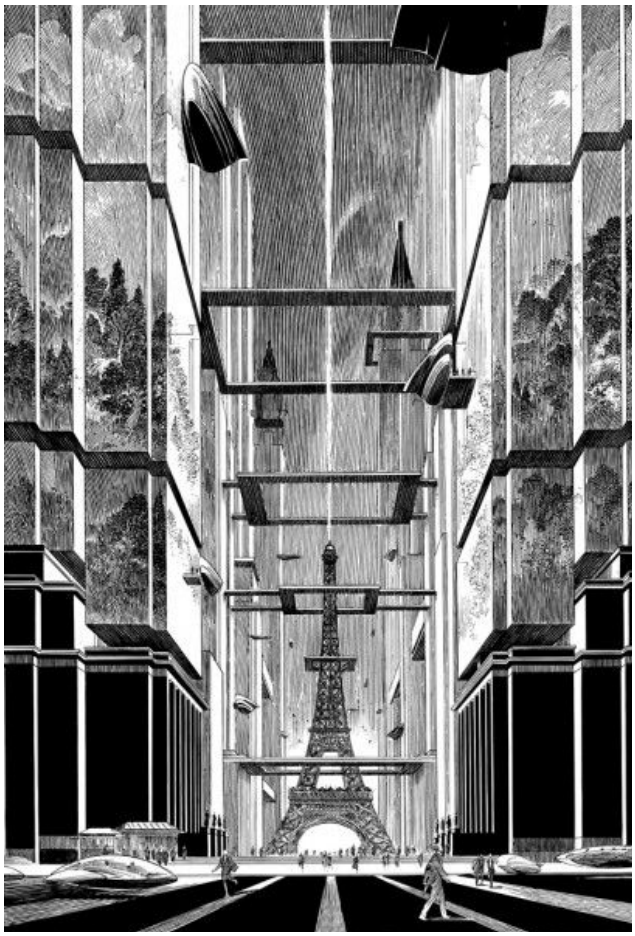

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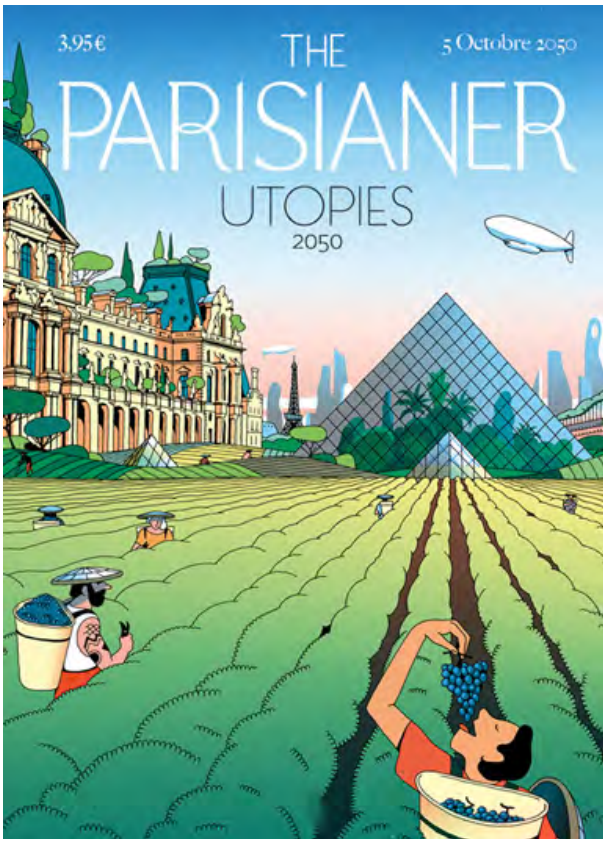

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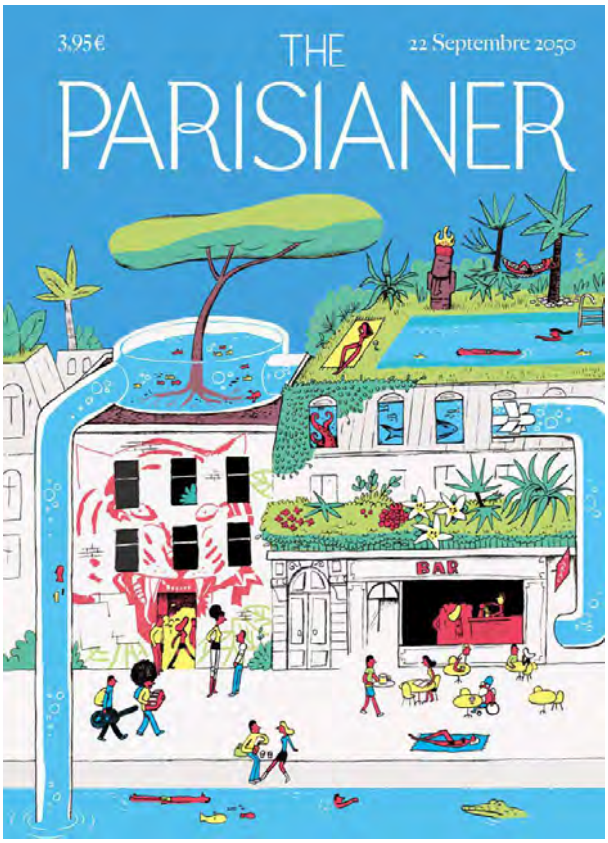

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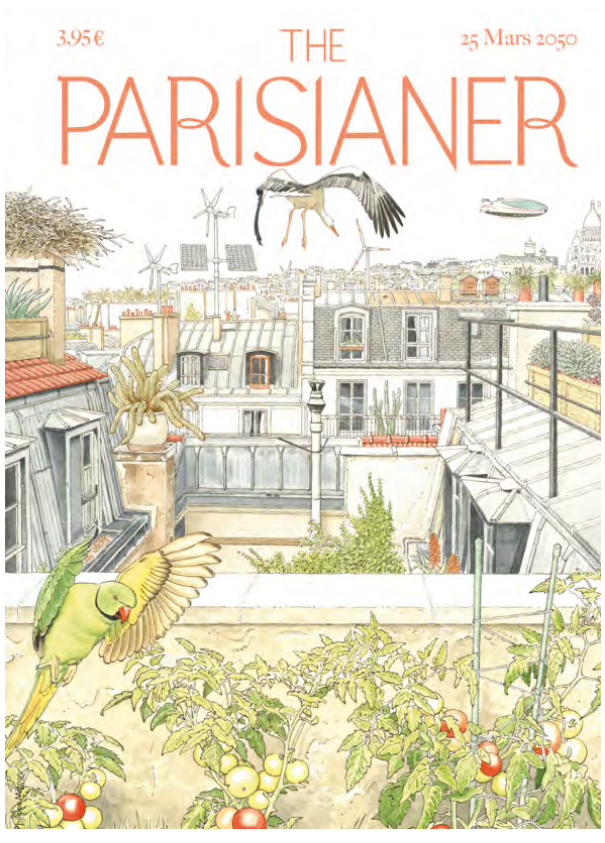

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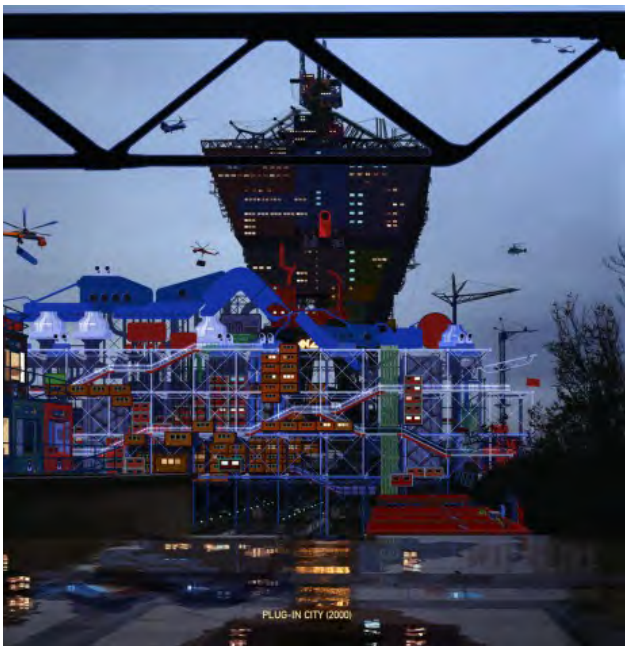

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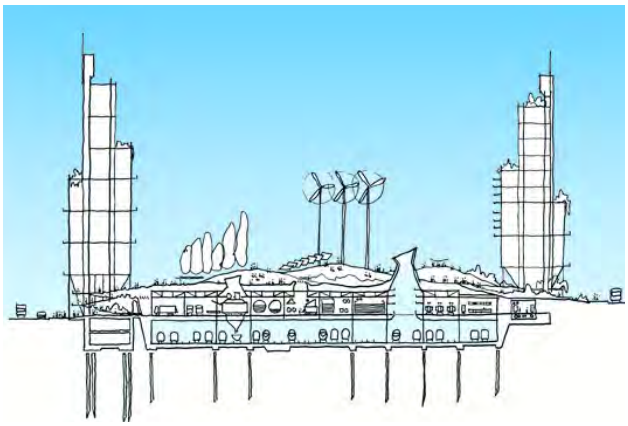

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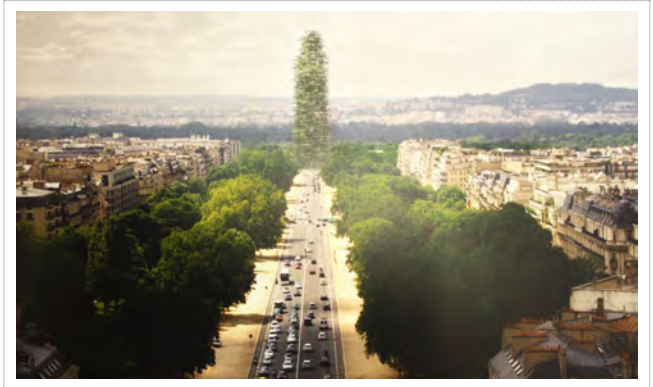

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Towards carbon neutrality in 2050

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