Extreme Weather Events and Air Pollution Peaks in the Light of Climate Change: The Limits of the Notion of Risk

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Abstract With the Anthropocene, the global risks induced by a deep degradation of the planet and a disturbance of the great biochemical cycles cannot be compensated or indemnified any more. Climate Change requires rethinking the notion of risk and hazard through the resilience of territories and their way of adapting to the environment. The management of climate control and air quality are closely linked and question the daily governance of cities that must integrate air, climate and energy into innovative and appropriate policies by all residents.

Keywords Climate change · Air pollution · Sustainable cities · Energy system · Adaptation · Resilience

The influence of humanity on the biosphere is such that the present era can be called Anthropocene[1] because, as D. Bourg points out (Bourg 2018): "*it is no longer a question of scenery, nor environment to which we would print a static mark, but of a sequence of which we are only a link and whose general movement escapes us and carries us away, without us ever being able to Stop.*" The fate of humanity seems more and more linked to that of its environment. It is interesting, in this respect, to resume the beginning of the book of M. Serres (1990) showing two men fighting while moving-sands, in the image of the great disturbances to which the planet is subject, are engulfing them. Human activities are responsible to these dysfunctions; they question the urgency of the management methods to be implemented. Given such perspectives, the notion of risk linked to extreme events is no longer operative.

[1]Qualifier proposed in 2002 by Paul Crutzen, Nobel Prize in Chemistry. Its final adoption by geologists is still controversial.

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Fight with cudgiels by Goya (1748–1826)

With the Anthropocene, global risks from a deep degradation of the planet and disrupted major cycles biochimic cannot be compensated or indemnified. Given the magnitude of the phenomenon of climate change and announced unpredictability of disaster, the notion of risk in insurance sense of the term is no longer appropriate. Henri de Castries, CEO of Axa,[2] makes the link between the one-off risk and the longer-term risk linked to Climate Change, by declaring: "*We do not have the choice*: *a world at +2 °C would still be insurable, a world at + 4 °C would certainly not be.*"

Even though IPCC (Intergovernmental Panel on the evolution of the climate) climate scientists are still reluctant to consider extreme events as markers of Climate Change, they are alert to public opinion as to what the reality of everyday life will be in a sustainable Climate Change. The lessons learned from these alerts help to better support a prevention policy that has been made possible by the entire natural risk management policy. Alerts and the concept of health risk have also been used for the management of air pollution, which at the present time can no longer be considered separately from climate risk, as is shown by experiments in many cities. The only possible attitude is that advocated by U. Beck in "the risk society" (Beck 2001) which is a pragmatic adaptation to the materiality of the world. The perspective of global climate change has upsetted the apprehension of extreme weather events as they anticipate the reality of future climate. How climate change management and the quality of the air they take into account these forms of adaptation to natural resources, the requirements of human health and that of the planet, too neglected at the time of the industrial revolution?

[2] AXA, a major French insurance company.

It is this question that is the subject of this contribution which is based both on the example of Climate Change and on that of air pollution whose evolutions, very different, tend to converge today to show little operational nature of the concept of risk when it comes to ensuring a better livability of cities that are, at present places that concentrate the vulnerabilities and challenges. Projection of these issues toward a certain future must not be seen as an inescapable threat that calls for passivity but rather as an incentive to better control the environment and to integrate it into the different planetary and local policies. However, the obstacles to overcome are numerous.

1 From the Extreme Climate Events to Climate Change Adaptation

Are heatwaves and extreme events are part of the chaotic and inherently variable nature of the climate, or are their occurrence and frequency increasing with global warming? However, the logic of insurance risk and that of Climate Change are different. The question of the cohabitation of these two different approaches has been analyzed in the SREX report, in 2012.[3] The confrontation with extreme events in the present, nevertheless, makes it possible to set up adaptation policies, as shown by the lessons learned from the 2003 heat wave.

1.1 Disaster and Risk Management Exist Before the Emergence of Climate Change

The management of risks, considered as the crossroads between a hazard and the vulnerability of territories, exists before the emergence of Climate Change and the first reports of the IPCC (Intergovernmental Panel on Climate Change). In his thesis (2015a, p. 154), Buffet (2015a) showed how the theme of disaster risk reduction has been gradually developed since the 1970s, and more particularly in the context of the International Decade for the Reduction of Disaster Risk Reduction, (1990–1999).[4]

The crossover between the two approaches has been difficult to achieve and Climate Change has been classified as emerging risk regardless of recorded disasters. On average, from 2000 to 2016, more than 220 million people were affected by natural disasters and more than 92,000 died. To USA (Valantin 2017), the estimated average cost for damage caused by so-called natural disasters was $3 billions a year during the 1980s and then $20 billions during the first decade of this century and $40

[3] https://www.ipcc.ch/pdf/special-reports/srex/IPCC_SREX_FR_web.pdf.

[4] It then experienced a further acceleration following the tsunami in South Asia in 2004. In 1990, a United Nations-specific body (IDNDR, which became UNISDR208 in 2000) is responsible for coordinating a work plan aimed at strengthening disaster risk.

billions from 2011 to 2012. In 2017, with hurricane Harvey and other disasters, the cost reaches 200 billions.

1.1.1 Disasters Have Given Rise to Different Types of Damage Mutualisation

Climate Change, integrated into the concept of the Anthropocene, reports a new type of hazard which challenges human responsibility. The early IPCC reports have kept a very climate-centric approach and therefore very (too) theoretical in dealing with climate risk control by separating natural phenomena from their social aspects (Kelman et al. 2015, p. 28). However, climate risk is an essential economic challenge because of the key role that can be played by insurance because it generates worldwide economic losses every year that the reinsurance industry estimates at 100 billions euros, of which only 30 billion are insured. Hence, the end of the insurance system is declared by Henri de Castries (cf. above). The second report from December 1995 confirms the responsibility of human activities on Climate Change. The publication of the third report from January 2001 concludes that there is **a probable link** between human activities and the increase in temperature since 1950. Following the IPCC's fourth report in 2007, the theme of natural disasters has been increasingly associated with Climate Change: "*Climate change contributes to a wide variety of extreme conditions*: *heat waves, torrential rains, fires, droughts, melting snow and ice*[5]." In France, the IFOP survey, conducted in September 2015,[6] shows that 31% of respondents state that humanitarian crises due to meteorological phenomena (floods, storms or droughts) are the consequences of Climate Change. The 5th report of the IPCC is published in September 2013, which states that the link between human activities and the increase in temperatures observed since 1950 is **extremely likely**. It would seem that the sixth report, from the introduction, would affirm: "Greenhouse gas emissions from human activities are the main causes of global warming, that has been occurring at an average rate of 0.17 °C (±0.07 °C) per decade since 1950."

It is thus the man who can prevent the climatic risk either by controlling the emissions of GHG (greenhouse gas) or by limiting the vulnerability of the territories. These adaptation actions are very diverse as shown by the example of heat waves (cf. below).

Risk management policies and those of controlling Climate Change belong to two different logics, however, and tend to subside within the "risk society" (Beck 2001). These two logics are differentiated by the longer time scale for Climate Change than for the emergency of the disaster. Thus, are two management modes that can even be contradictory: the actions brought to avoid the catastrophe, can neglect more radical

[5]Our Common Future in the Face of Climate Change—Final Declaration of the CFCC Scientific Committee 15, chaired by Chris Field and organized by UNESCO, Future Earth and ICSU.

[6]Ifop survey for Cap 21 Solutions conducted in September 2015 with a sample of 1000 people representative of the French population aged 18 and over.

solutions but more effective in the long term. The classic example is the construction of a dike to preserve a building when it would be better to leave or to move it.

The risks of increasing the frequency and intensity of natural disasters activate a discourse presenting each disaster as a sign of the impacts of Climate Change. This discourse is more about fear or threat than about integrating risk into everyday life (Charles and Kalaora 2017).

1.2 The Example of the Heat Wave of 2003

1.2.1 The Heat Wave of 2003 as a Precursor of Future Heat Waves

From 7 to 14 August 2003, in several cities in southern Europe, minimum temperatures were almost continuously above 20 °C (Fig. 1). Paris and Lisbon were particularly affected. Between 4 and 12 August, the maximum temperatures recorded at Paris-Montsouris remained well above 36 °C.

Studies on the modalities of this heatwave and its effects are still in progress (European project CANICULE) to draw the lessons of this episode whose frequency, according to the scientists of the IPCC is called to be multiplied. According to GHGs, emission scenarios beyond 2050, heat wave will be more intense, more durable and will happen early (from May) and/or later (until October). Thus, under the most pessimistic scenario envisaged by the IPCC (RCP 8.5), heat waves could become two to three times more numerous by the middle of the twenty-first century. We could observe on average on the horizon 2021–2050: nearly a heat wave a year. Studies

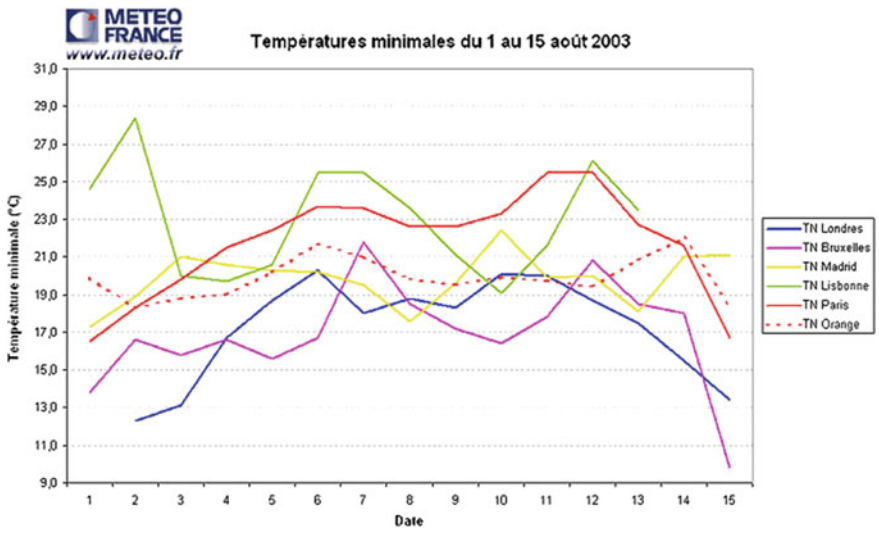

Fig. 1 2003, Mean temperatures of European cities, between August 1 and 15 (Météo France)

show that the most vulnerable regions to heat waves (South of USA) are also the most exposed to Climate Change.

1.2.2 The Damaging Effects of This Climatic Phenomenon Have Mainly Been Felt in Cities

According to the C40,[7] «*The number of cities exposed to extreme temperature will nearly triple over the next decades. By 2050 more than 970 cities will experience average summertime temperature highs of 35 °C (95 °F). Today, only 354 cities are so hot. The urban population exposed to these high temperatures will increase by 800 percent to reach 1.6 billions by mid-century*».

The city of Paris, where 1067 excess deaths were recorded during the episode, contributed by itself to 7.2% of the excess mortality while the Parisian population represents only 3. 7% of the French population (BEH 2018; Cadot and Spira 2006).

The geographical distribution of Parisian mortality during this episode highlights the importance of certain individual socio-demographic characteristics, specially the age and social isolation of people (Canouï-Poitrine et al. 2006). O'Neill et al. (2005) had highlighted the excess mortality of the most disadvantaged populations during the heat waves and attributed this excess to the unequal access to air conditioning which, according to him, should be generalized.

1.2.3 Although Age and Isolation Were the Main Factors in This Summer Mortality, the Characteristics of Housing and Urban Planning also Played a Role in Paris

Mortality was higher in dwellings located on the upper floors of buildings as the highest flats are more sensitive to the sun and less spacious. In Paris in 2003, living under the roof increased the risk of mortality by four. The density of urbanization favors the existence of an urban heat Island, sensitive specially at night when the walls restore the heat stored at the heart of the day. However, it is the remaining of high night temperatures that are more difficult to bear, from a health point of view. On the other hand, the proximity of sea, river or green spaces reduces the temperature of neighboring districts.

1.2.4 These Observations Make It Possible to Envisage What Measures Should Be Taken to Avoid the Harmful Consequences of Such Phenomena

This fine analysis of the characteristics of the Paris heat wave made it possible to outline solutions, or bundles of solutions, likely to mitigate the effects of the future

[7] https://www.c40.org/other/the-future-we-don-t-want-for-cities-the-heat-is-on.

heat waves. Indeed, sustainable development avoids the use of long-term harmful expedients such as air conditioning (Benmarhnia and Beaudeau 2018).

Thermal insulation of the building can affect both winter energy consumption and summer comfort by dividing the mortality risk by five, if natural ventilation is maintained. The orientation of the dwelling, the presence of shutters (occultation of the windows from the outside) and the opening of opposite facades result in significant differences temperature.

The introduction of green spaces, real islands of freshness, the greening of the walls can also refresh the city. The decrease in car traffic (or its ban as in Athens) in the centers can contribute to the same result.

The French health authorities have set up a national heat wave plan, aimed at improving forecasting by anticipating warnings from weather forecasts that are sometimes difficult to understand. The plan also has a social component encouraging the reporting of isolated seniors, while institutions have to provide a refreshed room to residents. It seems that the implementation of these devices results as a reduction in mortality during episodes of extreme heat that occurred in 2006 and 2017, but weather conditions were not comparable.

These considerations highlight the difficulties of adaptation policies that are impossible to manage by the only point of view of regulations because they correspond to technical and social innovations that cannot emerge from a strongly normative framework.

1.3 Some Reflections on Adaptation to Climate Change

The heat wave of 2003 helped to raise awareness of how badly the local climate has been integrated into planning policies. For example, the architecture, promoting the bay windows or neglecting the topoclimatic conditions of the exhibition, contributed to the unbridled consumption of energy. The first step in the actions to be taken is to put an end to bad adaptation. The last century and the beginning of this century have been marked in the Western world by a process of vulnerability and artificialization of environments.

Adaptation presents paradoxes since modern society has progressively freed itself from the climate to ensure better food and sanitary security. For example, in many countries the summer heat, thanks to the cold chain and air conditioning, is no longer reflected in a resurgence of dysentery and infant mortality. Adaptation, paradoxically, is not directly anchored in an approach of integration with nature but rather in protection approach which, to overcome the fluctuation of climate, tends to resort to sophisticated technical processes precisely to take refuge in a better-controlled world. The obvious health benefit of this type of adaptation raises ethical questions, as access to security is not available to everyone. What is the right mode of resilience to develop the territory: integrate the climate or protect it?

In fact, unlike climate models, adaptation must start from an analysis of the territory and its capacity for resilience. It must go beyond the analysis of risks and

possible disasters to create new opportunities, not just to fight against phenomenon with undesirable effects. Adaptation, according to the writings of the Stockholm Environment Institute,[8] affects behaviors, practices and policies. According to Buffet (2015b), "*In about fifteen years, adaptation has gone from a question of impact modeling to a human experience.*" He pointed to the example of Typhoon Haiyan, which devastated the Philippines and caused over 7000 deaths at the opening of COP-19 in Warsaw. The COP bulletin of 19 November 2013 does not hesitate to report on this event to encourage participants to combine actions to prevent Climate Change with those of extreme events: "*the world has entered an era of loss and damage devastating because of climate change. The collective failure of reducing our emissions and the necessary support for adaptation actions means that vulnerable communities, ecosystems and countries are increasingly faced with irreversible loss and damage. Typhoon Haiyan, which may have affected more than 9 millions people in the Philippines, is a stark reminder of the damage caused by the most severe storms. This position implies integrating not only emergency response but also prevention.*"

Adaptation should not be based on a threat but on the desire to improve the quality of life for all integrating health concerns and the notion of environmental health into policies. But the modern welfare state that wants to be protective uses the registers of fear and threat. The answers given are often partial and unsuitable because adaptation supposes the flexibility and dynamics of individuals likely to build their most resilient environment and the most favorable to their health (Charles and Kalaora 2017).

This type of adaptation, favorable to the health of individuals, is inseparable from the maintenance of breathable air quality. Indeed, the management of air quality, after having followed logic of the alert related to adverse weather situations must be thought today in a dynamic integrated to the control of Climate Change. Here again, the example of heat waves illustrates this requirement of an integrated approach since the health risks associated with heat are combined with those caused by an increase in ozone levels that accompanies, especially in the city, high temperatures. It is especially in cities that Climate Change and air quality create a new dynamic favorable to the implementation of innovations or experiments.

2 The Atmospheric Pollution Between Peak Management and Better-Integrated Air/Climate/Energy Management from Risk Management to Resilient Territories

The management of air pollution is much older and has had a trajectory quite different from that of Climate Change since air pollution has never been considered as a natural hazard. It has been regulated in the modern era on the respect of the standards to avoid the peaks of pollution than to control the chronic health risk. As with extreme

[8] Climate Change and Disaster Risk Reduction, 2014, http://www.preventionweb.net/english/hyogo/gar/2015/en/bgdocs/SEI,%202014.pdf.

weather events, air quality management has shifted from controlling the exceptional phenomenon (the peak of pollution), linked to unfavorable weather conditions to controlling daily chronic pollution. Currently, the vision of pollution is much more global and is a more radical transformation of the economy and society, while relying on a local scale of quality of life and justice. This necessary integrated vision no longer focuses on exceptional events, but introduces daily health concerns in the construction of urban governance.

2.1 A Brief History of Air Pollution from Meteorological Risk to Health Risk

The concept of risk in the field of air pollution has been used in different ways. The risk in the sense of the occurrence of a climatic hazard made it possible to understand the peak phenomenon and to trigger warnings but the risk has also become more sanitary and chronic (Roussel 2015).

For centuries, air pollution has been more a matter of impurity and waste, and thus of an anthropogenic origin. In the eighteenth century, it was taken into account by the miasma theory and the aerism and then dropped out, due to advances in chemistry and after discovery Pasteur microbes.

In Europe, the murderous London smog episode of 1952 marked a turning point in the management of air pollution, the control of which became imperative to accompany industrial development. The political agenda of atmospheric pollution is contemporary with the development of metrology, which has generalized the measurement and allowed to enact health standards at the European level. Thus, thanks to the objectivities of pollution, its management has gone from a subjective complaint based on the notion of inconvenience or nuisance to compliance with emission or concentrations standards. This orientation accompanies the massive industrialization of Europe after the Second World War. The development of electronics on the devices used revealed peaks of pollution while their reliability was lower to measure the background noise."

2.1.1 Industrial Alerts Guided by Weather Conditions

Thanks to advances in metrology, the authorities were able to set up warning systems when, adverse weather conditions were forecasted, so pollution levels might exceed the authorized standards.

These devices were located in industrial areas to encourage companies to change their fuel in case of weather risk. Their effectiveness reflected the linearity between sulfur dioxide concentrations in the atmosphere and industrial emissions and, with little media coverage, the alerts were part of an effort to control industrial waste by

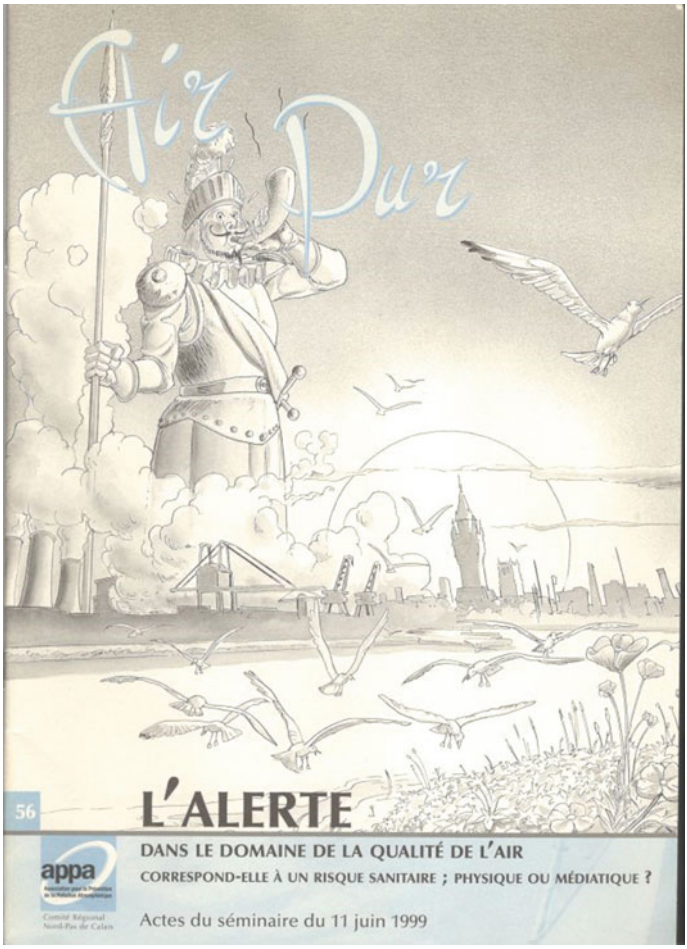

Fig. 2 Air Pur n°56 proceedings of Seminar presenting results of the CNRS study called "*does the alert in the field of the air quality correspond to a sanitary, physical or media risk?*" June 1999

the state. Over the years, the number has decreased due to greater control of polluting industrial emissions.

The development of reliable measurement networks has made it possible to undertake more precise epidemiological studies (Fig. 2).

2.1.2 The Health Risk Related to Air Pollution Becomes Clearer

The results of the Parisian measurement network AIRPARIF allowed some epidemiologists, trained at the Canadian school, to be interested in the effects of Parisian pollution. The ERPURS (Urban Health Hazard Risk Assessment) study carried out

by Ile-de-France health observatory between 1985 and 2000 is based on the temporal ecological epidemiological method. It highlighted a strong link between pollution levels and a number of health indicators such as the number of days of hospitalization. This work was supported by the results of many other studies built on the same pattern and covering several agglomerations, such as the NMMAPS projects in the USA (Samet et al. 2000a, b, c) and APHEA in Europe (Katsouyanni et al. 1996). These studies put air pollution at the heart of public health and health risks that question the responsibility of the state in the same way as other health scandals that occur at the same time about AIDS and asbestos or even dioxin. It is in this context that the EU is developing strong regulation and many standards[9] which the Member States undertake to respect.

Epidemiological studies have shown the existence of a relationship without threshold between pollution and health risk. References to annual averages emphasize chronicity risk that is not only focused on the goal of alert thresholds.

Yet in France, the air law in 1996 Air opened the way for quality management of air by alerts issued from the state and highly publicized.

2.1.3 Highly Publicized French Alerts

The persistence of the management by the alerts is a French specificity which is explained by the weight of the State which, under the pretext of its responsibility for health risk, manages the alerts instituted by the law and specified by procedures which rely on the AASQA (Associations approved for the monitoring of air quality). The authorities have had to manage three types of alerts by thinking of imposing restrictions on emissions to improve air quality: alerts related to an exceedance of the threshold observed on nitrogen oxides, and therefore in connection with traffic, alerts related to ozone as a result of the heat wave of 2003 and the Directive "ozone" in 2002. The link between traffic restrictions and the health risks associated with this pollutant in power irritatingly strong was more difficult to admit to population because ozone is a secondary pollutant spreading over vast areas.

According to the French High Public Health Council (HCSP 2012), the effectiveness of these alerts is limited only the fight against chronic pollution has a health effect. In addition, the peaks of pollution have little mobilized public opinion despite intense media coverage. The lack of results rather discouraged inhabitants who felt pollution as a threat related to a meteorological hazard that was difficult to control (Charles and Kalaora 2017). In the French context of management by the peaks considered as communication tools, the absence of alert for the particles had contributed to neglect this pollutant yet very sensitive (Fig. 3). Particle alerts, introduced in 2007, often corresponding to foggy days, have hit people's minds even more, since

[9]Directive 96/62/EC, as amended in 2008, distinguishes alert thresholds: "level beyond which short-term exposure poses a risk to human health and from which Member States take appropriate and immediate action" and limit values: "a level established on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing the harmful effects on human health and/or the environment as a whole, to be achieved within a given period and not to exceed once reached."

Fig. 3 Particles that darken the horizon strike the minds and impose means of prevention such as the wearing of masks during the Beijing Marathon (APPA)

the extent of the harmful effects of this pollutant has recently been discovered and has helped to raise public awareness.

2.2 The Importance of the Deleterious Effects of Particles in the Mobilization of Public Opinion

Scientific research on the effects of pollution has progressively recognized the role of particles and their massive health impact; this led to a reassessment, worldwide, of air pollution balance estimated at between seven million (WHO 2012) and nine million

annual deaths (Lancet Commission on Pollution and Health 2018) estimated[10] outdoor and indoor air combined. In 2013, after ten years of work on this complex issue, the WHO recognized carcinogenic to humans, classified into group 1, the outdoor air pollution.[11]

The publication of the number of pathologies affected by high levels of particles has struck the minds because the finest particles, crossing the boundaries of the organs, can contribute to the emergence of different cancers that the population dreads. In addition, the visibility of the dust that veil the atmosphere reinforces the impression of malaise (even if the ultra-fine particles, the most harmful, are invisible) and gives a reality to the figures of 48,000 deaths attributable to the pollution by PM announced by Public Health France (Fig. 3).

In Europe, particles come mainly from three sources that play a strong cultural role: car traffic, agriculture and the inside the houses so practically all inhabitants become emitters therefore actors of the air quality that has become "the business of all." Yet survey conducted at the level of Europe[12] shows that only 30% of women and 26% of men want better health information while the majority of EU citizens are opting for a regulation very institutional for reducing emissions at European level.

2.3 The Links Between Atmospheric Pollution and Climate Change

Now, ozone and particles (called short-lived climate forcers[13]) have effects on the climate, despite their shorter lifetime than greenhouse gases (GHGs) that can persist for several decades in the atmosphere. In addition, all these gases are mainly from combustion phenomena whose control is beneficial in many ways.

The challenges of climate change have emerged recently in spirits, it was able in drawing attention to CO_2, to hide the question of atmospheric pollution introducing some confusion with GHG emissions as shown studies on the perception of climate

[10] http://www.who.int/mediacentre/news/releases/2014/air-pollution/fr/. With the order of 1.2 millions annual deaths in China related to outdoor air, about 500,000 annual deaths in Europe, 240,000 in the USA and 48,000 in France.

[11] "The Working Group found that there is sufficient evidence in humans and in experimental animals for the carcinogenicity of outdoor air pollution in general and of PM in outdoor air pollution more specifically. These findings are supported by strong mechanistic evidence in exposed humans, including studies showing increased frequencies of micronuclei and chromosomal aberrations in individuals occupationally or residentially exposed to polluted air, as well as by studies showing genetic and related effects in animals and various experimental systems. At wide range of other effects related to carcinogenesis, including oxidative stress, inflammation and epigenetic alterations, have been observed in exposed humans and animals and in various experimental systems." (IARC monograph 109, p. 34).

[12] Eurobarometer 468, November 2017. http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/yearFrom/1974/yearTo/2017/surveyKy/2156.

[13] Their reduction begins to interest international bodies, http://ccacoalition.org/en/news/declaration-short-lived-climate-pollutants-ratified-members-parliamentary-confederation.

change (Boy 2013). Nevertheless, air pollution and climate change represent the aspects of the environment which, according to various surveys, concern between 30 and 40% of French and Europeans. These two topics are, rightly, very mixed. The emergence of the fear of a large-scale climate change has contributed to broadening the dimension of air pollution toward all environmental issues impacted and to better highlight the link between pollution and the energy system. The end of fossil fuels is very beneficial for air quality, which benefits from all the investments made in favor of energy innovation. On the other hand, the fight against Climate Change has been confined for a long time to the technical sphere in a top/down movement, while moving toward adaptation, and highlights the health benefits of the measures to be taken. China is a good example of the identification of co-benefit air/climate/energy/health.

Despite these conclusions, institutions are still very sectored and separate management of the air quality of the climate change that could lead to contradictions such as heating wood encouraged to reduce fossil fuels but may, without additional precautions, contribute to the increase of particulate levels in indoor and outdoor air.

On the other hand, at the city level, the two issues are better integrated and the benefits or collateral damage better controlled.

3 Cities and the Implementation of an Integrated Air/Climate Policy/Energy/ Health

More than 50% of the world's population lives in cities (77% in Europe) and 70% in 2050. Cities currently emit about 80% of global greenhouse gases. In France, 19 agglomerations exceed the European standards and show the insufficiency of the solutions used until now to clean the air of the cities.

The Paris Climate agreement in 2015 recognized the need for the involvement of "stakeholders" in the implementation of transformations related to Climate Change in a context where the mobilization of states is far below the stakes. In particular, cities and local communities have shown a real dynamism to engage, through innovative initiatives, the transformations needed to build a carbon-free world. They are particularly active in the exchange of their experiments within networks[14] that have been organized at different levels since the 1990s. The articulation between different sectors of urban life is a major challenge at the local level, precisely between the air quality, energy and climate. The latter, built according to distinct logics and constituting independent intervention sectors, must henceforth be the subject, in France, of a joint planning approach through the elaboration of the Territorial Climate-Air-

[14]UCCRN is a network of cities dedicated to providing good the Information That city leaders—from government, the private sector, non-Governmental organizations and the community—need in order to for Assessment current and future Risks, make choices That improve resilience to Climate Change and climate extremes, and take actions to reduce greenhouse gas emissions.

Energy Plans.[15] (PCAET) also meet difficulties, since some actions that favor the reduction of greenhouse gases are not necessarily beneficial for the reduction of atmospheric pollution, and vice versa.

3.1 Promotional Urban Policies for Air and Climate

The change in the energy system and the remains of fossil fuels can only be beneficial for air quality, which encourages cities to promote all innovations that can result in a reduction or optimization of energy consumption. Thus, climate change by accelerating the reduction of the most polluting energies is favorable to the quality of the air. New technologies promoted by "smart cities" can support this transition as long as they are open to everyone and not only to the technophile population. Innovations are developing in many sectors both technical and social: search for energy-efficient buildings, urban densification, reflections on modes of transport, health benefits, etc.

The services of the city, connected to international networks (C40 for example[16]), are important for partners to network and support local initiatives. This new context is fueling the creativity of managers tempted by the implementation of interesting experiments for urban life and creating local jobs not only in large industrial groups but also in small and medium-size enterprises that have seen the profit they could take from working with the city to create endogenous economic development.

These environmental imperatives in cities can only be imagined by considering, in the long term, a set of solutions involving the housing, city planning and mobility possibilities it offers.

In the field of urban transport, car pooling and its various variants, transport on demand, car-sharing systems and self-service bikes for pedibus and bikebus, the range of services to the mobility has grown steadily in recent years by relying on the development of digital systems.

The promotion of public transport and electric vehicles has the advantage of giving way to the smallest polluting diesel vehicles with quieter vehicles, which can reduce the noise level of cities, which is a major nuisance for city dwellers.

European cities seek to implement solutions to reduce vehicle emissions in the city. Thus, 232 LEZ "Low Emission Zones" have been established in 12 European countries[17] (Pouponneau 2018). In France, the principle of ZCR (restricted traffic zones) is supported by the energy transition law, the device operates according to a

[15]The procedures for drawing up and updating these new plans (compulsory for inter-municipal cooperation institutions (EPCI) with own taxation of more than 20 000 inhabitants) are specified in Law No. 2015-993 of 17 August 2015 on the energy transition for green growth, the decree n° 2016-849 of June 28, 2016. They will have to be realized at the latest on December 31, 2018.

[16]https://www.c40.org/.

[17]In September 2017.

selection of authorized vehicles[18] to enter the city center according to their seniority and therefore their membership in a Euro standard level. The presence of a LEZ, like that of an urban toll, should, in theory, accelerate the transformation of the car fleet and encourage the disappearance of the engine and contribute to increase the adherence to the soft modes or even the decrease of the frequentation of the city centers. This good evolution for the environment can only be beneficial for the health of the population.

3.2 In the Area of Housing and Urban Planning, Some Points of Vigilance Are Needed

The residential and tertiary housing sectors have a significant margin of GHG reduction since this sector contributes nearly a quarter of the final energy consumption responsible for greenhouse gas emissions. Housing insulation is beneficial in the event of heat waves (see above), but to reconcile the reduction of GHG emissions with the requirements of air quality, it is important that energy savings do not deteriorate the indoor air quality or thermal comfort.

The urban heat islands (ICU) are the object of growing concern in the urban spaces whose sensitivity to the heat waves is recognized (cf. above) The night temperatures recorded in the city center show 4 even 5° than in neighboring peripheries. The dense city, which is particularly important from the point of view of energy restrictions, is not without its health disadvantages, especially when it is composed of "canyons" streets, poorly ventilated, which trap pollutants in addition to heat. The main solutions considered for reducing the heat island are the reduction of energy consumption in the city and the creation of islands of freshness through the planting of vegetation and the development of urban agriculture.

Wood heating should be recommended with caution because if toxic emissions can be easily controlled in large boiler rooms, only efficient domestic heating methods should be encouraged. This vigilance focuses on open fireplaces and old wood stoves that not only generate indoor pollution but also contribute to increased particulate concentrations in the ambient air.

3.3 But Above All, Vigilance Must Concern Urban Governance

The challenges are considerable because they concern the future of the planet; the implementation of these challenges is based on profound cultural changes as it is

[18]The vignette The Crit'Air sticker is a macaron visibly placed on cars, motorbikes and light vehicles, indicating their level of pollutant emission according to their date of registration and to their type of carburant.

nothing less than revisiting the notion of inhabiting the land or the city by leaving more room for climate and the environment.

While international agreements grant a great deal of flexibility to local initiatives, the responsibility of the elected representatives, in partnership with the various stakeholders, is strong because they must ensure that the progress made contribute to a greater justice, as well in countries than in cities that need to become more inclusive.

3.3.1 The Inclusive City

The new tools with great flexibility of form allow all the actors of the city to imagine the city, with dwelling and mobility of the future remain inclusive. However, the innovative aspects tend to favor the city center compared to the periphery and the inhabitants most able to invest in new technologies. However, tools for assessing well-being and fair distribution are still modest because it is easier to define quantitative rather than qualitative objectives, while knowing that these question concern many sectors of urban management (Wheel-Legall et al. 2015).

It is necessary not to consider the air quality or energy savings are only profits or collateral damage of climate policies. Integrating management transgresses silo management logic of different urban projects, it is difficult to apply because health issues are still often considered a curative and non-preventive logic. Environmental health leaves the strictly sanitary world to question all sectors of urban life.

These topics question not only horizontal and transectorial fluidity but also vertical fluidity since the issues to be taken into account range from the proximity of the interior environments to the global dimension.

3.3.2 Management of Scales from Local to Global

Local initiatives by actors convinced of the need for action face the heterogeneity of situations and lifestyles that delay the implementation of coherent policies to train the entire population. About 81% of Europeans are aware of their environment as a factor in their quality of life and health, and Climate Change (Fig. 4) and air pollution are high on the agenda. On the other hand, we see that the importance given to these two factors depends to a large extent on the sensitivity of individuals to the environment and therefore to their level of information, which shows how much raising the awareness level remains an important goal for associations, because it is the inhabitants who, through their motivation, can advance the policies.

According to the 2017 Eurobarometer, 58% of knowledgeable individuals place a lot of importance on Climate Change and 49% on air quality, and this percentage is reduced to 24% in the general population for Climate Change and to 30% in air pollution that enters more into the sphere of proximity.

However, as demonstrated ozone alert, the solutions to be implemented don't necessarily lie locally and expected results can be shifted in time and space, which invites the political to remain consistent at different spatio-temporal scales.

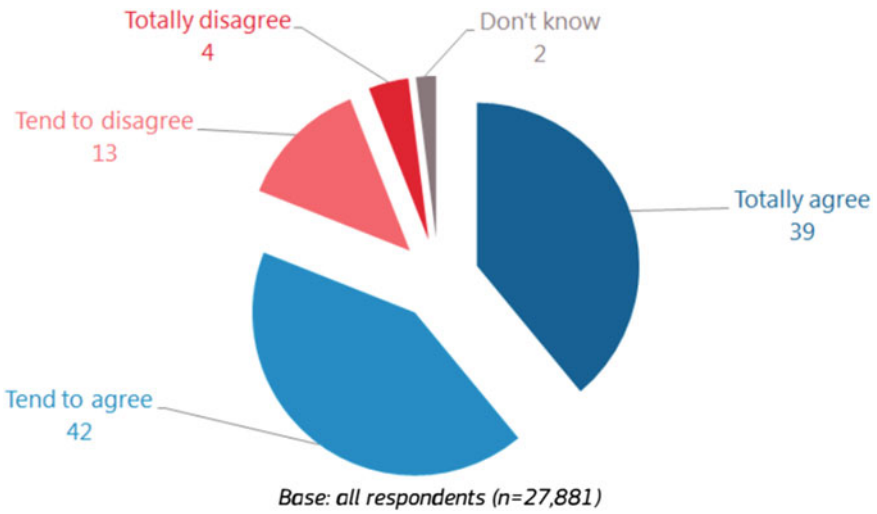

Fig. 4 Percentage of Europeans who consider the environment to have a direct impact on their daily lives and their health in response of this question: «Please tell me to what extent you agree or disagree to the following statement: environmental issues have a direct effect on your daily life and health». *Source* Eurobarometer Special Eurobarometer 468 2017

4 Conclusion

It seems that public opinion, carried by a number of NGOs, is beginning to realize that the control of Climate Change and air pollution is a condition for the survival of humanity in the medium term and even in the short term, since the recommended solutions are beneficial for health. The extreme events that will become more and more frequent illustrate what can become the daily reality of the future climate. In the context of the Anthropocene, the notion of hazard has evolved since the anthropic responsibility has become evident; thus, conventional risk and alerts responses are inoperative as well as state policies based on injunctions or regulations. It is a true transformation of the relationship between humanity and the planet that imposes itself; on the other hand, the actions undertaken are not at the scale of these stakes even if, especially in the cities, a dynamic, still confined to a few actions, begins to appear. The cultural change required is deep and institutions have not always taken the measure. Only the economic and financial world, supported by the consumer power and the sensitivity of the people can act in favor of the transformation of the energy system on a planetary scale and the reduction of the weight of the human activities on the Earth system.

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