RESILIENCE,
THE FUTURE OF SUSTAINABLE TERRITORIES

#10

Contents

Edito

Stéphane Cordobes

Geographer and photographer, researcher at the Lyon Urban School and advisor to the National Agency for Territorial Cohesion

Rive-de-Giers - one of many industrial wastelands in the area - ©S. Cordobes

"Resilience" seems to have made a name for itself in French territories. It's even become fashionable. For better or for worse: the concept provides a good perspective for addressing global change, but its aura of "novelty" and "transition", essential for any project today, means that it is likely to be misused. A logistics and employment zone is created in a depressed area: it's called economic resilience! Dykes are consolidated to prevent the risk of flooding: must be environmental resilience! Thermal rehabilitation of buildings in a neighbourhood regeneration project: label it urban resilience! There are countless examples. No criticism of such operations in themselves, which relate to territorial development, risk management or urban renewal; it is rather the fact that they are indiscriminately branded as resilience that raises questions. Doesn't such lavish use of the word mean that it will become devalued too quickly before it has fulfilled its true purpose?

What we need are effective words that encourage understanding, win support and make people act. Words that will successfully update discourse, representations and urban planning practices. Words that will permit us to be equal to the Anthropocene challenge that we are facing. We can judge its scope: our modern software for urban planning and development assumed that we had and were masters of a stable and eternal nature; that we could exploit a resource planet to the sole extent of our technological and scientific desires and powers; that growth was our unsurpassable horizon and a certain guarantee of progress for all humanity! Today, we are finding that our terrestrial habitat is damaged,

with limited and unfairly allocated resources, and that its biotic balance is increasingly threatened by the incalculable damage we have already caused on the one hand, and by the increasing number of extreme climatic and environmental contingencies – massive fires, heavy precipitation and floods, heat waves, drought, etc. – that are affecting us on the other. The modern fiction of plenty and of infinite progress leads to the observation of great vulnerabilities and uncertainties for humanity, and this is irrevocable. The Anthropocene requires us to build a New World by shifting from the modern consumption logic of terrestrial entities to that of regeneration. In other words, we must radically reinvent how we create territory, and therefore how we live in it and develop it. If properly understood, resilience is one of the words capable of helping us to think about this new shift.

Like many people, it was in the field of psychology that I first came across resilience and appreciated the richness of the concept. As I recall, it was a book about grief. After the loss and pain that come with the death of a loved one, the survivors managed to overcome the ordeal and invent a new life through slow, profound work and at their own pace. So resilience occurred after a traumatic and irreversible event. It was not a matter of protecting oneself, of maintaining or restoring an old state of equilibrium by going backwards, even less of erasing or forgetting. Through care, it led to the creation of a new personal universe, different from the previous one, but peaceful and viable.

With New Orleans, rebuilt after the devastation of Hurricane Katrina in 2005, I later became interested in its territorial

"
We must radically reinvent how we create territory, and therefore how we live in it and develop it.
"

transposition. Comparing this reconstruction to a process of resilience seemed obvious: a natural disaster with irremediable losses, a rehabilitation that involved attention to the inhabitants and spaces destroyed and led to a new territorial dynamic. However, the story is actually less convincing, or at any rate more ambiguous. The city centre districts worst affected by the disaster were also the poorest. Many of the plots of land occupied by destroyed and underinsured houses had to be sold at low prices, leaving their inhabitants no choice but to settle elsewhere. The razed blocks, made safe, redeveloped and rehabilitated, ended up welcoming new, better-off populations. This means that the resilience of the centre of New Orleans was the result of evicting many fragile African-American families who were condemned to move to distant urban areas, losing not only relatives who had died, but also the homes they owned and their attachment to a community and to a place. Katrina turned the predominantly 'black' city into a 'white' one. Resilience of a territory after a disaster, but for whom, at what human, social and cultural cost and on what scale?

What lessons can be drawn from these two brief examples? Firstly, true territorial resilience occurs after an irreversible disruption and denotes a deep and long-term process of regeneration. This prerequisite is not incompatible with the situation we are in. Indeed, entering the Anthropocene responsibly means recognising that the planetary catastrophe caused by the modern development project is already here, with no way out, no way back; and that not only do we now have to adapt, but we have to take care of our environments and reinvent our territories and ways of life.

Secondly, resilience projects can only be local. Just as the planetary nature of global change forbids us from believing that catastrophe will occur elsewhere, that having so far been spared ourselves, it does not concern us. This is an unthinkable position since the Covid-19 pandemic: it is now impossible to assume that we can be resilient locally without taking into account the quality of the interactions and interdependencies linking us to the rest of the world.

Any territory aiming at resilience at the same time as committing itself locally to a regenerating dynamic of its social ecosystem must simultaneously stop transferring the negative externalities of the model it adopts to 'others': watchwords such as care and regeneration, frugality and more equitable sharing, shortened circuits and solidarity-based interdependence thus become unavoidable.

And finally, the invention of new territories and habitable worlds through resilience mechanisms does not only have a technical or environmental dimension. It is in fact eminently political and cannot avoid a democratic review of the way in which we live together, share the common and limited resources of this world, and each contribute to this new human quest. It is therefore also social, mental, cultural, educational and, hence, eminently ecological. For us moderns, this is nothing more nor less than an anthropological revolution and a redefinition of our relationships with the people who make up our terrestrial habitat, whatever the place and the scale in question.

These seem to be some of the dimensions that should be taken into account in any resilience project in our Anthropocene world. Perhaps this is not yet the case. These are some of the dimensions that any resilience project in our Anthropocene world should take into account. This is perhaps not yet the case. There is no doubt that we must urgently adjust our practices, not so much out of fear of seeing the concept lose its credibility, as of not making the changes necessary for the concrete resilience of our territories and the survival of future generations.

Rive-de-Giers - an industrial town in need of resilience - ©S. Cordobes

Virginie Alonzi

Director of Strategic Foresight,
Bouygues Construction

According to the most pessimistic scenario predicted by new climate simulations carried out by French scientists contributing to the 6th assessment report published by the IPCC[1], the planet could be 6 to 7°C warmer by the end of the century than in the pre-industrial era. Beyond these projections, the Covid-19 public health crisis has immersed us in resilience in the form of a 'life-size' experiment: how do we collectively cope with a major unpredictable disaster?

Covid-19 has made us aware of the vulnerabilities generated by our models and of the urgency of bringing about desirable new futures in a complex world.

We are currently living in a context of uncertainty and systemic crises, with climate change, resource depletion, biodiversity collapse, economic and social crises and so on which will impact and transform territories in future decades!

The Covid-19 pandemic has made the term 'resilience' an overused word, subject to criticism and controversy. And yet, because of its systemic approach, the concept of resilience is gradually becoming a crucial factor in local, national and even international governance, opening up other paths, other fields of possibility.

Territorial resilience is **the capacity of a territory** (considering all its components: inhabitants, institutions, companies, infrastructures, flows, networks) **to continue to function independently of major impacts** (floods, pandemics, cyber-attacks, etc.) but also by reducing the **chronic**

stresses of daily life (air pollution, social inequalities, ageing infrastructures, etc.) and **by adapting in the immediate to long-term pressures** linked to irreversible trends (climate change, depletion of resources, erosion of biodiversity). A territory is then perceived as "resilient" when it is capable of **anticipating, reacting and adapting** to these upheavals, whether they are sudden or long term.

Today, territories are increasingly vulnerable: the number of climatic hazards and natural disasters has increased fifty-fold in a century and their frequency and intensity are likely to continue to grow, according to simulations. At a global level, the United Nations estimates that direct economic losses due to natural disasters rose by 250% between 1998 and 2017. In France, the cost of climate-related disasters has tripled since the 1980s, from €1.2 billion per year to €3.6 billion per year.

Climate disruption, global interconnectedness and chronic stresses are increasing the intensity and frequency of hazards and adding uncertainty to their future characteristics: increasingly sophisticated cyber attacks, rapid proliferation of epidemics, and more and more extreme weather events. So we need to develop a capacity to react to a widening spectrum of possibilities, to learn to react to disturbances and unknown phenomena in order to continue to function, independently of major upheavals.

[1] Intergovernmental Panel on Climate Change

How can we limit the impact of these hazards on buildings, infrastructures, networks and populations? How can we reconcile ecological imperatives, sustainable economic models and inclusiveness? Can a territory be resilient to all forms of disruption (climatic, health, digital, societal, etc.)? Is this paradigm shift influencing public policies?

Resilience can be difficult to make operational; in this context, we have conducted an open and multi-partner approach with public and private players from various backgrounds to co-construct possible futures over several months, in order to meet the challenges of the coming decades. Feedback, sharing of good practices, methods and tools, solutions, benchmarks, inspiring initiatives and co-construction were at the heart of the foresight-focused collaborative workshops.

The aim of this new trend book, **"Resilience, the future of sustainable territories"**, is to inspire and encourage action by sharing our strategic foresight research resulting from this approach and to contribute to speeding up the transition.

A resilient approach to the development of our territories entails simultaneously reducing various types of risks (health, climate, technological, etc.), adapting to changes that are already certain (increase in temperatures) and limiting factors of vulnerability (reducing carbon emissions, combating social inequalities, etc.).

Resilience takes a systemic approach, allowing for the cascading effects of disruption in order to reduce the vulnerabilities of territories. Resilience capacities are rooted in the specific characteristics of each territory (human, environmental, economic, health, organisational, political, etc.), and they must also reconcile such paradoxical notions as short term and long term, local and global scale, autonomy and dependence, individual and collective, etc. Alongside this, the involvement of the citizen or the inhabitant, at the heart of the governance process and their active participation in the transformation is essential to move towards responsive and adapted territories.

The resilience paradigm challenges our development models based on infinite progress and growth in a world of finite resources. Beyond an awareness of these vulnerabilities, territorial resilience depends on collective dynamics and the mobilisation of public and private players and citizens at different levels. It is in this context that Bouygues Construction, as a responsible and committed company, has sought to mobilise all its intelligence to co-construct and experiment with new models and methods, with the aim of identifying relevant responses to the complexity of the issues at stake and the current uncertainty, while reinforcing a multidisciplinary culture.

If resilience is adopted as an integrating framework for urban and territorial transformations, with a holistic vision, it will contribute to improving the quality of life of current and future generations. These new models are based on anticipation, attenuation, adaptation and cooperation; they are more respectful of ecosystems and the physical limits of the planet in the Anthropocene era. This is why resilience represents the future of sustainable territories!

> "
> The resilience paradigm challenges our development models based on infinite progress and growth in a world of finite resources.
> "

8

9

1

Resilience issues

Since the industrial era, human activities fuelled by a profusion of energy have profoundly disrupted the major planetary balances. In so doing, they have triggered ecological upheavals on a scale and at a speed unprecedented in the history of humanity. The most significant of these are climate change and the collapse of biodiversity. Damage done to ecosystems by human activity has grown exponentially since 1950 and has been described as the 'great acceleration'. In 2016, 15,000 scientists from 184 countries used analysis of global indicators to warn of unprecedented environmental degradation.

8 indicators
of planetary degradation since 1960

More than 600 marine dead zones (asphyxiated underwater life) were identified in 2010
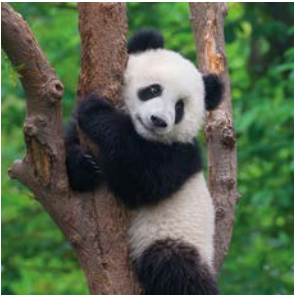
The 10 hottest years since 136 have all occurred since 1998

Freshwater resources per capita have been halved compared to 1960

Vertebrate species declined by 58% between 1970 and 2012

Between 1990 and 2015, **deforestation** affected an area of forest **the size of South Africa**
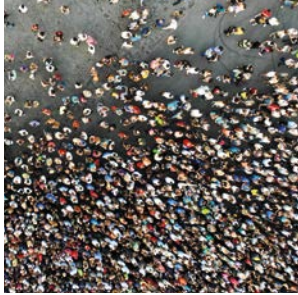
The human population could reach **11 billion in 2100**

The limits of sustainable fishing have been exceeded since 1992

Emissions of CO_2 **increase every year**

The Anthropocene age has begun

In 2000, American biologist Eugene F. Stoermer and Dutch chemist and Nobel Prize winner Paul Crutzen introduced the term "Anthropocene". This term views humanity as a geological force capable of changing the Earth system. Human intervention on the planet is considered to be such that it has a real geological influence on the biosphere and the Earth system.

Scientists have, for example, discovered non-natural rocks: plastic crust, a rock formed by plastic debris, on the coast of the island of Madeira in Portugal, and plastiglomerates, found in Hawaii, which combine shell debris and plastic melted by lava.

Environmental ceiling

As an illustration of the environmental ceiling set by the planet's limits, **Overshoot Day** designates the date on which humanity has consumed all the resources that Earth can regenerate in a year. It occurs earlier and earlier each year. From this date on, humanity is living on credit as far as natural resources are concerned.

2000	2010	2021
SEPTEMBER	AUGUST	JULY
22	**6**	**29**

Source: National Footprint and Biocapacity Accounts, 2021 edition: data.footpintnework.org

This concept highlights the incompatibility of our current linear model on which we have based our lifestyles with the maintenance of planetary balances. In 2009, Johan Rockström, then director of the Stockholm Resilience Centre at Stockholm University, established a framework of **global limits that must not be exceeded**, otherwise environmental changes will occur with uncontrollable effects. **Of the 10 critical thresholds identified, 5 have now been crossed:**

Roughly **27%** of animal and plant species are currently threatened with extinction on the planet

Climate change
Rate of CO_2 in the atmosphere

Erosion of biodiversity
Annual rate of extinction of species

Changes in land use
Changes in the world's forest area

Disturbance of the nitrogen cycle
Quantity of synthetic reactive nitrogen in the environment

Disturbance of the phosphorus cycle
Quantity of phosphorus in the environment

The 10 planetary limits

Our societies and territories must imagine other models that are more respectful of ecosystems and planetary harmony.

CLIMATE · OZONE · BIODIVERSITY · OCEANS · FRESH WATER · AEROSOLS · DEFORESTATION · NITROGEN · PHOSPHORUS · CHEMICAL POLLUTION

Status of indicator in relation to the planetary limit
- Risk of collapse
- Uncertain risk
- Status below risk threshold
- Not quantified

Types of interdependence
— Major link
— Minor link
— Potential catalytic effect
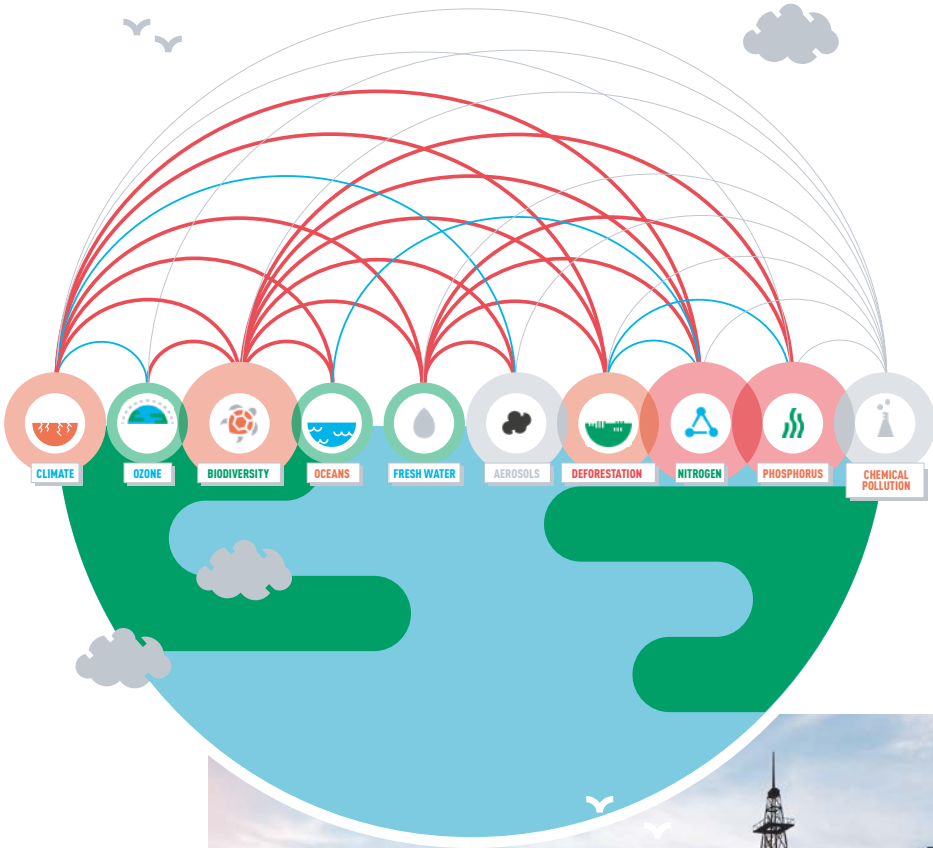
The vulnerability of hyper-optimised societies dependent on fossil fuels

Our current models, based on fossil fuels and the overexploitation of natural resources, threaten the environmental balance and are a source of vulnerability for our societies.

"At a territorial level, activities as essential as eating, getting to work or participating in social life have become dependent on oil-powered transport," says The Shift Project[1]. But the era of cheap and abundant fossil fuels is coming to an end (leaving aside their environmental impact). The contraction of oil supply may not yet have occurred, boosted in particular by the development of shale oil in the United States, but the International Energy Agency estimated in 2008 that the peak of conventional oil production had been reached. Moreover, the constant rise in extraction costs is a limit for this sector. Beyond the question of available stock, withdrawal from fossil fuels is indispensable in the context of the fight against climate change.

More broadly speaking, the systems we have built to meet our needs (water, food, housing, energy, etc.) and to structure the functioning of our societies (politics, the virtual sphere, finance, etc.) are complex, hyper-optimised and based on interdependent relationships: a large part of our food supply depends on just-in-time supply from distant sources; the circulation of information and energy flows relies on a limited number of players, etc. Under these conditions, the slightest disturbance can generate a downward chain reaction of these optima with multiplying costs (impact on human lives, material costs, loss of economic activity).

[1] Territorial resilience to remain on course for the ecological transition, The Shift Project, 2021

Different types of disruption

Disruptions take many forms and are not limited to climate-related hazards.
They can take the form of shocks (sudden, severe or large-scale events) or chronic stresses, which create continuous pressure and have more latent but no less significant effects.

SHOCKS

Flooding, heat wave, strong winds, riots or industrial unrest, cyber attack, pandemic, industrial accident, fire, sudden influx of refugees, geopolitical crisis, sudden pollution, etc.

CHRONIC STRESSES

Air and water pollution, soil depletion, social inequalities, poverty, anti-social and aggressive behaviour, social malaise, outdated infrastructure, etc.

Crises are more frequent and the pressure of chronic stresses is stronger

As a result of the breakdown of the major planetary balances and/or the vulnerability of our systems, crises and disruptions are becoming more frequent and unpredictable and are causing significant damage.

■ **The impacts of disruptions are increasingly perceptible in the territories.** Some impacts are already observable (drought, heat waves, new epidemics), while others are slow phenomena (coastal erosion, rising sea levels). They already justify restrictive measures: in the context of a water crisis in 2018, Cape Town restricted water consumption to 25 litres per person per day.

[1] Counting the cost, Christian Aid

■ **3,500 victims, 13.5 million people displaced, more than $140 billion in economic losses:** this is the toll of the 10 most costly extreme events of 2020, linked to global warming[1]: bushfires (Australia), storms (United Kingdom, Ireland, France, Italy), locust swarms (East Africa), floods (China, India, Japan, Pakistan), cyclones (India, Sri Lanka, Bangladesh), hurricanes (United States, Central America) and wildfires (West Coast of the United States).

■ **These events widen inequalities:** according to the same report, only 4% of economic losses were insured in the poorest countries, compared to 60% in the richest countries.

The Covid-19 pandemic

The Covid-19 pandemic has put a new focus on the concept of resilience

■ **By illustrating the type of disruption that can make our complex systems** unravel through its unpredictable, worldwide and systemic nature, with public health, economic and social impacts.

■ **By putting our capacity for reaction to the test:** the crisis has revealed the relative unpreparedness and great vulnerability of our societies, but it has also highlighted the capacity of local authorities to rebound after having been reduced to a "minimum service", restricted to their vital functions, as well as the strength of the solidarity and collective dynamics that have been formed spontaneously.

■ **It revealed the fundamental questions** that a society has to answer regarding the trajectories to adopt when confronted with the impacts of a disruption: "a return to normal" or "the new normal"?

Interest of a resilience-based approach

Faced with these disruptions, resilience is intrinsically **a positive concept, bringing hope and opportunities** to enable continuity of activity and functionality on the one hand, and to rebound towards more sustainable outcomes on the other. Resilience is defined as "the ability of a system to absorb shocks and reorganize itself in a changing environment in such a way that it maintains its functions, structure and response capabilities, and thus its identity."[2]

A compass to guide public policies and projects

Applied to the territory, it is relevant for all players (institutions, companies, non-profit organisations, inhabitants), infrastructures (buildings, networks) and flows (waste, materials, etc.). With its intrinsic virtues of adaptation and transformation, it serves as a compass to guide any public policy, initiative or project and, more broadly, provide a framework for understanding and anticipating the changes and threats arising from the Anthropocene.

A systemic approach

Territorial resilience implies a systemic approach that takes into account the interactions between the threats that affect the territory, whether they are natural (e.g. earthquake) or anthropogenic (e.g. industrial accident) risks or threats resulting from the Anthropocene. By taking into account the dynamics of risks and territories, the approach considers the cascade effects and multi-scale consequences that a disturbance can cause, in both the short and long term.

[2] A Treatise on Local Resilience, A. Sinaï, R. Stevens, H. Carton, P. Servigne, 2015

Cascading effects of Hurricane Sandy across New York City

Hurricane Sandy swept through the New Jersey coast and downstate New York in October 2012, causing heavy rains and winds and triggering a chain of events that affected economic and social life and claimed the lives of about 50 people. The losses in New York City were the result of the combined direct impacts of the event and the disruptions caused by the chain reaction of network failures. Hospitals and health facilities, for example, were evacuated both because of flooding and because of technical failures

(New York University Hospital, the city's largest medical facility, was evacuated because of a backup power generator failure). Similarly, a UNISDR report shows that the transport and building sectors were more affected by the collateral effects than by the direct damage associated with the heavy rains and winds (in terms of surface area affected)[1]. This crisis illustrates the fact that urban and territorial systems are based on a multitude of infrastructures, and the failure of one can bring the entire system to a standstill.

Interaction of risks: one or more hazards (torrential rain, flooding, high winds) trigger another hazard (industrial accident)

FLOODING
Waters rose up to 4.3 metres in New York City (East River and Hudson River floods caused by torrential rains)

MARINE POLLUTION
More than 1.1 million litres of diesel fuel leaked off the coast of New York due to a ruptured tank at a New Jersey refinery that was severely damaged by the hurricane

FIRES
Several fires (including a large one caused by a ruptured gas line and fanned by high winds) destroyed more than 50 homes

TECHNICAL NETWORKS
Power outages (1.5 million people left without electricity), landline, mobile and internet disruption for several days

Transport disruptions are the result of both direct effects and the breakdown of technical networks

TRANSPORT
- Petrol stations affected by the shutdown of the supply chain (2 refineries shut down for 8 days)
- 6 road tunnels out of service (e.g. Brooklyn-Battery Tunnel: 47,700 vehicles and 3,100 buses daily, closed for 21 days
- Traffic lights out of service for weeks at over 3,500 intersections
- 250 streets impacted by debris or falling trees
- Metropolitan network impacted for periods of 6 days to 7 months

BUILDINGS
375,000 New Yorkers evacuated

TELECOMMUNICATIONS
disruption of landline, mobile and internet networks for several days

HEALTH
6,300 patients evacuated from 6 hospitals, a psychiatric hospital and 18 other health facilities

ECONOMIC ACTIVITY
Manhattan made very difficult to access, stock exchange trading interrupted for two days on the NYSE and Nasdaq

▢ Hazards ▢ Network failures
▢ Examples of sectors affected by direct physical damage and business interruption due to chain failures (examples of impact)

Source: based on A. Grangeat, Vulnerability, resilience and cascade effects between technical networks: contributions of systemic and spatial modelling for planning and crisis management for network operators and civil security, PhD thesis, University of Lyon, 2016
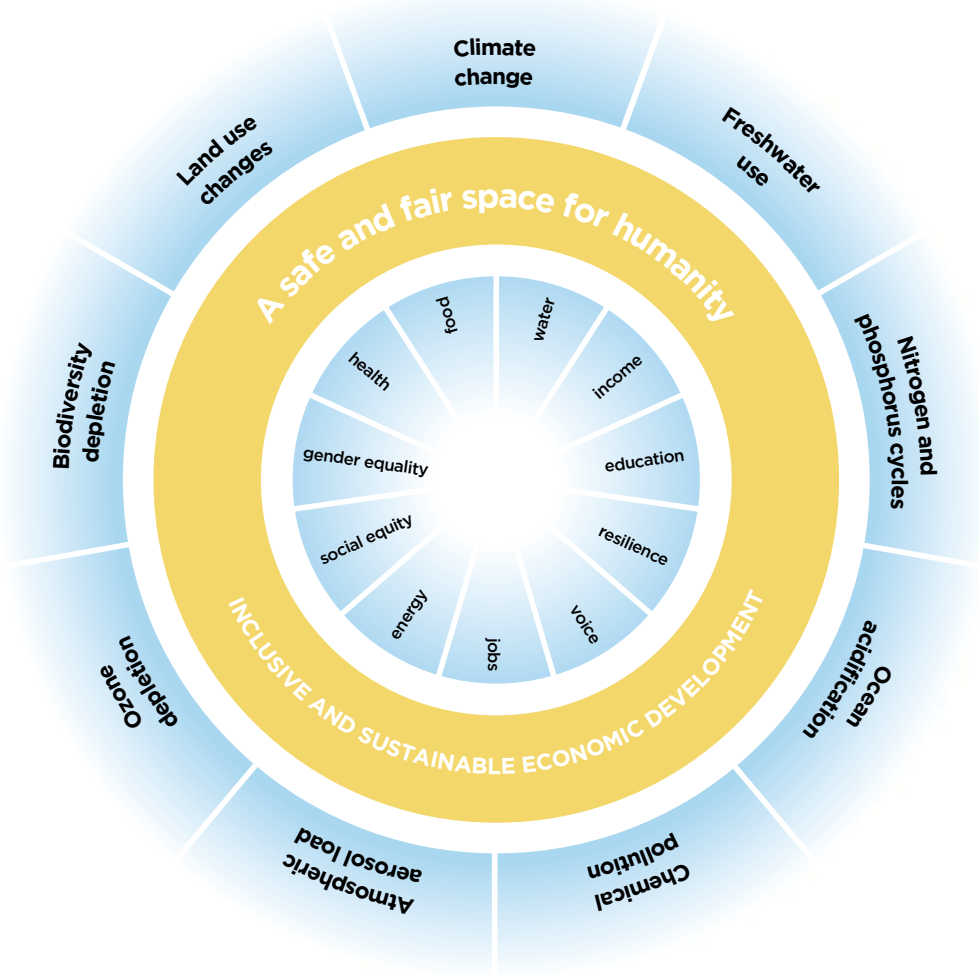
[1] Haraguchi, M. & Kim, S. (2014) Critical Infrastructure Systems: A Case Study of the Interconnectedness of Risks Posed by Hurricane Sandy for New York City, Columbia University for the UNISDR (United Nations Office for Disaster Risk Reduction).

A social model focused on the Earth system, life and well-being

The notion of resilience is linked to models of society which focus on the Earth system, life and well-being rather than on exponential growth, as exemplified by economist Kate Raworth's "doughnut" concept.[2] This concept establishes two conditions for more sustainable development of people: to guarantee vital and essential social needs (food, shelter, healthcare, security, education, a voice in the city, etc.), while remaining in line with the physical limits that the planet can bear (the planetary limits). Somewhere between this social floor and this environmental ceiling emerges a doughnut shape that represents the safe and fair space in which humanity can grow.
This makes resilience another way of responding to people's vital and essential needs.

[2] Kate Raworth, Doughnut economics: seven ways to think like a 21st-century economist, 2017

A safe and fair space for humanity

INCLUSIVE AND SUSTAINABLE ECONOMIC DEVELOPMENT

food · water · income · education · resilience · voice · jobs · energy · social equity · gender equality · health

Climate change · Freshwater use · Nitrogen and phosphorus cycles · Ocean acidification · Chemical pollution · Atmospheric aerosol load · Ozone depletion · Biodiversity depletion · Land use changes

A path towards sustainable cities and ecological transition

The concept of resilience is related to those of sustainable development and ecological transition.

To be sustainable, a region must be resilient: in its manifesto for sustainable cities, the non-profit organisation France Ville Durable identifies resilience as one of the four pillars of the sustainable city, by virtue of its capacity to adapt and react.

Resilience is also synonymous with the ability to adapt. This does not mean resisting or seeking a return to normality in response to disruption, but rather **moving towards a configuration that is less fragile, in a learning process, by transforming our models.**

By encouraging areas to adopt low-consumption, autonomous and low-carbon practices, territorial resilience is a key concept to tackle major ecological challenges (climate change, increasing scarcity of resources, growing environmental health risks and accelerated loss of biodiversity) and to stay on course for an ambitious ecological transition.

Resilience: the adapted and responsive city

This is a city that is aware of its vulnerabilities and its current and future environmental, health, economic, social, organisational and infrastructural resources, and has adapted its projects and governance accordingly.

It can still function despite major disruptions as it has adapted its systems in a more holistic way and has trained and supported its civil society to cope with and recover from crises.

It reduces its chronic stresses and impacts on ecosystems on a daily basis and places climate change adaptation on the same level as mitigation and develops projects and policies that systematically integrate the two issues.

The resilient city is caring and safe, it protects its inhabitants and its ecosystems, it can innovate and cooperate.

Source: Extract from the Manifesto for Sustainable Cities, France Ville Durable

> "
> In summary, territories will be increasingly subject to crises and disruptions related to climate and ecological changes. Whereas the transformation that they must imperatively undertake to avoid the worst – the ecological transition – is an extremely risky process economically, socially and politically.
> In such a context, the objective of territorial resilience cannot be to return to normal, but rather to enable this transformation: the resilience of territories to remain on course for the ecological transition.
> "

Laurent Delcayrou
Territorial Resilience Project Manager, The Shift Project

Territorial transposition

Resilience entails global thinking for territories. This process needs to guide all public policies, initiatives and projects at a territorial level so that they can resist disruptions (cindynic resilience) whilst remaining compatible with the effects of large-scale factors, like climate change (global resilience).

Each territory is responsible for analysing and understanding the different risks and threats to which it is exposed and its vulnerabilities, but also identifying its assets and potential for resilience. These different aspects depend on the geographical characteristics, resources and ecosystems that constitute each territory. Ultimately, a territory's resilience also means considering the services and functionalities associated with it, as well as the systems on which they rely.

It is essential to carry out a multi-scale analysis as there are vulnerabilities that can be caused by large-scale dependency (e.g. supply from global logistics circuits) or smaller-scale ones (interdependence of urban services that can cause cascade effects in the event of a disruption). In a similar way, resources and assets can also be looked at from a local and inter-territorial point of view (e.g. cooperation agreements between a metropolis and a rural area).

Strengthening legislative, standard-setting and regulatory structures

Legislative, standard-setting and regulatory frameworks are evolving to guide cities and territories towards greater resilience.

International conventions

International bodies advocate the development of territorial resilience strategies

187 UN member states have adopted the Sendai Framework for Disaster Risk Reduction 2015-2030, a global agreement that aims to reduce and prevent the risks of natural disasters. Compared to its predecessor, this framework focuses on prevention, disaster risk reduction and resilience building rather than on managing disasters once they have occurred. It also clarifies the importance of social resilience and the role of civil society in the governance of resilience.

Legislation

In France, several changes in legislation have incorporated the principles of resilience:

■ **Legislation introduced in August 2004 to modernise civil protection established an obligation to implement a Municipal Protection Plan** (Plan Communal de Sauvegarde, or PCS) for cities, towns and villages equipped with a Risk Prevention Plan. These plans are useful for councils in dealing with civil protection events affecting their municipalities. They define the organisation planned by the municipality to ensure that the population is alerted, informed, protected and assisted in the event of a disruption, and that council services are maintained. They specify and define the actions to be taken (continuity plan for town hall services, crisis unit, directory of players, logistical and human resources, procedures for accommodating and feeding people) and envisage scenarios according to risks that

are of relevance to the specific territory (for instance the PCS in Grenoble covers house fires, gas leaks, earthquake, chemical accidents, epidemics of diseases transmitted by mosquitoes). The PCS complements other existing provisions such as the Municipal Information Document on Major Risks (Document d'Information Communal sur les Risques Majeurs, or DICRIM), whose role is to inform the inhabitants of a municipality about natural and technological risks and the measures put in place to deal with them.

■ **A new national flood risk management policy was introduced following the European Union's Floods Directive of 2007.** It is being implemented locally in the regions in the form of local flood risk management strategies, turned into concrete actions as part of a **flood prevention and action programme**. Flood risks are addressed in a broad spectrum covering public information, vulnerability reduction, risk prevention, monitoring and forecasting of weather phenomena.

However, these documents adopt a single-hazard approach and do not take account of disturbances relating to the Anthropocene.

■ **The 2021 law "to combat climate change and strengthen resilience to its effects" (or the "Climate and Resilience" law)** marks a new milestone in legislation. It implements some of the 149 proposals of the Citizens' Climate Convention aiming to reduce greenhouse gas emissions by 40% by 2030, in a spirit of social justice. Presented as a breakthrough bill marking the start of an ecological era by some, but lacking in ambition for others, it is intended to anchor ecology in the French model. With regard to urban planning, its ambition is to slow down the consumption of natural, agricultural and forest areas by halving the rate of land artificialisation by 2030, compared to the previous decade. This is an intermediate target before achieving zero net artificial land use by 2050.

Standards

Standardisation organisations create resilience standards for cities

International Standard ISO 37123, "Sustainable cities and communities – Indicators for resilient cities", provides a set of indicators that cities can use to assess their level of resilience. It was developed under the supervision of UN-Habitat and aims to contribute to Sustainable Development Goal (SDG) 11: Sustainable cities and communities.

Objectives relating to the reduction of the rate of soil artificialisation

Enabling soils to perform their biological, hydrological, geochemical and geomorphological functions, which are impeded by waterproofing and certain types of surfacing that prevent the absorption of carbon, promote heat islands and increase the risk of flooding.

Protecting natural, agricultural and forested areas with a view to ensuring the resilience of food production in the regions and preserving biodiversity, which is particularly affected by transport infrastructures and soil pollution.

Limiting urban dispersion linked to the fragmented development of buildings, particularly in suburban areas and along coastlines. Scattered construction involves the costly extension of networks (roads, drainage, electricity), creates dependence on the car, distances people from public services and weakens territorial cohesion.

2

Territorial resilience in action

Disruptions and challenges (particularly climatic and ecological) call for measures at global and national levels, but territories must also take them into account at local level in order to anticipate and prepare for them.

Territories share their visions and approaches

How do local authorities integrate resilience into their actions with regard to the main risks identified? What are the risks and vulnerabilities that they prioritise in their areas? What difficulties and levers do they identify? Around twenty regional players shared their feedback with us as part of a survey entitled "Resilient Cities and Territories" conducted in September 2020, in collaboration with Chronos and Banque des Territoires, with support from France Ville Durable.

Communities are aware of a "global systemic risk"

Local authorities that took part were clear about the interconnected nature of the risks and the potential for uncontrolled cascading effects.

They identified events likely to disrupt the "precarious balance of the system" (supply chain disruption, relocation of a major economic player in the region, etc.) and did not rule out any risk: pandemic, cyber attack and information system blackout, industrial accident, fire, flooding. Chronic stresses likely to affect the mental or physical health of the population were particularly highlighted: pollution, but also unemployment and job insecurity. Their responses point to a "global systemic risk" encompassing natural and man-made risks and the major threats arising from the Anthropocene.

Contributors to the survey

Local authorities on various levels: departments, intercommunal structures, municipalities

Several types of representatives of local authorities: elected officials, chief executives, department directors

Survey: "Resilient Cities and Territories", Bouygues Construction, Chronos, Banque des Territoires, with the support of France Ville Durable, September 2020

Climate disruption is the focus of concern

Risks relating to climate disruption are of great concern to them because of the potentially catastrophic scale of the phenomena and their occurrence in various forms throughout the year (droughts, heatwaves, floods, extreme cold). Communities consider the trends to be worrying and anticipate an increase in the frequency and intensity of disturbances. They associate these climatic phenomena as much with sudden events (swollen rivers and coastal flooding, heatwaves, etc.) as with chronic stresses (drought) which they feel powerless to cope with.

Vulnerabilities are very closely linked to social issues

There are two types of approaches to how local authorities prioritise risks and address resilience:

- The first approach is based on the idea of survival, the preservation of the system (with a view to preventing it from collapsing or breaking down) and the protection of the population's vital needs (physiological needs, need for safety, as defined by the Maslow Pyramid: drinking water, eating, etc.). Instead, it considers resilience in the face of a shock.

- The second approach reflects a more global perspective that aims to satisfy the essential needs of our societies: education, shared territorial identity, improvement of the human living environment and of each individual's social situation.

> "Flooding is well managed on the whole, unlike drought, which generates numerous conflicts of water use between industrial and agricultural activities."

> "We have no territorial resilience strategy written down anywhere, but our climate plan, our Territory of Innovation initiative and certain strategic documents such as the local intercommunal urban plan for housing and transport show that we take a very broad approach."

Testimony of local authorities

Local authorities identify several vulnerability factors:

- Vulnerability at the individual level, which affects people in a fragile situation: isolated people, those in poor health, etc.

- Factors that threaten social cohesion: social inequalities, a deepening distrust of institutions and political parties.

- Global difficulty in imagining risks that are beyond our control and in accepting risk, which slows down the transformation of our models. This is the principle of cognitive dissonance with regard to risk: we perpetuate development methods that feed our vulnerability. As an illustration, local authorities cite the urban sprawl that continues to progress in spite of repeated laws (the Law for Solidarity and Urban Renewal in 2000, the Law for Access to Housing and Renovated Urbanism in 2014). As far as uses are concerned, lifestyles and consumption choices do not always tend towards sustainability (air travel, for instance).

The impacts can already be seen in the territories and are increasingly perceptible. They feed feelings of a lack of preparation and insecurity among the population. The local authorities in question see this as an additional threat, likely to fuel a negative spiral (stress, fear, aggressiveness) and to encourage people to withdraw into themselves.

Apart from the population, municipal workers are also affected by these disruptions and some local authorities see signs of exhaustion among their staff who are on the front line of crisis and stress management.

Local authorities have identified several levers:

Better coordination of players, engagement of the population, broad cooperation between municipal services.

Most of the local authorities taking part in the survey adopted a global approach to resilience. They initiate diagnoses or global reflections, without necessarily going as far as to develop a territorial resilience strategy. Many of them combine this global approach with more sector-specific reflections, differentiated according to the types of risks and vulnerability, which they then apply more broadly. Their approach is rather pragmatic and is based on existing local tools, such as the Municipal Protection Plan (PCS). On the other hand, the local authorities in question had no knowledge of existing tools (Cerema's territorial resilience compass, the 100 Resilient Cities programme's toolbox, Ademe's Regional Trajectories for Adapting to Climate Change, etc.).

They are transforming their modes of governance to develop their processes, whether by working on participatory approaches, creating local think tanks or adopting common methods between municipal departments. With regard to the latter point, local authorities consider that more needs to be done to improve coordination between individual departments and the major players.

Local authorities are convinced of the need to mobilise citizens and community networks, and they are initiating numerous actions to raise public awareness of the risks (major risks and chronic stresses) that threaten their territory and to prepare them to react: the formation of a municipal civil security reserve, awareness-raising programmes in schools and then for the whole population, the implementation of volunteer programmes, and the organisation of local citizen conventions. They consider that the inhabitants' role in the governance of resilience is still too limited, identifying this as one area that must be developed in the immediate.

Territorial resilience initiatives

Faced with the crises that have occurred in recent years, whether one-off or chronic, it has become necessary to implement territorial resilience initiatives. How can territories acquire the tools and organise themselves to develop their capacity to cope with shocks and stresses and to anticipate their impacts? Each territory must develop its own response, as there is no single path to achieve it. The initiatives carried out in the territories reflect the diversity of possible methods. However, they do all share a common base that permeates them all: acknowledgement of the major international consensuses on urban development (SDGs, the Paris Agreement, New Agenda for Cities), a cross-sector approach, engagement of local players and co-construction.
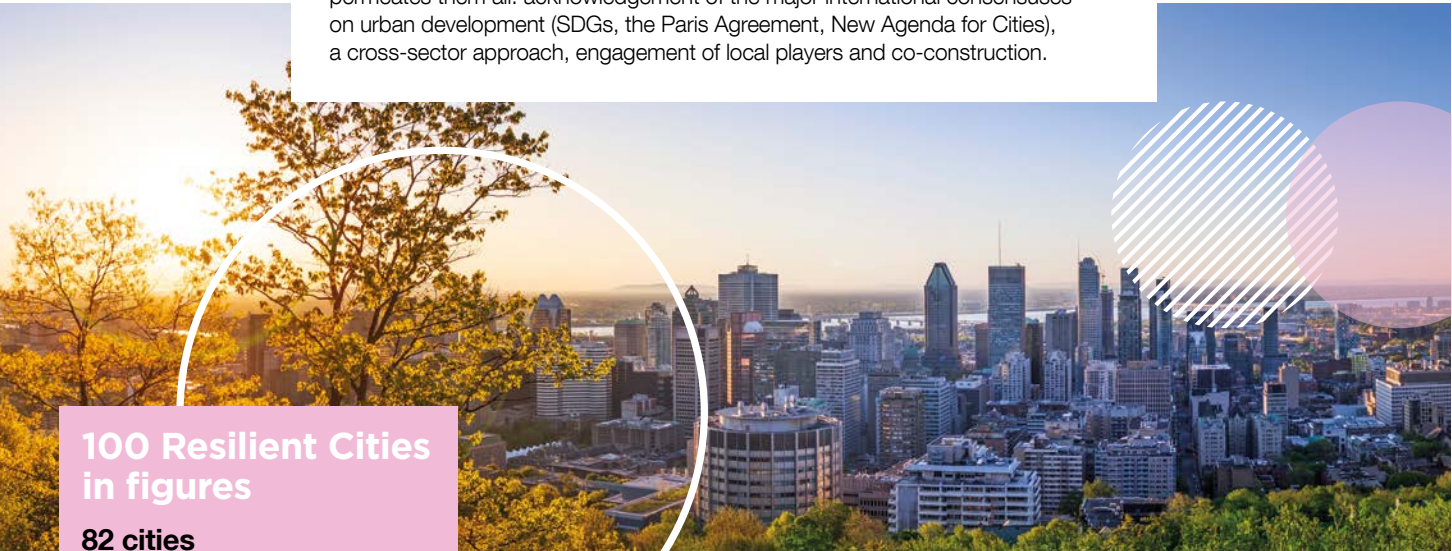
100 Resilient Cities in figures

82 cities
on five continents have developed their resilience strategies

70%
of them have more than
500,000 inhabitants

Highest population:
Lagos, Nigeria
(20 million inhabitants)

Lowest population:
Ramallah, Palestine
(45,000 inhabitants)

Examples of cities:
Vejle (a Danish city of 113,000 inhabitants), Glasgow, Thessalonica, Rome, Cape Town, Dakar, Melbourne, Quito, Medellin, Toronto, Louisville, Semarang (Indonesia), Surat (India)

The City of Montreal's resilience strategy
The 100 Resilient Cities Programme

In 2014, Montreal was the first city to join the 100 Resilient Cities (100RC) network, initiated by the Rockefeller Foundation to help cities devise resilience strategies to deal with the multiple shocks and stresses threatening them, including those linked to climate change. Four years later, Montreal launched its strategy for a resilient city, backed up by an action plan, and created an Office of Ecological Transition and Resilience. Co-constructed with more than one hundred internal and external partners and with citizens, this strategy focuses on developing the capacity of citizens to act, arguing that social capital is one of the main drivers of their resilience and that of their community.

The Office reports to the deputy city manager for quality of life and its members work alongside civil security and business continuity teams, which in turn report to the civil security and resilience department. Through this positioning, the Office of Resilience maintains an across-the-board view of the city and the challenges it faces.

The Gironde department: a territorial resilience strategy

The Agenda 21 mission of the Gironde department became La Base in 2014, a public innovation laboratory that is now responsible for steering the department's resilience strategy. In 2019, the Departmental Assembly initiated this reflection on its territorial resilience strategy, in a co-construction process involving territorial councils which involved local authorities and inhabitants of catchment areas within the department, a citizens' panel of 40 people and players in the social economy. The initiative led to a number of actions:

■ Creation of a territorial resilience kit intended for local authorities, including a serious game designed to raise awareness of the notion of resilience and a tool to test the level of resilience of a project

■ Implementation of "Gironde Alimen'terre", a programme intended to encourage more resilient modes of food production and consumption

■ Trial of a universal basic income covering the Gironde department, which began in 2020

■ Setting up of a citizens' participatory budget and the objective of establishing a "resilience budget" for 2030, with the aim of achieving "100% of aid to municipalities subject to resilience criteria"

■ Support for the implementation of Business Continuity Plans (BCPs) to better prepare local authorities for disruptive shocks, whether sudden or large-scale events.

The performative building of resilience

Lauriane Sabatier and Magali Reghezza-Zitt analyse how cities understand and implement the notion of resilience in their article, "Building resilient cities: designing resilience in a performative way. The 100RC program."
By analysing 82 resilience strategies developed as part of the 100 Resilient Cities (100RC) programme, they show that resilience is a local construct which corresponds to each city's specifics and characteristics. The definition and content of resilience are therefore unique to each territory.

■ The 16 Chief Resilience Officers in the 100RC programme who were questioned for this study stated they have used at least one tool supplied by the programme, and 12 of them have also developed tools of their own.

■ The intentions of the Foundation's approach were clear: to provide the keys to breaking with siloed decision-making processes and developing new models of governance, but without offering ready-made solutions.

■ The tools and workshops conducted for this programme were designed along the same lines, but the participating cities embraced the concept of resilience in a broad sense and developed very specific strategies according to their needs:

• Racial discrimination and social justice issues are a high priority for North American cities

• European cities deal with inclusion in terms of poverty, unemployment and inequality, including the stresses of poor air quality, immigration and terrorism

• Latin American cities focus on issues of violence and insecurity, linked to poverty

• Demographic pressure and the lack of sewage networks are two issues that are very common in the strategies of African cities

• One of the main priorities highlighted by Asian cities is environmental pollution

• Other characteristics, such as population density, history and the political colour of the cities, also influence the perception of risks and the definition of priority objectives.

In conclusion, resilience is less a goal in itself, associated with clearly defined operational measures, than a method for both recognising vulnerability and transforming governance.
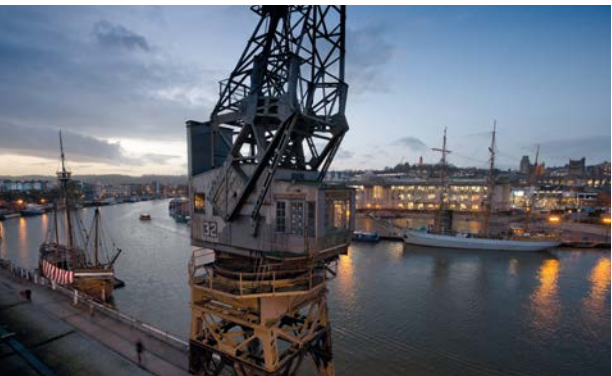
City of Bristol and Bristol Green Capital: Building a positive future for Bristol after Peak Oil

In 2007, Bristol City Council launched the Bristol Green Capital Partnership, a network of partner organisations that have agreed to work collectively to transform Bristol into a "green" city. Two years later, the City Council and Bristol Green Capital commissioned a report called *"Building a positive future for Bristol after peak oil"*, which analyses the city dependence on oil in a series of key sectors (transport and mobility, food, healthcare, power and utilities, key economic sectors, public services) and identifies actions to be taken to improve local resilience and prepare for the after peak oil. The report warns that political programmes and major transport infrastructure projects take carbon emissions and traffic congestion into account, but rarely peak oil and risks of shortages.

City of Barcelona, 3Ss
(security service supply)

In Barcelona, the operational management of urban resilience preceded the existence of a strategy. In 2007, following a series of crises linked to several events (the collapse of buildings during tunnelling works, drought, interruption of regional train traffic due to works, an incident involving an electricity distribution substation), Barcelona launched the 3Ss project with IQS university to evaluate the vulnerability of infrastructure networks and services that are indispensable to the functioning of the city (water supply, drainage, electricity, mobility, etc.) and gain a better understanding of how they are interrelated. Two years later, resilience committees were set up in order to launch and develop projects that would reduce vulnerabilities. As of 2011, Barcelona launched a resilience platform to analyse risks and to improve emergency procedures and the management of resilience. A participant in major international programmes on resilience (UN-Habitat's City Resilience Profiling Programme, UNISDR's Making Cities Resilient, the Rockefeller Foundation's 100 Resilient Cities and the C40), the city has now developed its resilience strategy.

Loos-en-Gohelle: How sustainable development drives transition and territorial resilience

Located in the heart of the Nord-Pas-de-Calais coalfield, Loos-en-Gohelle has been profoundly affected by the coal mining industry from the 19th century until the closure of the last mine shaft in 1986. To cope with the social, economic and environmental impacts of this industrial model, and then its decline, this town of 6,500 inhabitants turned to sustainable development in the 1980s to ensure its transition and ensure the resilience of the area. Symbolising this transformation, Base 11/19, the last pit in the town to be closed, has become a model site for sustainability, providing around a hundred jobs and a serving as a place for people to live, learn and be entertained. Among other amenities located there are a national resource centre on sustainable development, a cluster of eco-businesses, a circular economy competitiveness cluster and a theatre, Culture Commune.

Identified by Ademe as a demonstrator of change management towards a sustainable city, Loos-en-Gohelle's approach is based on **telling the story of the territory** and its specific history (in particular promoting its mining past and local culture) and on the **systematic involvement of the inhabitants**, who are committed to the town's transformation. During the process, the town even recruited a storyteller, whose mission was to understand how the inhabitants were experiencing the transformations in progress and to help the elected officials to structure the narrative they were making of it.

Loos-en-Gohelle is now working on adapting the scale to enable transition **to take place at regional, national or international level.** To this end, it has established the "Loossoise method" for change management and has tried to identify the conditions for success, for the benefit of other territories wishing to embark on a systemic transition. In 2019, the desire to network with peers and to compare experiences

Sud Alsace Transition: What's the future for South Alsace?

In 2017, an organisation called Sud Alsace Transition involved a hundred citizens in a territorial prospective study for South Alsace over a 20-year period.
The study presents six scenarios likely to occur in South Alsace according to future trends in the environmental, geopolitical, economic and social context and defines the objectives for a resilient South Alsace. The exercise underlines the need for the involvement of the population and makes this report a tool to allow everyone to get involved in their community and to engage elected officials.

of transition with other pioneering towns (Malaunay, Le Mené and Grande Synthe) also led to the creation of **the Transition Factory,** an alliance of 300 stakeholders (local authorities, civil society organisations, businesses, universities) who have signed up to a Charter. They all strongly believe that the territories are major players in the ecological and social transition. By pooling the resources of its community, this alliance intends to structure a systemic change management engineering for the benefit of territories.

The Transition Factory promotion organisation, which is chaired by the mayor of Loos-en-Gohelle, Jean-François Caron, is coordinating a support programme for a number of pilot territories. The Puy de Dôme Department, in particular, joined in the venture in February 2021 with the ambition of accelerating the implementation of its Master Plan, a roadmap for transition at department level.

FOCUS
Networks of resilient cities

In spite of its success, the 100 Resilient Cities (100RC) network was shut down in July 2019. Three entities have been created to take over its activities:

■ **The Global Resilient Cities Network (GRCN),** led by cities that were previously members of 100RC and sponsored by Rockefeller Philanthropy Advisors. It helps cities to act, prioritising those that are committed to the resilience of the most vulnerable people and communities. The cities no longer receive funding, and take part in the network o a voluntary basis.

■ **The Resilient Cities Catalyst (RCC),** created by senior managers of the former 100RC, with support from the Conrad N. Hilton Foundation and from Facebook. This organisation aims to help cities implement strategies and actions to strengthen their resilience.

■ **The Adrienne Arsht-Rockefeller Foundation Resilience Centre,** whose mission is to "reach one billion people with resilience solutions to climate change, migration and human security challenges by 2030."

Interview

Éric Bevillard

Town Councillor responsible for urban planning and territorial resilience in Gières, a town of 7,000 inhabitants in the outskirts of Grenoble

Does it bother you that resilience is too often assimilated to risk management or confused with transition?

E.B.: There are lots of examples. At the level of the building, the players think in terms of energy transition but the subject of adaptation is still not ingrained in terms of practices. We receive projects for buildings that are very efficient in terms of insulation but which, at the same time, incorporate large south-facing windows that will make the buildings unbearable during heat waves.

The case of solar panels also illustrates the confusion that can exist between these approaches. They are generally installed to achieve a better carbon footprint or to comply with the E+C- label. This is a prerequisite, but it is not enough in itself. You should also include a detailed analysis of the act of energy consumption: for example, you should inform residents of the amount of energy available and the times when they will be able to consume it so that they can adapt their uses. A global approach is always needed, covering the evolution of processes, the technological contribution (if relevant) and the human dimension through uses and behaviour.

Even though resilience is not risk management, rooting it in risk can help to talk about it and to educate stakeholders. But if resilience is considered in relation to a disturbance (or to a risk), the actual type of disturbance is of little importance. Reflection and action should rather concentrate on improving properties that strengthen the system's resilience to any type of perturbation: surplus, rustic, adaptive, integrated, learning, etc.

Do you believe in what the French government calls the shock of simplification, i.e. radical administrative streamlining?

E.B.: According to the theory of the archaeologist and anthropologist Joseph Tainter, human societies grow steadily in complexity until they reach a point where they become vulnerable to collapse. The continuous process of increasing complexity makes our societies more fragile. This complexity is felt at the level of municipal management: action is carried out within a framework constrained by standards and regulations over which the municipality does not always have any room for manoeuvre (e.g. management of the urban development plan by the city, restrictions arising from the urban development plan and the flood protection plan).

To simplify processes, we need to speak the same language. With this in mind, we are currently working on an environmental and resilience charter at the level of buildings in order to raise awareness of the subject among all the local players and to have a common benchmark for citizens, companies, etc. This will allow the resilience of projects to be prepared well in advance: materials adapted to temperatures above 50° C, creation of cool islands, reversibility and modularity of public buildings, open ground reserved in construction projects for vegetable gardens, search for a balance between the densification of housing and respect for biodiversity, choice of heat-resistant plant species, planting of shrubs that provide food for birds, etc.

"

Without the shock of simplification, you can't put resilience into operation

"

What other actions are being implemented in Gières?

E.B.: Actions have been undertaken in several areas to develop a culture of solidarity within the municipality, to revitalise the social fabric, to raise awareness of resilience and discuss the actions to be implemented, and to strengthen the territory's food autonomy.

Some initiatives have been developed with the pandemic, such as a system of identifying and supporting vulnerable people by other citizens, organised by the town hall since the lockdown in spring 2020. A mobile third place has also been created. As part of this initiative, run by private individuals and associations and supported by the municipality, a small vehicle travels to meet the inhabitants to offer a place of conviviality and a space for exchange in the form of workshops.

Inhabitants will also be involved through an extra-municipal commission that will focus on the resilience of the territory. Some fifty people, including citizens, representatives of associations and members of the town council, will be invited to study certain subjects and give their opinions. Finally, a communal orchard will be planted on public land, in a district that has experienced social and economic difficulties. This public space will be able to provide food for the population in the event of difficulties in accessing food, but above all it will be a vector of social cohesion, something that is essential in the event of a crisis. We are not seeking food autonomy for the city, which is an impossible dream. On the other hand, other solutions can be explored, such as twinning the city with a nearby rural area that could supply it on a preferential basis, in a reciprocal relationship beneficial to both areas.

You have plenty more ideas waiting to be rolled out…

E.B.: We are brimming with ideas, but implementing them is dependent on our budget and human resources. Frankly, day-to-day management takes precedence over these projects, however badly they are needed. We want to act on aspects as diverse as urban planning, food supply circuits and the culture of solidarity, which we have already touched on, but also the resilience of the town as an organisation (simplification of processes, a backup system for all digital processes, functions and equipment to be preserved in the event of a disaster, etc.). We also want to mobilise people's imaginations.

On this last point, we are planning workshops with high school students. They are made aware of environmentalism from a very young age, but there is too much of a tendency to think that we can save the world by throwing plastic bottles in the right bin and installing wind turbines. I think they're ready to hear a more honest message: the world in 2050 will probably be much more damaged than it is today. We would like these students to imagine what it would be like to live a week without access to oil, gas or electricity, or a month with a temperature of 50° C: what can we put in place to live serenely in this situation? The intention would be to make them aware of the depletion of certain resources and how our lives will be changed by rising temperatures and reduced access to oil.

Covid-19 has wreaked havoc with their lives, but the changes to come will transform their lives even more.

FOCUS

The rise of the cyber attack

2020 saw a sharp rise in the number of cyber attacks on local authorities in France and around the world:

■ In excess of ten local authorities of all levels and sizes have been affected in France: the Grand Est region, Eure-et-Loire departmental council, the Aix-Marseille-Provence Metropolis, the La Rochelle agglomeration community, and towns such as Bondy (53,439 inhabitants) and Saint-Paul-en-Jarez (4,831 inhabitants).

■ Cities hit by ransomware attacks have had to pay large sums of money in ransom to regain the use of their information systems (e.g. Lake City, Florida) or spend large sums of money tovv rebuild their infrastructure (e.g. the cities of Baltimore and Atlanta in the United States).

The National Institute for Cybersecurity and Resilience, which was created in 2020 in the wake of these cyber attacks, offers a forum for debate and the exchange of ideas on digital transformation and its effects on resilience and security with professional cybersecurity experts, mayors and other elected local officials, economic decision-makers, business leaders and local authority officials. Its purpose is to provide support for territories and their operators and agencies, alongside the existing national resources that deal with cybersecurity (e.g. ANSSI, the French national cybersecurity agency, and Cyber Malveillance, the national assistance mechanism for victims of cyber-malware).

What is the role of digital technology in territorial resilience?

Digital technology undoubtedly has a role to play in strengthening the resilience of territories in the face of disruptions. Data governance is a key tool for anticipating phenomena, knowing and diagnosing the vulnerabilities of the territory, modelling future scenarios according to changing climatic effects, issuing alerts and managing emergencies. Digital tools can also support systemic approaches and serve as a medium for creating broader stakeholder engagement, citizens in particular. The cases of Dijon (urban hypervisor, connected control centre) and La Grande-Motte (digital twin) illustrate how cities can use data for a variety of applications relating to territorial management: governance, decision-making, communication, etc.

Nevertheless, digital technology is also subject to vulnerability to natural hazards or those linked to human activity: a natural hazard may be accompanied by cascading effects leading to the failure of certain digital tools in a given area; cybercrime may paralyse municipal services over a relatively long period.

Digital technology also has a significant impact on ecosystems: it is responsible for almost 4% of global carbon emissions (twice as much as civil aviation[1]), and in 2019 it generated 53.6 million tonnes of non-recyclable or poorly recyclable waste electrical and electronic equipment worldwide, 21% more than in 2014, according to the Global E-waste Monitor.

Consequently, the relationship has to be measured between, on the one hand, benefits from the use of digital technology and, on the other hand, environmental impacts and resulting vulnerabilities (to natural hazards and the risks of power cuts and cybercrime). The emerging concept of right-tech is based on the idea of frugal innovation: using appropriate and sufficient technologies to meet an identified need, while maintaining compliance with strong environmental constraints[2]. Breaking with the principles of the technology race and of complexity, the right-tech approach is inspired by the principles of low-tech but without refusing the use of state-of-the-art technologies if they are relevant and with respect to environmental forecasting.

[1] Deploying digital sobriety, The Shift Project, 2020
[2] "Right-tech innovation: towards the end of a wholly technological approach",
La gazette de la société et des techniques, Annales des Mines, no. 100, January 2019
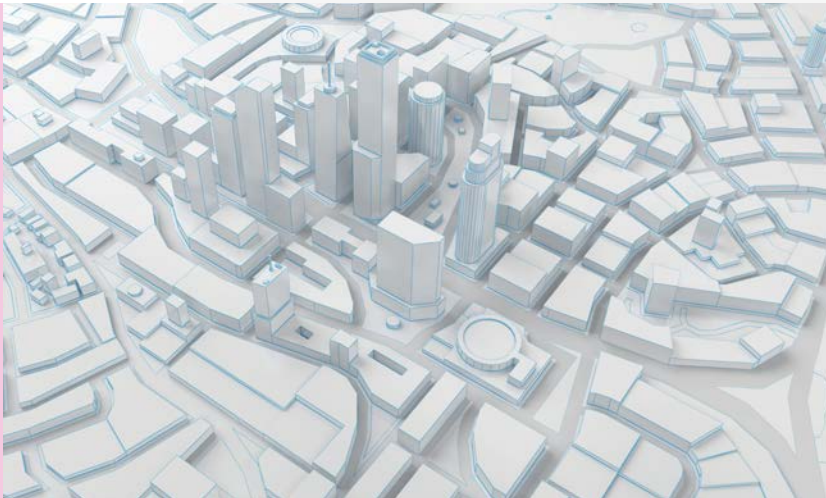
Tools

To analyse the net energy relevance of connected projects, The Shift Project has developed a mathematical model called STERM (Smart Technologies Energy Relevance Model). The organisation states: "This model is only the embryonic version of a tool, and is intended to be used by both private and public actors to develop genuine operational tools, appropriate for their policies." The Shift Project has also chosen to implement this mathematical model using Python programming language and to make the code freely available.

https://hubinstitute.com/2020/Sustainable/Cities/Interview/SmartCities-JacquesBeltran-DassaultSystemes-3DEXPERIENCityVirtual-EuroRennes-JumeauNumerique

> Digital twin technology has great potential for local authorities and stakeholders. To ensure that the twin is properly integrated into the community, a step-by-step approach is recommended. The local authority must first acquire and master its 3D data base, and then the departments must develop use cases according to their needs, while learning to use the applications themselves.

Chloé Friedlander
Smart City project manager, Banque des Territoires

REFERENCE

Digital twins for more resilient cities: the pilot operation in La Grande-Motte

Territories are complex systems that are constantly evolving. Using digital technologies, we can model, simulate, visualise and experiment with the characteristics of a territory with the aim of making it easier to manage. The digital twin is a virtual replica of a territory, exactly as it functions[1]. Far from being a simple 3D replica of a territory, it works by aggregating data from various sources (regulatory, geospatial, environmental and usage data along with real-time data provided by sensors) to create a representation of a city or territory and to generate information that will be used to guide action. This type of tool may take account of architecture, urban planning, use and its consequences (property prices, pollution, etc.), networks and flows, subsoil resources and geological strata.

The digital twin offers almost unlimited potential for applications, from development strategy, urban planning, simulation and crisis management (playing out disruption scenarios) to everyday management issues. This explains the importance of clearly defining needs in terms of uses and geographical perimeters, as Banque des Territoires recommends in its guide for local authorities: "The digital twin is a solution and a response to a need, but it is not an objective in itself. The process of defining needs and objectives is therefore fundamental."

The Helsinki 3D+ tool is used in the Finnish capital to create simulations of physical phenomena, including 3D simulations of wind flow dynamics, simulation of solar gain and simulation of shadows cast on the ground as part of the Kalasatama eco-neighbourhood. In the Paris region, a smart platform

launched in 2019 makes it possible to evaluate the solar potential of buildings and inform the inhabitants of the region.

It is also a powerful tool for transforming organisations because of its systemic approach and its ability to create a common system of reference. As a unified source of data on the territory, it encourages different agencies to work together and helps de-silo specialised departments, contributing to the implementation of more effective, systemic policies. This is one of Rennes Metropolis's stated objectives in deploying its 3DExperienCity Virtual Rennes tool.

Nevertheless, as Banque des Territoires points out, implementing a digital twin requires real maturity on the part of the local authority in terms of conducting digital transformation projects, as well as a risk and opportunity analysis with regard to the ethical, legal and economic issues at stake concerning technological choices, governance and cyber security linked to this type of project.

In La Grande-Motte, in southern France, Bouygues Energies & Services is currently carrying out a digital twin experiment in the framework of a strategic partnership between Dassault Systèmes and Bouygues Construction. As in Rennes, the 3DEXPERIENCE platform acts as a support for the digital twin. This time, the partnership enables the tool to be adapted to the needs of a territory's maintenance operations: with a view to reducing costs, the platform is being tested for street lighting management. So that any potential malfunctions can be better anticipated and visualised (e.g. defective bulbs), the town has been rendered in 3D in a digital model on which each element managed appears, as well as multiple pieces of relevant data (such as the exact location, energy consumption, etc.).

[1] Mirror, mirror: the digital twin of the local community, Banque des Territoires, July 2021

OnDijon: how a smart, resilient territory is coping with the crisis

In 2019, Dijon Metropolis and a consortium led by Bouygues Energies & Services launched the first connected territory in France, modernising the infrastructures of the metropolis, introducing an urban hypervisor and managing the connected control centre which centralises the major functions of the metropolis (municipal police, roads services, public transport, etc.). This will entail some 140 kilometres of optical fibre that will eventually enable all urban installations to be connected and managed remotely and centrally (traffic lights, street lighting, video protection, tram circulation, water network management, etc.).

Indeed, with numerous connected elements of infrastructure, controlled remotely and in real time, Dijon Metropolis can modify its management of the urban space. It is possible, for example, to control traffic lights to improve traffic flow in the event of an accident, to control electric bollards allowing access to the city centre and to provide remote surveillance of all public buildings.

During the first lockdown, the town hall's phone information service was incorporated into the OnDijon project, converted into a toll-free number available 24/7 to enable members of the public to ask any question related to the crisis, with the exception of those relating to medical matters. The telephone portal changed its nature, from being an information service on municipal services (e.g. opening times of the swimming pools) to an information line on local and national decisions. Around 4,650 calls were taken between March 15 and April 13, 2020 (local travel certificates, opening of shops and schools, measures for coming out of lockdown, etc.) and enabled 95 isolated people who were not registered with the local social action centre to come forward. The consortium welcomed additional tele-operators who came to bolster the

information service staff during this period, and the crisis room in the connected control room naturally became the venue for regular gatherings of all those involved to take stock of the public health situation and update the information to be shared, particularly with the public.

By facilitating the flow of exchanges, the ability to react quickly and the improvement of coordination between services, the tool has helped to strengthen the local authority's resilience to this crisis. But it is also calibrated to deal with other types of disruption. In anticipation of a flood risk, for example, it centralises data relating to the measurement of the water level and can launch and circulate alerts rapidly. Lastly, a public participation application is integrated into the OnDijon project to encourage the involvement of residents and benefit from their reports.

3

Creating and monitoring resilient territories

Challenges such as climate change, the risk of terrorism, chronic air pollution, an increase in cyber attacks, growing inequalities and social tensions have put local communities in the front line. The consequences of these issues are becoming more and more obvious.
And in the background, the imperatives of the environment are urgent, calling for a profound reorientation of our economic models that is compatible with social and territorial cohesion. All territories are concerned, to a varying degree depending on their geographical location, their resources and their economic organisation.

The resilience process starts by accepting the reality of these issues, their systemic dimension and what is now the irreversible nature of certain phenomena, such as climate change. The scale of the challenges to be faced and the transformations to be made could lead to a feeling of powerlessness in the face of risks that are out of our control. On the contrary, resilience brings with it the idea of coordinated action over the long term to better prepare and adapt territories and all their components (population, businesses, infrastructure, etc.).

Far from being without resources, we are now well equipped to undertake these transformations. There are more and more frameworks and guidelines, diagnostic methods, tools, solutions and inspiring examples, and these are getting more and more accurate thanks to the players and territories involved. Faces with these common challenges, networking and a logic of pooling take shape, as in the case of the call for commons launched by ADEME, the French agency for ecological transition, in March 2021, in partnership with the French Development Agency (AFD) and the National Agency for the Cohesion of Territories (ANCT). Based on Open Source and the coordination of ecosystems of players and communities, it aims to bring together all willing players, to capitalise on feedback and to mobilise collective intelligence to enhance the resilience of territories by supporting the creation and sharing of commons.

What is the starting point and what is a resilient territory? These are the questions that a territory wishing to engage in a process of transformation and concerned with resilience might ponder. There are many points of entry. Some territories develop a territorial resilience strategy (e.g. the City of Paris); others evaluate public policies or projects from the perspective of resilience. Some opt for a targeted approach (e.g. the Department of Nièvre's strategy of adaptation and climate resilience), while others tackle the issue through the essential functions that must be addressed to ensure the resilience of the territory (e.g. how the Greater Angoulême Agricultural and Food Territorial Project is structured around the issue of the system's overall resilience).

Whatever path is adopted, resilience serves as a compass to guide decisions, but without ever abandoning the systemic approach. In this way, approaching the question from the angle of climate resilience invites us to consider the impact on the local territory of the macro consequences of climate disruption which endanger the harmony of human societies: declining agricultural yields, massive migrations, water wars, diseases, etc.

The systemic approach is also valid in the search for adapted solutions. Cooling solutions chosen to combat urban overheating, for example, have to address human health globally (taking into account the effect on the risks of seasonal allergies in vegetation programmes, or the effect on the spread of mosquitoes carrying vector-borne diseases in solutions involving the presence of water, etc.).

Finally, limiting ourselves to the capacity to react to any kind of disturbance is not enough. Working to promote resilience also means trying to understand the causes of these disruptions.

The 6th IPCC report is clear on the issue of climate change:

"

We need a radical transformation of processes and behaviours at every level: individuals, communities, businesses, institutions and government. We need to redefine the way we live and consume.

"

Frameworks and guidelines

In recent years, several frameworks and sets of guidelines have attempted to standardise theoretical and practical knowledge about territorial resilience.

Some adopt a global approach and identify the key principles of resilience (Resilience Compass – Cerema) or key functions for territorial resilience (Action plans for local resilience - La Traverse). Others follow a targeted approach based on adaptation to climate change (Recommendations for resilient territories adapted to climate change – French Partnership for Cities and Territories) or food resilience (Towards food resilience - Les Greniers d'Abondance).

Action plans for local resilience
La Traverse

After a nation-wide survey of France focusing on local initiatives for ecological and social transition, the non-profit organisation La Traverse is proposing a series of action plans for local public decision-makers, citizens' groups and other stakeholders to support and strengthen local resilience initiatives.
These plans are structured around five lines of action that correspond to five essential functions that ensure the resilience of the territory, whatever the local context:

■ Improving food autonomy
■ Reducing energy needs and produce locally
■ Creating a living environment conducive to the health of inhabitants
■ Fostering intellectual autonomy and social solidarity
■ Relocating and circularising the economy

Publication date: 2020
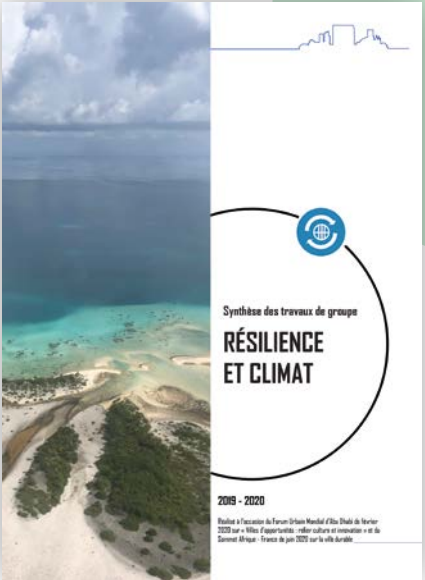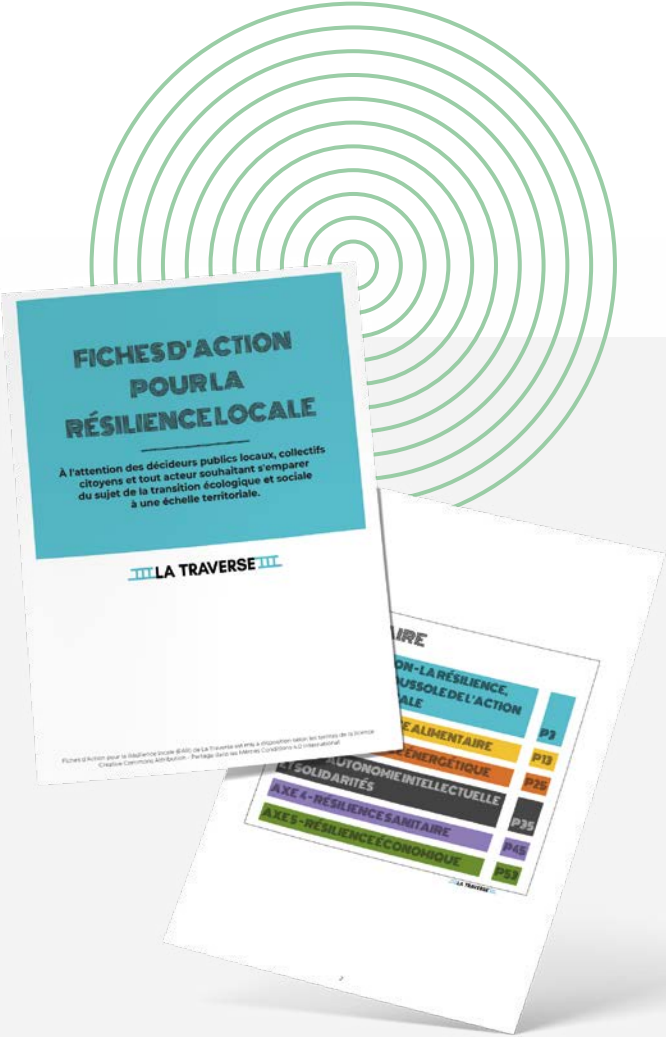
Recommendations for resilient territories adapted to climate change
French Partnership for Cities and Territories (PFVT)

This was a joint contribution by French players in urban development on the occasion of the World Urban Forum in Abu Dhabi in February 2020 and the 2020 Africa-France Summit on Sustainable Cities, this guide details six recommendations, illustrated by examples, for territories that are resilient and adapted to climate change:

■ Governance is essential to implement resilience policies regardless of the scale of the threatened perimeter
■ Low consumption of energy and land in the cities: key tool of resilience
■ Involving all territorial actors: major component of resilience
■ Integrate nature in the cities
■ Rethink the territories after a crisis
■ Cooperate to reach our goals together

Publication date: 2020
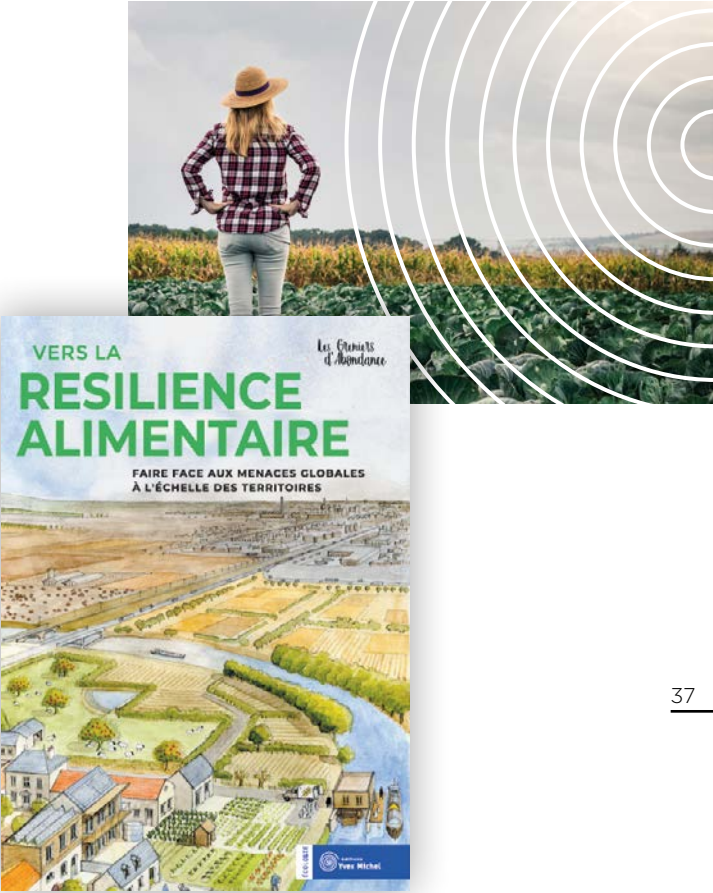
Towards food resilience. Coping with global threats at the territorial level
Les Greniers d'Abondance

This guide is a reference for any territory that envisages embarking on a food resilience programme. It provides a detailed overview of the vulnerabilities of our food system in the face of systemic disturbances (climate change, depletion of resources, collapse of biodiversity), and identifies eleven paths to food resilience, with an operational approach in the form of drivers of action.

Publication date: 2020

The Resilience Compass
Cerema

The Compass aims to guide territories in strengthening their capacity to prepare for, react to and adapt to the various disruptions that may occur, whether they are isolated crises or long-term trends. Structured around 6 principles and 18 levers and illustrated with inspiring examples, it provides a framework for analysing any project or public policy through the prism of resilience.

Publication date: 2020
Source: Cerema

Levers Principles

Cohesion – Solidarity
- Culture and know-how
- Solidarity
- Ability to act

Strategies – Governance
- Shared governance
- Territorial cooperation
- Integration of vulnerabilities

Anticipation – Watch
- Knowledge of threats
- Information - education
- Preparing for crises

Robustness and continuity
- Reduced exposure
- Solidity and reliability
- Continuity of services

Adaptation, learning and innovation
- Monitoring and alerting
- Feedback and benchmarks
- Innovation, experimenting

Sobriety and basic needs
- Vital and basic needs
- Resilient economy
- Planetary limits and resources

Aurore Cambien

Project Director at the Resilience-Transition-Climate unit, Cerema

INTERVIEW

From reference framework to going operational: the Cerema Resilience Compass

Published in October 2020, the Resilience Compass aims to guide territories in strengthening their capacity to prepare for, react to and adapt to the various disruptions that may occur, whether they are isolated crises or long-term trends. Structured around 6 principles and 18 levers and illustrated with inspiring examples, it provides a framework for analysing any project or public policy through the prism of resilience.

**You describe the resilience compass as a reference framework which consolidates and standardises the lessons learned from the theoretical corpus and the practices tested in the territories.
How do we move from a reference framework to putting the levers for action into operation?**

A.C.: The compass provides reference points on the notion of resilience and on the levers on which a territory can take action. Despite the inspirational elements that provide concrete examples of these levers, we quickly became aware of the need for a brick relating to the means of implementing these levers of action. We are in the process of supplementing this reference framework with tools to enable territories to act.

In developing these tools, contextualisation remains an important issue. Territories are not faced with the same hazards, vulnerabilities or needs depending on their geographical location, organisation, social and economic dynamics and their level of maturity with regard to resilience. So the idea is not to present a "recipe" for resilience but to guide territories in their transition process according to their profile.

One of these bricks is a self-diagnosis tool for territories to use. What is its purpose be and how was it devised?

A.C.: The aim of the self-diagnosis tool is to determine the level of maturity of each of the 18 resilience levers. It will be easy to pit it into service, and it will help territories to become aware of the actions they are carrying out on each of the levers, but also of the range of possibilities.

We have chosen to prototype the tools as part of the support we are providing to the territories. This has meant that we can start from their needs while testing the tools on an iterative basis. We launched a call for partners in February 2020 with two non-profit organisations, Notre Village and Le Grand Secret du Lien, aimed at rural communities that want to revitalise their transition processes.

Among these partners, the case of Assat, a rural town of 1,797 inhabitants located in the Pau catchment area, is interesting. It is relatively unaffected by natural and technological risks, but is aware of the threats linked to the Anthropocene. In particular, it expects to be faced with situations of water stress in future years. The diagnosis of maturity has enabled the municipality to define its priorities to respond to these clearly identified challenges: increasing awareness and motivating all the players, by carrying out joint actions to educate people about these global challenges, and supporting them in implementing changes in individual or professional practices (e.g. training local players to use water more sparingly).

In your work to support the territories, you have developed other use cases for the resilience compass…

A.C.: The approach was different with the Territorial Coherence Scheme (SCoT) for the Basque Country and Seignanx, which already incorporated in-depth diagnoses and action plans which had been developed. The approach was to analyse the way in which these existing mechanisms could contribute to resilience, using the compass as an analytic grid. This raised awareness of the 18 levers of action and made it easier to take ownership of them. New ideas for action have emerged which are under consideration for the SCoT Guidance and Objectives Document.

In the case of the development of the Greater Reims Territorial Climate, Air and Energy Plan, Cerema's support enabled the approach to be broadened first beyond the single issue of climate, then beyond that of adaptation, technical solutions and planning. Climate resilience is addressed broadly, with human and organisational factors included, for example. The compass was presented during workshops that brought together some fifty local stakeholders to establish a shared diagnosis of hazards and their consequences.

What are the next steps?

A.C.: Our objective is to circulate the resilience compass and its tools widely in the territories. At the same time, we are seeking to continue our support for local authorities on the strategic side of things. To do this, we are thinking of launching a call for partners to support ten or so territories, based on an analysis of their risks and vulnerabilities and taking into account the irreversible long-term changes linked to the climate emergency, a massive decline in biodiversity and the increasing scarcity of resources.

Principles and qualities of a resilient system

A Treatise on Local Resilience illustrates the qualities of a resilient system using six bio-inspired symbols, each representing an aspect of resilience.
We have included these images because they help to visualise different aspects of this notion of resilience. However, literature on the topic is full of other keywords that characterise a resilient system: diversified, surplus, autonomous, flexible, integrated, learning, inclusive, etc.

Spider's web, strong yet flexible.

Reed, which bends but doesn't break and recovers its shape rapidly.

Coelacanth, which has survived on Earth for 400 million years, a symbol of sustainability.

Chameleon, capable of adapting to different situations by modifying the colour of its pigments or making itself invisible.

Colony of ants is self-organised. It solves complex problems thanks to a multitude of simple individual behaviours that give rise to a collective intelligence.

Caterpillar, which leaves its comfort zone and abandons a familiar environment to become a butterfly and develop in a totally different habitat.

A Treatise on Local Resilience,
A. Sinaï, R. Stevens, H. Carton,
P. Servigne, 2015

DIVERSITY

The diversity of varieties and species grown on agricultural land limits the spread of diseases and pests. By combining species and crops, mutual services can be obtained between species (protection, exchange of nutrients). Complementary organisms in a given environment improve the resilience of the whole.

The Bec Hellouin organic farm in Normandy practices intensive organic market gardening according to the principles of permaculture, without mechanisation or plant protection products. Its operation is based on a wide range of production and associations of species and is based on relay crops (crops that are started before the previous one has finished). A four-year study carried out by INRA on the economic viability of this alternative farming model confirmed its profitability.

FLEXIBILITY AND AUTONOMY

In Hackbridge, in the southern outskirts of London, the New Mill quarter is being developed on a 13-hectare abandoned industrial estate, Felnex. Included in the project was the construction of a school that was designed for flood risk in this 100-year-flood zone. The school had to be built above the highest water level of about 0.9 m and provide a refuge for the population of the neighbourhood in the event of flooding. In the event of a crisis, the school, linked to a nearby energy production centre, has to serve as a central point for managing the energy production system, supplying the population of the quarter and providing information. The renewable energy production facilities (photovoltaic panels, mini hydroelectric power station) were chosen on the basis of their compatibility with the flood risk. They have to continue to function autonomously should the river overflow.

This example calls for qualities of self-reliance (limiting dependencies to ensure basic needs) and flexibility (adopting alternative strategies according to whether it is a normal period or a time of crisis).

© Valode & Pistre Architects

AUTONOMY

An apartment building that is self-sufficient in water and energy
ABC (Autonomous Building for Citizens) in Grenoble, Linkcity, Suez, Valode & Pistre Architects, Bouygues Bâtiment Sud-Est
The ABC demonstrator consists of two apartment buildings and includes 62 homes (42 intermediate rental units and 20 social rental units). It has been designed to be adapted to the site and the photovoltaic roofs are oriented towards optimal sunlight, so as to achieve a zero energy balance and annual self-sufficiency in energy and water of up to 70%. The concept, which was developed by Bouygues Construction R&D, places tenants at the heart of the project, raising residents' awareness of new ways of living before they move in, training and assisting them in using the equipment, and developing a collective dynamic throughout the residence on new uses in the areas of mobility, energy saving, waste management and shared spaces.

LOW CONSUMPTION

Low consumption requires us to change our models and lifestyles by focusing on the real needs of people and on a balanced and shared use of resources. This makes it one of the levers for tackling climate and environmental issues. At the level of territories, it is reflected in a reduction in energy consumption and then the decarbonisation of energy, the reduction of waste at source, reuse before recycling or recovery, a decrease in urban sprawl and less need for commuting.

In 2017, as an experiment, the municipality of Argentan in Normandy redefined "strict needs" by switching the street lighting off at 11 pm.
The result was conclusive, thanks to preparatory work with the population: very little negative feedback, a saving of €90,000 over the course of the year, and certainly a positive impact on biodiversity. The experiment has been made permanent.

© Superuse Studio

Bātiment
Frugal
Bordelais
Le label de l'urbanisme résilient

GOOD PRACTICE

Frugal building label

📍 Bordeaux

In May 2021, the City of Bordeaux launched the Bordeaux Frugal Building label, a standard for adapting buildings to climate, energy, environmental, economic and social issues.
Consisting of 42 criteria and drawn up with the involvement of many professionals in the sector, the label forms part of the city's desire to implement more resilient urban planning. The label will be awarded provisionally when the building permit is issued, and will be confirmed at an open meeting attended by the public when the building is handed over. The criteria include the use of bio-soured, geo-sourced and recycled materials, the use of locally produced resources, the performance of the building envelope and the quality of the housing (the label stipulates an exterior room of at least 10 m²). The label also encourages refurbishment rather than new build in order to limit the artificialisation of land. According to the Bordeaux City Council, the excess costs, which it estimates at between 15 and 20%, could be absorbed if the property market were regulated. Ultimately, this standard is intended to be integrated into the local urban planning scheme.

LEARNING

The system is capable of learning from disruptions and anticipating them so that it can strengthen and transform itself. Adapting to change requires constant updating of existing knowledge, regular benchmarking of good practices and ensuring good feedback.

The "Build Back Better" concept is the 4th priority of the Sendai Framework for Disaster Risk Reduction 2015-2030. In situations of post-disaster recovery and reconstruction, the aim is to strengthen readiness for disasters and to rebuild better to make communities less vulnerable to future disasters. In this context, a project called Relev (Reconstruction of territories: levers for anticipating natural disasters) aims to develop a multi-disciplinary methodology for improving the management of the reconstruction of territories following natural disasters, covering geography, civil engineering, geology, urban planning, architecture, psychology, sociology and history. Under the leadership of Cerema (a public interdisciplinary centre of expertise serving local authorities and government departments), it involves five universities and is funded by the French National Research Agency (ANR). In particular, it is contributing to equipping local players on the islands of Saint-Martin and Saint-Barthélemy in the recovery from hurricanes Irma and Maria in September 2017.

INCLUSION

The system meets everyone's needs, paying particular attention to the integration of the most vulnerable.

In June 2020, researchers Bachir Kerroumi and Narcis Heraclide published a study[1] assessing the inclusion capacity of urban resilience strategies implemented by three cities: San Francisco, Tokyo and London. In particular, they consider the presence or absence of systems and policies that can increase the resilience capacity of people with disabilities and the social and institutional structures of these cities with regard to disability issues.

In San Francisco, as a result of the coherence between the national legal framework based on a social model of disability and the city's political and organisational framework (including the involvement of disability stakeholders), people with a disability were effectively included in the resilience strategy. Some fifteen organisations of people with disabilities work in close collaboration with the City and County of San Francisco and the local government created the Mayor's Office on Disability in 1998, tasking it with supervising the city's policies in order to guarantee that they are compliant with the Americans with Disabilities Act of 1990, federal legislation guaranteeing equal rights to citizens with disabilities.

[1] **Narcis Heraclide, Bachir Kerroumi. Inclusive resilience and anticipation: the case of disability within urban resilience strategies.** International Strategic Management Conference, June 2020, France.

ROBUSTNESS

A system designed to limit the spread of faults and potential damage in the event of a crisis or disruption.

Private Mobile Radio (PMR) is a private communication network for professional use owned by an organisation (industrial and transport companies, local authorities, police, fire service, etc.) and which are only accessed by its members These networks are independent and confidential, hosted directly by the entity that implements them and they are dedicated solely to its activity. This makes it possible to secure communications and guarantee the availability of the system. These networks are designed to remain operational in the event of a major crisis and to ensure continuity of service, provided they are properly dimensioned. During the Brussels bombings in March 2016, the Belgian police's PMR system was saturated because the infrastructure had not been designed to absorb a peak in activity linked to such an exceptional situation.

In France, these networks are used in particular by critical infrastructure operators, i.e. public or private organisations that operate facilities that are essential to the life of the country. There are 259 of these operators, designated by the French government and subject to a security system for vital activities produced by the Secretariat-General for National Defence and Security.

SURPLUS

Duplication of components allows some components of the system to compensate for the loss or failure of other components. This principle is applied, for example, in the construction of data centres. Tier IV certification, issued by the Uptime Institute, is obtained when each component is duplicated: this means that the data centre has several circuits for power supply and cooling distribution. In conflict with optimisation strategies, surplus capacity needs decisions to be made to avoid superfluity. If the data stored in a data centre is of vital importance, Tier IV certification is justified to avoid the risk of data being deleted because of a power outage or a failure of the data centre temperature control system.

The examples given as illustrations of the qualities of a resilient system refer to the different phases that a territory undergoes in the event of a disruption:

■ Preparation for and anticipation of any type of disruption

■ Response and action to absorb a disruption and mitigate its effects

■ Rebound and recovery following a disruption that involves the capacity of the territory to take a new course

■ Transformation and adaptation to the new situation by learning from the experience gained

Although these phases (which can sometimes be concomitant) call for different responses, they have several success factors in common. Two of these are essential:

Better shared governance, encouraging the involvement of all players

It is based on cooperative relationships and the development of each player's autonomy and relies on collective intelligence to co-create the responses best suited to the local context. It covers a variety of aspects, from the participation of all the players (inhabitants, companies, local authorities, non-profit organisations, etc.) to the implementation of systemic local policies associated with cross-disciplinary management of the authority's services, including inter-territorial cooperation and the search for a more complementary relationship between the territories. To quote Johanna Rolland, Mayor of Nantes and President of Nantes Metropolis, speaking at a colloquium dedicated to resilient metropolis authorities.[1] "Questions of resilience and cooperation are interlinked. We have to experience differently the relation between urban and rural areas and that between the big city and the territories that surround us."

[1] Colloquium for resilient metropolises: metropolises in transition seek territorial trajectories , POPSU, January 2021

GOOD PRACTICE

Guidelines for the involvement of citizens in Loos-en-Gohelle

📍 Loos-en-Gohelle, northern France

For the past 30 years, the town of Loos-en-Gohelle has been experimenting with a change management method to make the transition from its mining model to a more sustainable development (see page 26).

It is based on the systematic participation of inhabitants and local players, whose involvement is crucial to the success of this transformation. Public meetings (more than 200 per term of office), co-construction of developments (local public spaces, etc.), co-production of urban planning documents (Charter for the Living Environment, local urban plan, citizens' solar plan, etc.): everything is designed to develop citizen empowerment. And it works, as shown by the success of "fifty-fifty", a scheme that encourages and supports citizens' initiatives. Any citizen, group of residents or association with an idea can apply to the town and sign an agreement to implement their project, with financial and technical support from the town council.

Since it was launched, several hundred citizens of Loos-en-Grenelle have been involved in the scheme, and an average of five or six projects are implemented each year, including the construction of a skate-park by young people or the installation of solar panels on the roof of a church. Once a year, as part of an annual citizens' forum ("Faites in Loos"), the council gathers together residents with projects in a hall, where they go up on stage and, answering a journalist's questions, tell their stories.

GOOD PRACTICE

Territorial creative responses: collective intelligence to get through the crisis

In March 2020, the CNFPT (National Centre of the Territorial Public Service) launched the "Territorial Creative Response" initiative to address the Covid-19 crisis. The experiment seeks to help local authorities to learn from the situations experienced during the crisis and to harness collective intelligence to come up with creative solutions and prepare for the next phase. The **ripostecreativeterritoriale.xyz** website works in a collaborative and open way, with governance by working groups. It offers resources, participation in working groups and methods to help territories in their transformation. At a local level, Riposte Créative Bretagne in Brittany is sharing a collaborative mapping of initiatives and players in the region involved in solidarity and mutual aid, as well as various resources to prepare for the post-crisis period. These include a "collaborathon", a 4-part questionnaire to learn from the crisis (what forms of cooperation? what should we stop? what should we maintain? what should we create?), and an exercise called "Talking together about the aftermath", which aims to collect and consolidate individual responses on this subject in small groups.

46

GOOD PRACTICE

OASIS schoolyards:
a new approach to infrastructure management

📍 Paris

A number of schoolyards have been transformed into cool islands by replacing asphalt surfaces with permeable materials adapted to high temperatures, open areas, increased vegetation (trees, vegetable gardens, shaded areas) and the installation of fountains.

These cool islands are open to local residents outside school hours during heat waves. For a single investment, the project impacts several public policies, affecting social cohesion (a meeting place for residents), recovery of rainwater, health (shelter for vulnerable people in heatwaves, well-being of schoolchildren in calm schoolyards), education (greater awareness of climate change) and the promotion of biodiversity in the city. Eleven municipal departments played a part in this project and several participatory workshops were organised with users (school students, teachers, maintenance staff, etc.).

IN FIGURES

Local and community initiatives in the context of the Covid-19 crisis

35%
of people in France say they have built closer ties with their neighbours since the crisis began

57%
of people in France say they have been involved in at least one active community support initiative since the beginning of the crisis

39%
of people in France say they have experienced a personal desire to become involved and to do something useful for society

Source: ObSoCo, The Day After, May 2020

Social cohesion and solidarity between players

The Covid-19 crisis has shown the importance for a territory of the capacity of its players to take action and set up collective dynamics in the event of a disruption. Initiatives from civil society and the chains and collectives created to deal with the emergency demonstrated a capacity for self-organisation, solidarity and the creation of self-help networks (neighbourhood self-help groups, advisors accessible in apartment buildings, makers of masks, etc.).

According to the American sociologist, Eric Klinenberg, in the event of a crisis, it is the failure of social infrastructure that can be most damaging. These physical places (libraries, third places, community gardens, etc.) or organisations that shape the way people interact contribute to the resilience of a territory. In a study of the deadly heat wave that struck Chicago in 1995, Klinenberg showed that the highest mortality rates occurred in communities whose social infrastructure had deteriorated the most, in similar demographic contexts.

"When it is well developed, the social infrastructure encourages contact, mutual support, and collaboration among friends and neighbours; when it is degraded, it inhibits social activity, leaving families and individuals to fend for themselves," according to the website[1] of [S]City, a collective of researchers and professionals exploring the link between cognitive sciences, architecture and urbanism.

In order to strengthen its resilience, a territory will work towards social cohesion by talking about and promoting local culture and know-how, fighting against social inequalities, promoting community life and showing solidarity towards the most vulnerable populations. At the neighbourhood level, local living spaces facilitate social interaction and institutional or associative initiatives can help to re-establish social links.

[1] www.scity-lab.com

47

GOOD PRACTICE

Volunteers in Paris
Developing a culture
of solidarity
to increase resilience

📍 Paris

To strengthen their resilience, territories need their inhabitants. The City of Paris has made this the first pillar of its territorial resilience strategy: "an inclusive and cohesive city, which builds on the strength of its residents to become more resilient." To put this principle into practice, the City has created a grassroots network of citizens which aims to reinforce the means of intervention of local authorities in the territory, whether in the event of a crisis or on an everyday basis. It is also a way of developing a culture of support among citizens. The missions offered to volunteers who sign up cover a wide range of themes: climate, solidarity, cleanliness, democracy, greening, intergenerational links, first aid, sport, culture and respect for public space. Volunteers are given training in partnership with a number of associations and institutions.

"

When friendliness is created in a sustainable and methodical way in an area, it undoubtedly makes the area more resilient. To put it another way: the more a city resembles a village, the more resilient it is.

"

Patrick Bernard
Founder of the Republic of Hyper-Neighbours

LA RÉPUBLIQUE
DES HYPER VOISINS

GOOD PRACTICE

Hyper-Neighbours
Social engineering
to enhance friendliness
in large cities

📍 Paris

In 2017, Patrick Bernard, who founded the association, came up with the idea for a "Republic of Hyper-Neighbours" whose aim was to "transform a neighbour who says hello 5 times a day into a Hyper-Neighbour who says hello 50 times a day." Located in the 14th arrondissement of Paris, the experiment is designed to demonstrate that friendliness is not just a matter of good feeling but should be considered an economic asset in which it is necessary to invest in order to create the city of tomorrow. To make itself better known, the association organises a large number of events (large street meals, carnivals, open-air cinema shows, etc.), schedules regular meetings in the neighbourhood and is responsible for three major projects: the living territory and its sustainable development, local health, and citizen takeover of public space. In concrete terms, this has led to the creation of planted streets, collections of bio-waste, the creation of a health centre and the transformation of a crossroads into a village square, a project in which the association was actively involved. To scale up, the initial project is now planning to replicate its 14th arrondissement laboratory in several "villages" with a population of 5,000 located in different arrondissements and in a town in the inner suburbs of Paris. In each of these villages, a "neighbourhood friend" will be responsible for connecting the local inhabitants from morning to night and helping them to realise their aspirations and joint projects. The cornerstone of the project is the establishment of a "neighbourhood school" where future neighbourhood friends will be trained in three years in this new type of social engineering.

"Social Ties and Resilience"

This is the title of an R&D project led by Bouygues Construction's Sustainable Neighbourhoods team and Professor Alain Bourdin, sociologist and urban planner, from the Paris School of Urban Planning. What can the Covid-19 crisis teach us about social resilience, particularly in its territorial and urban dimension?

The aim of this field survey is to meet around fifteen structures[1] that have initiated, supported or observed practices that have helped to forge social links in the context of the pandemic. They concern housing the disability sector, the student population, the social and solidarity economy, local authorities, associations and businesses. By analysing these practices, lessons can be learned from them. What were the underlying issues behind these practices? What social dynamics have they generated? What meaning do they have for users? Are there any common features that can be identified?

The conclusions will help the actors of the urban fabric to understand the configurations that can contribute to strengthening social links, whether at neighbourhood or city level.

"

We live in societies of individuals, but that does not imply that links with others are not necessary. On the contrary. They are numerous but never automatic and always fragile. This is why creating social links, especially in times of crisis, has become a major challenge for the survival of society and a civic duty.

"

Prof. Alain Bourdin
sociologist and urban planner,
Paris School of Urban Planning

[1] Including Alpes Isère Habitat, Maif Social Club, National Pensions Fund (CNAV), Students for the City Foundation (AFEV)

Methods and tools

For several years now, there has been a growing range of methods and tools to help cities and territories make resilience a way of thinking that guides local public action. There are more than a hundred of them, developed by various types of players: international organisations, consultancy structures, associations, national institutions, etc.

They can be based on a holistic vision of resilience (e.g. ARUP's City Resilience Index) or propose a sector-based approach (e.g. ADEME's Trajectories of adaptation to climate change in the territories) and apply at several scales: building (e.g. Green Building Observatory's Bat-ADAPT), neighbourhood, city or large territory. Most of them include a diagnostic dimension, an essential step, but their purpose varies:

Diagnostic assistance and raising awareness of resilience

■ Food Resilience Calculator for Territories (CRATer) - Les Greniers d'Abondance

Global methodology including a diagnosis of resilience or vulnerability with which to build a resilience strategy and an action plan:

■ City Resilience Index - ARUP
■ Trajectories of Adaptation to Climate Change in the Territories - ADEME
■ Asian Cities Climate Change Resilience Network - ICLEI

Decision-making tool (prioritisation of investments, simulation of the impacts of a crisis)

■ HAZUR - OptiCits

Setting any of these tools in motion forms part of a local authority's long-term approach and requires strong support from the public.

FOOD RESILIENCE

CRATer
Les Greniers d'Abondance, 2020

Thanks to this digital tool for calculating the food resilience of territories, it is possible to diagnose the main components of the territorial food system (land policy, agricultural population, production methods, the balance between production and needs). It aims to answer a crucial question: Is my territory capable of ensuring the food security of its inhabitants? The results are delivered in the form of a pre-diagnosis that identifies priority issues, the main vulnerabilities and potential action levers for the territory.

GLOBAL RESILIENCE

City Resilience Index
ARUP, supported by the Rockefeller Foundation

The 100 Resilient Cities programme, launched in 2013 and funded by the Rockefeller Foundation, set out to help cities around the world become more resilient to the shocks or stresses that can impact them. The City Resilience Index, an urban resilience diagnostic method developed by ARUP as part of the programme, identifies 12 resilience objectives corresponding to four dimensions (health and wellbeing, infrastructure and environment, economy and society, leadership and strategy) and proposes a grid to define a resilience score for each objective. The Index is based on the idea that it is possible to identify universal factors of urban resilience and proposes a holistic approach to resilience.

CLIMATE RESILIENCE

TACCT
Ademe, 2019

Trajectories of Adaptation to Climate Change in the Territories (TACCT) is an initiative that provides a toolbox for local authorities to devise a climate change adaptation policy: diagnosis, development of the strategy and its action plan, monitoring of measures and evaluation of the strategy.

CLIMATE RESILIENCE

ACCCRN
ICLEI - Local Governments for Sustainability

This tool enables local governments in Asia to assess their climate risks in their own context (urbanisation, vulnerability) and to formulate corresponding resilience strategies.
The process is divided into six steps: engagement (political support, stakeholder involvement), research and assessment of climate change impacts on the territory, assessment of vulnerabilities and capacity for adaptation, development of a resilience strategy, implementation and evaluation.

CLIMATE RESILIENCE

Bat-ADAPT
Green Building Observatory, 2020

Bat-ADAPT is a tool that helps buildings adapt to climate change. It diagnoses the climatic vulnerability of an operation by combining the exposure to climatic risks at the address of the operation and the sensitivity profile of the building, and proposes simulations until 2090. On the basis of the diagnosis, the tool proposes ways of considering the implementation of priority adaptation actions for the building.

GLOBAL RESILIENCE

HAZUR
OptiCits (spin-off of Ramon Lhull University), a pilot project with the City of Barcelona

Both a method and software for analysing and managing resilience, the tool makes it possible to diagnose critical points in the interconnections between urban operators and services (public and private) by simulating the overall impact of a disruption and its domino effects on a variety of urban services. It encourages more trans-disciplinary and integrated management of the city.

GLOBAL RESILIENCE

Making Cities Resilient 2030
United Nations Office for Disaster Risk Reduction, 2020

The Making Cities Resilient campaign was intended to implement a framework for action to increase resilience at local level. It defined ten key principles for city resilience and provided a series of tools for this purpose: rapid risk assessment, disaster dashboard, peer review, etc. Over 4,300 cities all around the world signed up to the initiative. It has been succeeded by Making Cities Resilient 2030, which was launched in 2020 with the aim of accelerating resilience efforts at local level, drawing on a broad partnership of players with expertise in urban resilience (World Bank, International Committee of the Red Cross, UN-Habitat, etc.). The programme, which is accessible to local governments, citizens and any stakeholder working alongside cities, offers a large number of resources to create a roadmap for territorial resilience (services, tools, etc.) as well as access to the community of participating entities.

BOUYGUES CONSTRUCTION REFERENCE

Strategies for resilient real estate

A methodology for the climate resilience of buildings and neighbourhoods

Camille Gautier

Innovation leader, Elan

This methodology has been designed for investors. It is intended to take account of the impact of climate change on the real estate value of an asset or property. It measures the impact of various climate hazards on buildings, networks and usage areas. It includes the formulation of adaptation strategies with an evaluation of the financial means required.

As a responsible property consultant, Elan has been focusing on urban resilience for several years now. It helps property developers to take into account the impact of climate change in their projects. What were your motivations?

C.G.: The number of climatic hazards and natural disasters – droughts, storms, heat waves, floods – has increased 50-fold in a century and according to climate simulations, their frequency and intensity are expected to continue to grow. Our design and construction methods are going to have to change in order to address this reality and anticipate future developments. In fact, the building sector is both partly responsible for global warming (it accounts for 26% of national greenhouse gas emissions in France) and a victim of its effects.

Numerous levers can be used to decarbonise projects by limiting greenhouse gas emissions, including intensifying the use of existing facilities to optimise them, anticipating flexibility and reversibility of structures, encouraging active mobility, limiting consumption during operation, and integrating biodiversity and the principles of the circular economy. But to work towards resilient projects, this mitigation strategy must be combined with an adaptation strategy, aiming to reduce the impact of hazards linked to climate change.

What methodology have you developed to implement this adaptation strategy?

C.G.: We have developed a methodology intended to define the vulnerability of an asset to climate risks, and then to identify recommended actions to help protect against them in a resilience strategy adapted to the project.

During the first phase of diagnosis, we identify the climate hazards that may impact the site under study and carry out a technical inventory of the building (or an analysis of the design data in the case of new build and renovation. The approach is divided according to types of spaces: buildings, networks and places of use. This allows the analysis to cover elements relating to user comfort and building performance, for example. By cross-referencing the analysis of climatic hazards and technical design, we can establish a level of risk criticality specific to the building under study, and then evaluate the costs of

> *The number of climatic hazards and natural disasters – droughts, storms, heat waves, floods – has increased 50-fold in a century and according to climate simulations, their frequency and intensity are expected to continue to grow.*

Bertelotte student residence
Bouygues Bâtiment Île-de-France - Habitat Social refurbished 4,400 m² of office space, converting it into a 139-room student residence at 28 rue du Colonel Pierre Avia, in the 15th arrondissement of Paris. The facades consist of prefabricated timber panels employing bio-sourced straw insulation from the Paris region.

Owner: Paris Habitat

Architect: NZI

inaction (repairing damage and potential loss of rent).

In the second phase of the methodology, we build an adaptation strategy for the property. We determine the recommendations to remedy the various risks identified, specifying a timeframe for implementing the recommendations, a level of investment and the level of impact on the risks they address. Based on the analysis of the risks, recommendations and associated costs, we then calculate the impact of the strategy on the asset's market value and rental value. This financial approach is carried out with a partner, on the basis of a variety of climate change adaptation scenarios and up to the year 2050.

Has this methodology been field-tested?

C.G.: We have implemented this methodology on behalf of two investor clients on seven office buildings. The objective was to anticipate potential deterioration attributable to the climate change impacts throughout the life of the buildings and to estimate the financial costs of repairs. At stake are rental losses, increased obsolescence and non-compliance with regulations, thereby entailing a high risk of devaluation of their assets. This is why we talk about financial revaluation of assets. Our clients were persuaded and they now intend to apply this methodology to all their future acquisitions so that climate risk is factored into their CAPEX figures from the outset.

What are the next steps?

C.G.: As part of our ongoing efforts to improve the tool, we are working with a start-up partner specialising in the collection and modelling of climate data, capable of anticipating climate change over extended time periods (up to 2050). This will enable us to make more accurate projections than by using public data from Météo-France.

We also have several prospects for development. The first of these would be to work on scaling, transposing the methodology to the development of urban projects rather than that of a single building. The second would be to adopt a more global vision of urban and territorial resilience by integrating issues related to society, security, water, biodiversity, food and health and by taking account of their systemic nature.

4

Inspirations

A variety of points of entry into the field of territorial resilience are possible: developing a territorial resilience strategy, reflecting on the resilience of a project in the face of long-term disruptions. Some players choose to work on a given type of disruption. Here we focus on two of the most recurrent themes: food resilience and climate resilience.

Food resilience

On average, in the top 100 French urban areas, 98% of food is made up of "imported" agricultural products while 97% of local agricultural produce is "exported": this was the finding of a 2017 Utopies report on urban food autonomy. The main cause is the long value chains of the globalised economy, in which production sites and areas of consumption have moved further apart, increasing both the need for logistics and carbon emissions.

A dependence on fossil fuels, hyper-specialisation of territories and players, the economic vulnerability of farmers, as well as the degradation and loss of soil fertility, and pollution linked to the widespread use of pesticides and fertilisers: although awareness of these fragilities and the limits of intensive and globalised agri-food systems was accelerated by the Covid-19 crisis, other, more sustainable trajectories were already emerging in the territories, such as the development of agro-ecology or movements to relocalise food.

As early as 2010, the town of Grande-Synthe, in northern France, developed a strategy for a local, resilient and sustainable food system as part of a more global approach to cities in transition. In 2014, the town of Albi had the ambition of improving its food autonomy. In 2018, Dijon Metropolis was one of the winners of the French government's call for expressions of interest in a project for a territorial demonstrator of a sustainable agricultural and food system. In 2019, the motion for a resolution on the food resilience of territories and national security' was narrowly rejected in the Senate. And in 2021, the municipality of Biriatou, in western France, included the risk of food supply disruption into its Municipal Emergency Plan.

In the top 100 French urban areas, **98% of food is made up of "imported" agricultural products** while 97% of local agricultural produce is "exported".

FOCUS

A sustainable food project to achieve ecological and social transition

📍 Grande-Synthe (Nord)

Faced with widespread unemployment (particularly among young people under 25) and a high level of insecurity among its inhabitants, this town of 22,700 inhabitants has chosen to turn its policy towards improving the environment and quality of life of its inhabitants in order to fight against social difficulties. This is reflected in its food strategy:

■ **100% organic meals** in school canteens since 2011

■ **Shared vegetable seed bank and "do-it-yourself" workshops** set up by the People's University of Grande-Synthe (a municipal public education service)

■ **Shared and community gardens** at street level in housing developments

■ **Management of 25 hectares of agricultural land to create an urban farm:** the aim is to support the creation of agricultural and organic market gardening activities (installation of young farmers) while supplying the kitchens of school canteens, the elderly, medical establishments and companies with organic food and short supply circuits.

Beyond the micro-local scale, Grande-Synthe is working with the Dunkirk Urban Community to assess the various sectors, to develop agricultural practices and to find complementary actions with other territories.

Governance Inter-territory cooperation for food supply

📍 A reciprocity contract between Toulouse Metropolis and Pays Portes de Gascogne

Resulting from a national experiment, the idea of reciprocity contracts is to go beyond the rationale of opposition between territories. They encourage complementary and cooperative activities between rural, suburban and urban areas, particularly when it comes to food supply.

Indeed, food is at the heart of the cooperation between Toulouse Metropolis and the Portes de Gascogne PETR (Pôle d'Équilibre Territorial et Rural, or Territorial and Rural Balance Cluster). Thanks to this cooperation, which aims to supply Toulouse's central kitchen and the national wholesale market in Toulouse, the PETR's producers have been able to structure themselves. The multi-year orders placed by the metropolis ensure that the growers' production is fully sold, and so they are able to structure themselves to respond to these markets. Vegetable growers, who have not previously been coordinated, have been able to organise themselves into a network. Local producers in the Gers now also have a presence at the national wholesale market, where all produce from the Gers can be bought in a single 100 m² warehouse, called Carrément Gers. For the metropolis, it means that quality products are guaranteed.

Beyond the transition towards a more environmentally friendly form of agriculture, access to healthy food for all and the creation of local employment, the resilience of local food systems also entails adapting to the consequences of climate change and the massive decline in biodiversity that is occurring: increased risks of drought and tension over water use, the risk of reduced pollination of crops, the spread of pests affecting the health of crops, variable yields from one year to the next, and the weakening of the economic balance of agricultural systems.

FOCUS

Pathways to food resilience

The organisation Les Greniers d'Abondance has identified:

5 global threats to the food system

🌡️ **Climate change**

🌿 **Collapse of wild and cultivated biodiversity**

🏞️ **Soil degradation and artificialisation**

💎 **Depletion of energy and mining resources**

🏭 **Economic and political instability**

11 pathways to food resilience

■ **Increase the agricultural population**

■ **Preserve agricultural land**

■ **Promote the technical and energy autonomy of farms**

■ **Diversify varieties cultivated and develop seed autonomy**

■ **Adopt integrated water management strategies**

■ **Evolve towards a nourishing agriculture**

■ **Generalise agroecology**

■ **Develop local tools for storage and processing**

■ **Simplify and shorten the food supply chain**

■ **Eat more plant-based food**

■ **Massively recycle nutrients**

LINKCITY REFERENCE
Planning and property development projects to tackle the challenge of food resilience

To meet the challenge of food resilience, all players in territorial and urban development must be involved, through new forms of action and cooperation. Planning and property development projects cannot be limited to the development of urban farms and agricultural production spaces in urban interstices.

We should now be thinking on the scale of an ecosystem, a pool of resources enabling virtuous exchanges, and of the agricultural world and rural areas, in a spirit of territorial cooperation. Agri-neighbourhoods, agropolises and food belts are the foundations of Linkcity's progress as a player in property development towards this new way of building cities and territories.

Caléac serious game
Linkcity, LAET (University of Lyon 2)

To simplify and streamline logistics and food purchasing is one of the eleven approaches to food resilience identified in the Greniers d'Abondance reference guide. This entails reducing our dependence on food transport, thanks to local distribution channels and local shops. The logistics of short supply circuits, which are currently less structured than long circuits, lead to proportionally higher marginal and ecological costs, which are a brake to the development of short circuits. The challenge is therefore to support the transition of logistics systems dedicated to short food circuits through appropriate infrastructure.

Developed with students from the University of Lyon, the Caléac serious game offers an understanding of urban logistics as a tool for developing and improving short food circuits. By playing the roles of several key players (producers, local authorities, transporters, mass retailers), players cooperate with the aim of improving the food autonomy of their area. To do this, they invest in strategic infrastructure (urban distribution centre, collective restaurant, farm drive, cold rooms, farm, etc.) and form partnerships. The tool aims to raise awareness each player category's constraints and objectives in order to encourage dialogue and the emergence of collective solutions.

© Sempervirens Landscaping
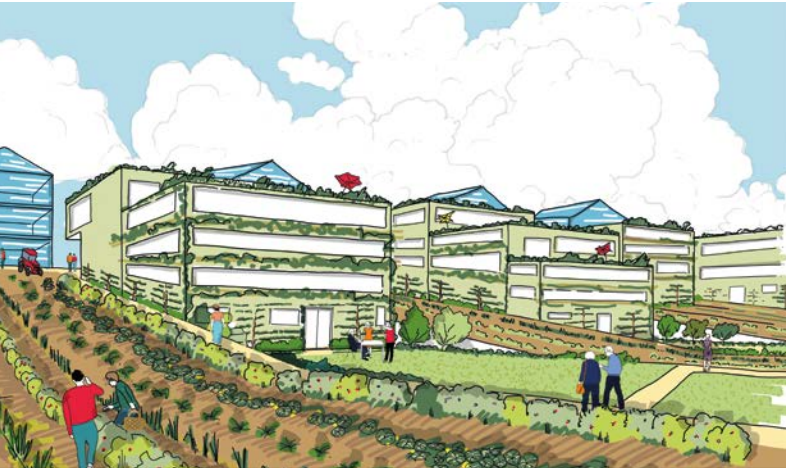
PROJECT
The Distillery Net Zero Artificialisation demonstrator
📍 Villeneuve d'Ascq, Sainghin-en-Mélantois, France

At the overlap of town and countryside, the Distillery project is intended to link agricultural and urban worlds. Located on single-crop agricultural land and on the site of a former waste dump, it is intended to put the objective of Zero Net Artificialisation into concrete practice, with the progressive transformation into a multi-crop model with a strong emphasis on organic farming and short supply circuits. Every square metre of agricultural land used is restored within the project through the rewilding and revitalisation of polluted areas, the creation of a wetlands for ecological transition with a diversified landscape and the compensation for the loss of use of the damaged fields through the implementation of a diversified agricultural economy oriented towards organic farming, particularly on rooftops.

This transition is being led by a recently created agricultural organisation, Récoltes & Nous, which aims to unify the agricultural system of Villeneuve d'Ascq and the Mélantois area, and then of a larger part of the Lille Metropolis. In addition to guiding the players towards eco-responsible agricultural practices, the organisation also has a mission to raise awareness among the general public and local players of the importance of the role of agriculture in the region. The idea is to create a real agricultural project beyond the site, integrating 200 hectares of agricultural land in the vicinity of the project with a structured and multidisciplinary ecosystem so that it can be commercially viable.

Guided by the landscape, the urban project suggests a gentle transition between town and country. The concept is that of an urban project in an agricultural landscape (preserving as much as possible of the existing agricultural land) and of a large landscape rising on the roofs and offering, depending on where you are, two visions of the district: a rural vision going into the city and an urban vision leaving it.

Owner: BDT, Linkcity Nord-Est

Urban planning and landscaping: Caucheteux-Bello

Architects: Sempervirens / RVB Paysage

Viewpoint

The role of planners and developers in food governance projects

> "
> In the framework of projects, planners will now seek to collaborate with food system players more closely, and at an early stage, regardless of the scale.
> "

Julie Lequin

Head of research and development at SaluTerre (a socio-landscape design office)

Sébastien Palluault

Consultant in social innovation, Associate Director of Ellyx (Specialist in social innovation)

As part of a study for Linkcity, Julie Lequin of SaluTerre and Sébastien Palluault of Ellyx have analysed the challenges of food governance in urban development models. They suggest ways of making food an across-the-board priority in planning and property development.

The food issue: a recent factor in the field of urban planning

In France, the link between planning, urban development and food took off in the 2010s: the food issue is now part of the urban policy agenda of the metropolises. The food issue is also being included in the specifications of planning and property development projects.

However, this approach has focused until now on the development of agricultural and food production spaces in the urban interstices (gardens at the foot of buildings, green roofs, urban farms, vertical agriculture) and the food issue is rarely dealt with in a comprehensive manner. However, food is multidimensional and involves

public health issues (food crises, obesity, nutritional qualities), environmental issues (CO_2 emissions linked to transport), cultural issues (tangible and intangible heritage), economic issues (jobs, impoverishment of the agricultural world) and social issues (social ties, integration).

Ways of making food an across-the-board priority in planning and property development

Planners and property developers are not currently seen as players in local food systems, except in matters relating to the construction and management of commercial space. In the framework of projects, they will now seek to collaborate with food system players more closely, and at an early stage, regardless of the scale: site projects (shared gardens, sustainable food education centre, public market garden park, vegetable garden, collective kitchen), multi-site projects (third-place food centre, food hall, fertile neighbourhoods) or cross-site projects (food webs).

Conditions for success in involving planners and property developers in territorial food dynamics

These players can be guided in their approach by five guidelines for action:

■ **Promote integrated territorial projects in terms of planning,** based on the food web model, for example. Inspired by the concepts of green and blue webs, it allows spaces to be considered in relation to each other: webs of gardens (shared gardens, micro-gardening areas, etc.) and, to link these cores, landscaped and nourishing links (edible hedges, gardening boxes, etc.) and functional links between these spaces (skills, equipment, logistics, etc.).

■ **Encourage projects that promote diversity of use and create multiple benefits related to the food issue.** As part of a Grand Paris call for projects on the Monceleux site in Sevran, Linkcity (the lead contractor) responded with a multidisciplinary team, for which the landscaping contractor, Interscène, invited SaluTerre to design an urban agriculture programme for the proposed district. Aurore, an organisation specialising in social and professional insertion, was then included in the programme, bringing expertise in economic development and social inclusion. The food production and distribution hub includes a number of spaces and a diversity of uses: an academy for gardening and healthy eating, a restaurant space,

a public food park, a natural garden area and micro-market gardening spaces.

■ **Involve operators on the ground and residents throughout the project and co-produce with them** by creating, for example, temporary facilities that prefigure the future project or participative facilities to stimulate dynamics among residents. For example, the rehabilitation project for the Fives-Cail industrial wasteland, led by the Société de Rénovation de Lille, includes two spaces foreshadowing the project: a communal kitchen and food halls.

■ **Listen to food governance networks.** "Food policy councils" are springing up in the United States (Los Angeles) and Canada (Montreal, Toronto), with the purpose of creating spaces for food governance involving public institutions, private players, civil society and academics, on the scale of these territories. In France, Bordeaux Metropolis created a Sustainable Food Governance Advisory Council in 2017.

■ **Step aside, and embrace a change in practices:** integrating the food issue means changing the intervention frameworks on which development projects are usually based. It becomes necessary to produce new economic models, modes of governance, technical operating methods, etc. This requires a capacity for innovation, a long-term "committed" position and a desire to take part in the social experimentation processes carried out by social and welfare economy networks, research laboratories and local authorities.

A rise in
temperature of
6 to 7°C
by the end
of the century:
the most pessimistic
scenario according to
the 6th IPCC report

62

Climate resilience

The planet could be 6° to 7° C warmer than it was in the pre-industrial era by the end of the century: this is the worst-case scenario predicted by new climate simulations carried out by French scientists contributing to the 6th assessment report of the IPCC (Intergovernmental Panel on Climate Change).

The Paris Agreement, an international treaty adopted by 196 parties at COP 21, held in Paris in December 2015, set the goal of limiting global warming to below 2°C, preferably 1.5°C, compared to pre-industrial levels. This threshold is both a political compromise and a cap beyond which it is estimated that the impact on human societies would be massive and difficult to control.

Multiple challenges are linked to climate resilience:

■ **Protecting against extreme events,** the frequency and intensity of which will increase (cyclones, droughts, heat waves, floods) and anticipating changes relating to slow phenomena (rising sea levels).

■ **Preserving ecosystem balances,** on which human life depends, and combating the decline in biodiversity.

■ **Limiting the effects of global warming** that threaten the harmony of human societies: falling agricultural yields, massive migrations, water wars, diseases, etc.

Overcoming the challenges linked to climate change requires parallel actions for **mitigation** that aim to reduce the greenhouse gas emissions responsible for global warming, and for **adaptation**, anticipating future climate conditions in order to take decisions today that are compatible with the situation tomorrow. These two aspects are complementary and inseparable. Climate resilience brings a broader approach, integrating human and organisational factors, for example, and the logic of low consumption in the perspective of an ambitious ecological transition.
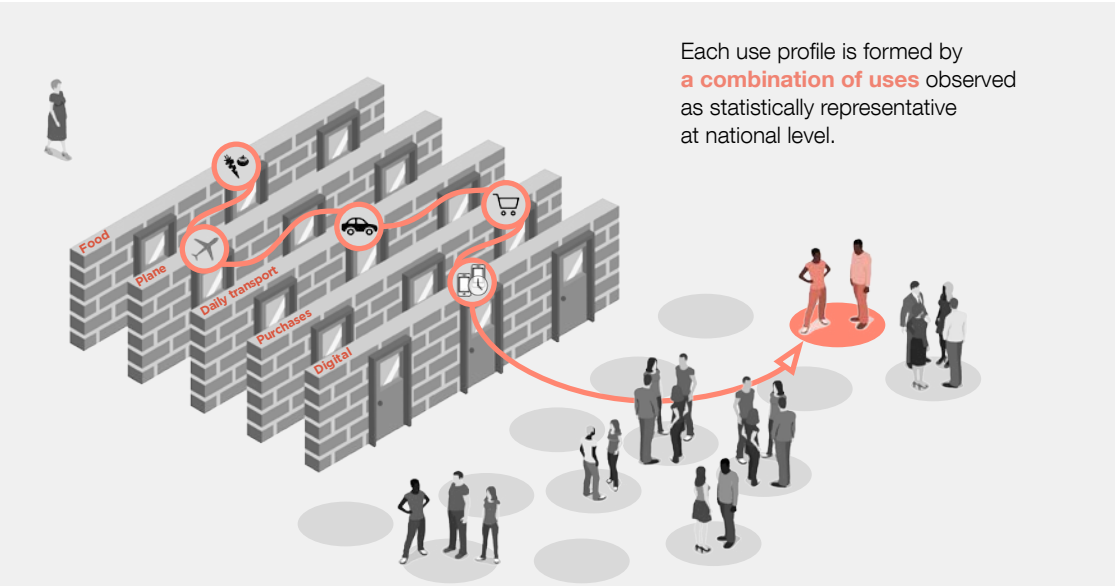
Neighbourhoods in transition

CEA, Ideas Laboratory, Michel Serres Centre, Bouygues Group, Yvelines department council, French Federation of Electricity

How can users be integrated at the heart of a neighbourhood approach in post-carbon transition and how can expert and user knowledge be reset to encourage the emergence of low-carbon lifestyles? This is being explored by the cross-disciplinary innovation project, Neighbourhoods in Transition, led by the Centre Michel Serres (CMS), in collaboration with the Yvelines Department Council, and commissioned by the Bouygues Group and the French Electricity Federation (UFE).

The study is enriched by the cross-fertilisation of expertise: CEA (the French Alternative Energies and Atomic Energy Commission), which is associated with the project, is developing models of the energy mix at local and territorial levels, while the CMS is providing its understanding of changes in lifestyles and practices at the regional level and is designing tools to be used in neighbourhoods and facilitate dialogue between local players in the transition.

The tools were designed by a team of eight students from the Michel Serres Centre from various backgrounds (political science, engineering, sociology, architecture, etc.), who spent a year on the project.

Each use profile is formed by **a combination of uses** observed as statistically representative at national level.

63

USE PROFILE DIAGNOSIS

This diagnosis is based on a segmentation of use profiles that are statistically representative on a national scale, based on the combination of five differentiating uses that emit carbon, related to diet, air travel, daily transport, purchases of new or second-hand manufactured objects and digital uses.

At neighbourhood level, users in this neighbourhood identify the use profile that corresponds most to them. They are questioned about the geography of their living areas and their lifestyles and they assess their carbon footprint. This phase, conducted in the field and/or online, is administered by means of a questionnaire, an interactive map, a carbon accounting tool, qualitative interviews and citizen foresight workshops.

A PILOT TRIAL

The Use Profile diagnosis was carried out in the Bel-Air neighbourhood of Saint-Germain-en-Laye, in the Paris region.
This neighbourhood has a population of 3,500. Its topography isolates it from the rest of the city and it has a high concentration of social housing. 453 people responded to the surveys during the test phase (in the field or online). The results revealed five differentiated usage profiles, which differ from the usual categorisations (age, gender, socio-economic category, etc.).

Full details were compiled for each use profile:
- **Average carbon impact** by sector of uses
- **Use patterns**
- **Map of journeys**
(destination, reason and mode of transport) by users
- **Perceived strengths** of the neighbourhood
- **Perceived weaknesses** of the neighbourhood
- **Readiness for change** by sector
- **Willingness and areas for citizen participation**
- **Conditions for enabling citizen involvement**
- **Their view of the players who should lead the transitions**

"NEIGHBOURHOODS IN TRANSITION" WEBSITE

www.quartiers-en-transitions.org

This website is the interface of the network of neighbourhoods in transition to encourage the commitment of players, inform them and bring them together around the transition process at neighbourhood level. For example, the quantitative surveys conducted during the test phase in the Bel-Air neighbourhood could be accessed online, on the website.

In parallel and in addition to the Use Profile diagnosis, the CEA is developing a carbon footprint configurator, Conemca, which can be used to represent the major contributions to greenhouse gas emissions from activities directly linked to the district. The tool can form part of a collective approach that involves the stakeholders in a new or existing neighbourhood project. It enables them to create an energy model for the neighbourhood, to check its overall coherence and provide two global evaluations, one in euros and the other in terms of tonnes of CO_2 emitted.

The innovative nature of Conemca – which does not claim to be accurate in each specific area of expertise, as many other tools do – lies in its global approach to the neighbourhood's energy system and its connection to the national energy system. Conemca provides a very simplified answer to the complex problem of variable production and consumption.

Viewpoint

Fabrice Patez

Territory Director
Saint-Germain - Loop of the Seine,
Yvelines Departmental Council

The Department of Yvelines quite naturally provided its support to the project for two main reasons. Firstly because it addresses the major issue for the near and distant future of our societies, which is the ecological transition; because the ecological transition - the way we will do it and the pace to which we will do it - will and already has an impact on the balance of our lifestyles, on social relations and including (even more strongly) on populations the most fragile. It is therefore natural that a Department, a local authority in charge of human and territorial solidarity, joins initiatives that make it possible to understand, anticipate and act on the social impacts of the environmental transition.

Secondly, the proposed approach presents the originality of starting from the uses and not, as too often, technical solutions. However, considerate uses as the main lever for change is consistent with a concern that must become central to public action. How to better take into account the point of view of users, their expectations, their feedback, their proposals and their contributions in the development and conduct of public policies. In this regard, the methodology developed in the "Quartier en transition" project is exemplary.

When the city overheats

Urban overheating is becoming a recurrent problem, resulting from the cumulative effect of climate change and the urban heat island (UHI) phenomenon.

Climate change is leading to greater intensity and duration of heat waves (hot air masses causing high temperatures for several consecutive days) in different parts of the world.

These meteorological phenomena themselves reinforce the UHI, a climatic effect corresponding to a difference in temperature between the centre of conurbations and peripheral or natural areas, which can exceed 10° C during heat waves. The effect is even more marked at night, when the heat stored by the artificial soil and buildings is released into the air, keeping the temperature high. Faced with the various consequences (social, environmental, economic) and climate projections, local authorities are now faced with the need to adapt their cities to counter this phenomenon.

FOCUS

Quality of life and adaptation to climate change

80%
of people in France
are affected by heat waves

During heat waves,
50%
of them take shelter in their homes.
Only 17% go to a cooler place
(a building or an outside space
offering shade

13%
or 6 million people say they
do not feel comfortable anywhere
during heat waves

67%
of people in France feel that their
homes allow them to bear heat
waves, but only 17% "completely"

Only 47%
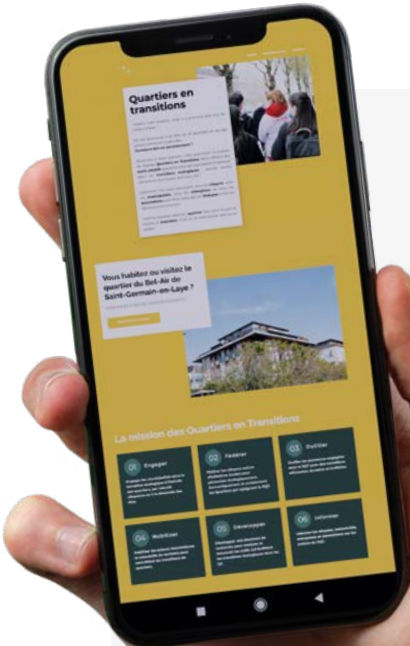consider that they live in an area
that is adapted to heat waves

Source: Observatory of Uses and Representations of Territories, ObSoCo, 3rd edition, September 2021

Diagnosis is a prerequisite for adapting action strategies to UHIs.
Detailed mapping of the phenomenon calls for specific tools (e.g. measuring surface temperatures by thermal infrared radiation) because the monitoring networks of weather stations are generally not dense enough to characterise it precisely. These quantitative measurements must be accompanied by qualitative surveys of users, both to identify their feelings and perceptions and to make them aware of the vulnerabilities linked to UHIs.

Diversity is a key quality of a resilient system, inviting players in the urban fabric to combine solutions and activate a variety of levers to combat UHIs. In order to enlighten the choices of the players in the territorial fabric, ADEME published the guide **Cooling Cities: Various Solutions** in May 2021. It proposes a multi-criteria and operational approach to mature and emerging solutions, adapted to different climate contexts.

In particular, the document includes a summary comparing the effectiveness of 19 main urban cooling solutions from different perspectives (city scale/pedestrian scale, day/night, etc.). It also analyses the impacts of the solutions (on the carbon footprint, energy consumption, drinking water consumption, use of resources), their overall cost and the co-benefits they bring (in terms of biodiversity, rainwater management, carbon sequestration, urban and scenic quality, uses, health and comfort).

Challenges in the fight against UHIs

Comfort of users
Daily use of outdoor spaces and buildings can become uncomfortable for users.

Human health
Greater health risks (heat stress, sunstroke, dehydration or hyperthermia) for the elderly, infants and young children, women over 45, people suffering from chronic diseases and psychiatric illnesses.

Preservation of plant and animal biodiversity
Risk of extinction of certain species or of proliferation of certain invasive species.

Resilience of infrastructure
Risk of damage due to heat (especially for roads and railways).

Management of energy demand
Risk of increased demand in the summer period in buildings and transport.

What makes an Urban Heat Island?

Morphological parameters	Surface parameters	Anthropic parameters
Wind obstruction due to urban topography	Low evapotranspiration and evaporation (a high proportion of impermeable surfaces have replaced vegetation, natural soil and water)	Heat emissions due to urban activities (transport, industry, etc.)
Trapping of radiation (limited opening of the urban landscape to the sky)	Heat absorption and storage by urban surfaces (low albedo materials and high thermal inertia)	Heat emissions linked to mitigating the effects of UHI on a human scale (air conditioning)

Viewpoint

Élodie Briche

R&D Coordinator for Sustainable Urbanism, Urban and Regional Planning division, ADEME

Cooling cities: various solutions is a book based on scientific literature and a substantial bibliography. It provides a qualitative analysis of the different types of solutions for combating UHIs, based on the current state of knowledge. What is the next stage for ADEME?

The challenge for the future is to make progress on the quantitative analysis of solutions. This implies increasing the number of experiments associated with evaluation approaches, in order to have measured data on the real effect of different solutions in a given context.

To support these approaches, Ademe has launched the PACT²e Call for Research Projects (CRP), "Planning and Developing in the face of Climate Change, the Transition of Territories". The first strand of the CRP relates to reducing the effects of extreme climate hazards on both urban and territorial scales through adaptation solutions based on nature or the design of sustainable urban forms.

Also in this perspective of combining scientific analysis and field experimentation, Ademe is preparing to publish a collection of 17 international urban cooling experiments that analyse solutions with remarkable elements (co-benefits, sustainability, etc.) in different types of climates around the world.

Types of solutions

Nature and ecosystem services

Greening of soil, facades and roofs, permeable ground

Infrastructure

Materials with high albedo and low thermal inertia, humidification of the road surface, an increased number of fountains and misters, creation of shade with stretched canvas, Canadian well (geothermal exchanger)

Urban organisation and building design

Reduced car traffic, passive buildings without air conditioning or with limited cooling capacity (through- and bi-orientated), solar protection, natural ventilation at night, high performance insulation

Urban morphology

Bioclimatic urban planning (exposure, building orientation), open blocks, ventilated streets

GOOD PRACTICE
Rue Garibaldi
📍 Lyon

To mitigate the effects of urban heat islands (UHIs), the Greater Lyon area has been taking steps for many years to implement three action levers: the cooling power of trees, reducing water consumption and the reflective power of surfaces (albedo). The 2017-2030 Canopy Plan aims to develop the territory's tree heritage to achieve 30% of canopy surface by 2030, by preserving the existing trees as much as possible and through a vast tree planting programme of more than 300,000 trees.

At the same time, the Permeable City project that was launched in 2017 is intended to ensure that water is used in a sustainable manner, as this is necessary to develop the city's tree heritage, taking into account the local context of growing water scarcity and the increased risk of droughts.

This strategy is reflected in some major redevelopment projects. As part of a rehabilitation project, Rue Garibaldi (a 5 km long urban boulevard in Lyon) has been greened, and a ditch has been built to recover runoff water from non-roads. Sensors assess the degree of coolness achieved and check the watering needs of the trees. If necessary, the operation is carried out using water from a 600 m³ underground storage basin cistern. A number of road surface materials have been tested, with a preference for those that absorb more heat, and lanes are now reserved for soft mobility.

GOOD PRACTICE
Lisière d'une Tierce Forêt
📍 Aubervilliers

Initiatives are emerging on a micro-local scale, such as the Lisière d'une Tierce Forêt project, which is intended to transform a highly mineral car park located in front of a residence for young workers into a cool island.
The 72 trees that were planted were slected for their ability to transpire, and the asphalt was removed from the car park and replaced by a porous concrete surface. A water storage basin which can be used for the trees at times of water stress reinforces the system and reflective and permeable materials have been installed throughout the site. An evaluation of the cooling impact was carried out on the heat stress of pedestrians. Measurements indicate a decrease in the apparent temperature of 2.5°C on average over 24 hours, going down to 6°C at around 1 pm. Aside from its impact on the UHI, the project restores the natural water cycle and contributes to well-being and social cohesion by providing a pleasant outdoor space for the users of the residence.
The logic of maximising the impact of an intervention in an urban environment and a holistic vision of the issues (social, environmental, etc.) are at the heart of the resilience paradigm.

Microclimatic assessment: LIED, Météo-France

Project manager: Fieldwork architecture

Project owner: Alteralia

PLANNING & URBAN DEVELOPMENT REFERENCE
UHI modelling as a tool for cooling urban design

Pont des Tanneries district in Dijon, University of Burgundy, Bouygues Construction, Linkcity

Modelling the UHI phenomenon on the scale of urban projects makes it possible to anticipate its effects and to adjust the urban design accordingly. This is the purpose of an experiment carried out in the Pont des Tanneries district of Dijon by the University of Burgundy, the Centre for Expertise in Energy Efficiency (C3E), Bouygues Construction R&D and Linkcity. The aim was to concretely measure the calorie savings of an urban cooling design in the Ponts des Tanneries district in Dijon. The modelling carried out at district level made it possible to evaluate the impact of urban planning and architectural choices, vegetation, soil treatment, facade materials, etc. This exercise had a concrete impact on certain choices linked to the project: limitation of impermeable surfaces, addition of cast shadows, limitation of sun rays on facades and good positioning of plantations, in particular at "hot spots".

Miami
United States

Miami was the first city in the world to appoint a Chief Heat Officer in the city's Resilience Office.
In 2020, the city broke its heat record for the month of June, reaching a temperature of 37°C that month. As part of the Adrienne Arsht-Rockefeller Foundation Resilience Center's Extreme Heat Resilience Alliance programme, the mayors of Miami-Dade County in the United States, Athens, Greece and Freetown, Sierra Leone decided to appoint Chief Heat Officers, with aid for funding the position provided by the organisation.

FOCUS
Cooling down the city

A study[1] carried out by the CIRED (International Research Centre for Environment and Development), the CNRM (National Centre for Meteorological Research), Météo-France and the CSTB (Scientific and Technical Centre for Building) shows that if parks and green spaces accounted for 10% of Paris's land area, if building insulation and white coatings were generalised and air conditioning temperature settings were increased from 23°C to 26°C, the outside air could be cooled by 4.2°C at night and energy consumption would be reduced by 60%. This study relies both on public policy actions at the scale of the building stock and public spaces, but also on individual behaviour, such as air conditioning.

[1] Early adaptation to heat waves and future reduction of air-conditioning energy use in Paris, Vincent Viguié et al, Environmental Research Letters, 2020

Planning the city with water: managing the resource and dealing with risks of flooding

In France, one person in four and one job in three are exposed to flood risks, either from overflowing rivers or marine submersion.[1] Given this observation, and prompted by the European Flood Directive, France adopted a national flood risk management strategy (SNGRI) for the first time in 2014. Resilience is one of the main objectives of this strategy, which considers both the most exposed sectors (territories at significant risk of flooding) and the sectors spared from flooding in recent decades.

The challenges linked to the risks of flooding are all the greater as climate disruption has resulted in an increase in the frequency and intensity of extreme weather episodes, and in particular of intense rainfall incidents. In an urban context, characterised by a high level of soil sealing, these phenomena will increase the frequency and severity of flooding risks linked to urban runoff, along with the associated pollution. Around the world, a growing number of large urban centres are faced with the paradox of more frequent and intense flooding at the same time as water stress.

To reduce the scale of the impacts, cities are now adopting stormwater source management initiatives, which aim to maximise the absorption of rainfall by the surrounding environment and to reconstitute a water cycle in the urban landscape. The idea is to preserve or restore spaces that allow natural water runoff and thus limit runoff.

[1] First national flood risk assessment, EPRI, 2011, Ministry of Ecology, Sustainable Development and Energy

FOCUS

The MYSTIC partnership

The MYSTIC research and data exchange partnership between IFSTTAR, EPA Paris-Saclay and Cerema aims to better understand and assess the impact of neighbourhood development on the water cycle, with the urban campus located in the Moulon neighbourhood on the Saclay plateau as a case study. The aim is to observe the effects of the construction of the joint development zone on evacuated runoff and on the surface water table. To do this, a 3D geological model of the area was built – surface water table levels have been monitored continuously since 2012 – and a detailed, integrated hydrological model is being used to simulate the effects of various development scenarios. The research model will be further extended to simulate the impact at the end of the development.

To rethink water resource management, the Chinese government launched the national "Sponge Cities" programme in 2014 with the goal that by 2030, 80% of the surface area of these cities will incorporate developments that promote the absorption, retention, storage, purification, drainage and reuse of 70% of the stormwater that falls on them. The 30 pioneer cities combine several types of facilities for this purpose: ditches, rain gardens, depression zones, green roofs, urban water bodies, permeable road surfaces, etc.

In order to encourage the consideration of these issues on an operational scale, the European Centre for Flood Risk Prevention (CEPRI) identified six planning principles in 2015 to guide local authorities and professionals in the context of urban renewal projects in flood-prone areas.

1. Incorporate a protection system into urban planning

The multi-functional dyke concept, for example, refers to protection works against flood risk, where the structure also serves a different purpose (housing, mobility, etc.). It makes it possible to take into account the problem of available land in dense urban areas, by consolidating several uses within the same area.

Other technical solutions exist, such as super dykes (the back of the structure is filled in and can be developed) or the installation of mobile protection devices (watertight barriers that avoid the construction of permanent structures). This type of structure can be authorised to protect existing constructions or in the context of urban renewal operations.

Nevertheless, the presence of this type of structure does not remove the risks and in fact exposes the area to an additional hazard – that of a breach of the dyke – which can cause greater damage than a flood without the presence of the structures.

2. Restore more space for water in dense urban centres

When a river floods, it spreads over larger areas than it normally occupies. These spaces allow the flood to be cushioned, i.e. to attenuate the phenomenon. This means avoiding or reducing obstacles to the flow of water.

3. Locate businesses and urban infrastructure taking into account their vulnerability to flood risk

In France,
1 in 4 people
are exposed
to the risk
of flooding

GOOD PRACTICE

A flood-resilient neighbourhood

📍 Matra district, Romorantin

Developed between 2010 and 2016 alongside a river, this neighbourhood of 150 homes incorporates the element of water in its design: water is a feature of the neighbourhood's landscape, which helps to give a visual warning of danger. Residents can see the water gradually rising and take appropriate action in the event of flooding, seeking shelter if necessary. The architectural design of the neighbourhood reflects ownership of resilient urbanism at Matra[1]. In this project, compensatory measures have been taken to preserve the principle of "hydraulic transparency" in this urbanised flood zone: the aim is neither to increase the water level in the area nor to reduce the expansion area or the flood storage capacity. Car parks located on the ground floor of apartment buildings have been designed to be flooded in the event of a 100-year flood so as not to impede the flow of water.

© Éric Daniel-Lacombe

[1] Lenouvel, Julie (2020). Resilient urban planning, a new paradigm for the construction of cities in the face of flood risk? The example of the Matra district in Romorantin-Lanthenay, Revue Urbanités.

4. Design buildings and infrastructure adapted to the presence of flood risk in their areas

Various architectural processes can be used to construct buildings adapted to flood zones. Pile construction, elevated construction, floating buildings and amphibious buildings (resting on the ground in normal times and floating along a guiding column in the event of flooding) are all avoidance strategies, i.e. keeping out of the water.

© Nikolai Benner

GOOD PRACTICE

A redevelopment project in a flood zone

📍 Zollhafen district, Mainz, Germany

In the context of this project to redevelop a former port area subject to flooding, development decisions were guided by the need to adapt to the risk of flooding. The secondary roads are laid out at ground level but the main road is designed to cope with an annual probability flood level. All housing is designed with an elevation equivalent to the extreme flood level. Underground car parks are allowed, on the basis that they can be used as water retention areas if necessary. The city provides each new resident with information documents concerning the flood risks and the behaviour to adopt in order to develop individual and collective responsibility in the face of flooding. In the event of a major flood, the city has identified safe evacuation routes: the roads are marked with special signs to indicate which ones are passable, and the city has drawn up a plan to inform the technical and medical services.

5. Ensure that technical networks remain in operation

Technical networks are fundamental to the functioning of the city. They support the flow of many essential services: urban transport, drinking water supply, sanitation, telecommunications, energy supply, etc. In the event of flooding, the continuity of these services must be maintained to support management of the crisis.

6. Designing multifunctional spaces that can be put to use for emergency mitigation in the event of flooding

© C40.org

GOOD PRACTICE

A multifunctional, floodable public space

📍 Benthemplein Watersquare, Rotterdam, Netherlands

This public square is made up of three large ponds. In fine weather, it is used as a basketball court, skate park or amphitheatre, but during heavy rainfall it allows water to be retained. The project was designed with the involvement of users of adjacent amenities (school, church, theatre) and residents. It achieves maximum impact from the investment by enabling the storage of rainwater, improving the quality of the urban public space and providing an educational dimension on the function of the watersquare.

GOOD PRACTICE

Dakpark urban park

📍 Rotterdam, Netherlands

This 1 km long park is built 9 metres above the ground, above a shopping centre and close to an existing dyke. The space between the dyke and the shopping centre was filled in so that the dam and the shopping centre-park form a single structure. The level of protection of the dyke was modified taking into account the effects of climate change and sea level rise scenarios.

In my opinion

Sébastien Maire

General Delegate of France Ville Durable

Resilience as a horizon

"A new fashion, renunciation, too technical, too complex, unintelligible for the population, incompatible with how our companies and administrations work and their culture…" Just a few years ago, in the 'world before' the public health crisis hit us, the very term resilience, applied to cities and territories, was mocked or ignored by the majority of public and private decision-makers. Yet the issues and the need to adopt this new paradigm were already perfectly clear well before their pandemic struck. Moreover, whether or not we manage to carry out the necessary transitions or transformations of our cities and territories to meet the challenges of the Anthropocene, our new horizon is resilience, and it must become a priority.

Resilience is our only horizon if we do not quickly realign our economies on a global scale so that they are compatible with the planetary boundaries[1] that condition – some would say for the short term – the Earth's habitability for the human species. Crossing it is already and will increasingly be a source of crises and extreme events. Natural catastrophes and weather events that are "the worst since records began" will increase in frequency and intensity: heat waves, droughts, floods, storms, sea flooding and forest fires, even in areas that have been spared until now, will call for rapid adaptation of our territories, cities, neighbourhoods, buildings, infrastructures and technical systems, which were not designed to cope with them. But our human societies and social systems will also have to develop new capacities for resilience. As GDP growth is mechanically impossible to dissociate from energy consumption[2], the inevitable weaning of the economy from energy in future years[3] will in any case constrain the economy as long as it remains based on a growth imperative; geopolitical dependence and non-renewable

nature of the metals and rare earths essential to the new digital economy, as well as its dramatic environmental impact[4], will have the same consequences. And will the inevitable massive migrations caused by climate change, which will rapidly render territories uninhabitable[5], particularly in the southern hemisphere, also radically alter the world's geopolitical, economic and social balance, well before today's ten-year-olds reach old age? Our current trajectories therefore call for resilience to be made a priority in order for populations to given protection and security.

But if we do not want to reach that point, and if we are to envisage a more positive future for our ten-year-olds, resilience must also be our horizon, because it is both the condition and the process needed to drive the indispensable ecological, energy and social transition of our economies, by strictly framing them between a social floor and an environmental ceiling.[6] If the necessary change of direction is implemented, it will lead to equally unprecedented upheavals, because the degree of urgency demands that it be radical. To begin with, major cultural and philosophical deconstructions in visions and representations, and in education: recognising that the ideal of the ultra-consumerist lifestyle of OECD countries is at the heart of the problem, because it mechanically destroys the framework necessary for the life of the human species; deconstruct historical techno-centric and techno-solutionist visions (these are also at the heart of the problem, as they were built in most cases without taking into account planetary boundaries) in order to move towards a happy state of low consumption or frugality[7]; redefine prosperity to differentiate it more sharply from opulence and the accumulation of material goods[8]; reconsider the very notion of humanism and the place of

human beings in the biosphere, not as central or superior but as one element among other living beings. The upheavals will also be economic and social, entailing major risks for the maintenance of public order and social cohesion: the forced transformation or abandonment of whole areas of the economy of the useless and superfluous and the millions of jobs they support and the reorganisation of work and businesses so that first and foremost they serve to preserve the common good will require the creation of medium and long-term social safeguards to guarantee the maintenance of the quality of life of the employees concerned, particularly the lowest income earners. The holistic and multidisciplinary vision, the permanent awareness of cascading effects, and the tools, responses and systemic solutions provided by the resilience paradigm can be powerful assets for driving these transformations, while anticipating and reducing the impact of their consequences.

By focusing the priorities of territorial action on the capacity to meet the essential needs of the population (housing, healthcare, food, security, education, etc.), regardless of the hazards of climate change and the impact of the transformation of the economy, it can also contribute to reducing inequalities, since these needs are not guaranteed today for the majority of the world's population or for a significant part of the population of OECD countries.

Here we see the interest of the very basis of the concept of territorial resilience: to transform the crisis we are facing into an opportunity to respond to other challenges, to improve the situation, to envisage the post-crisis period not as a return to the initial situation but to a better situation, as if there hadn't been a crisis.

Adopting the paradigm of resilience as the logical framework and driving force of the indispensable transformations of our economies, our territories and our ways of life means no longer seeing these transformations as setbacks, backward steps, losses of quality of life, but on the contrary, unique opportunities to improve the human condition and its prosperity in future centuries.

> " Resilience is our only horizon if we do not quickly realign our economies on a global scale so that they are compatible with the planetary boundaries. "

[1] Rockström, J., Steffen, W., Noone, K. et al (2009). "A safe operating space for humanity". Nature 461, 472–475. https://doi.org/10.1038/461472a

[2] Caminel, Thierry (2015). "L'impossible découplage entre énergie et croissance", in Économie de l'après-croissance. Politiques de l'Anthropocène II, edited by Agnès Sinaï. Paris, Presses de Sciences Po, Références, chap. 4, p. 97-115. https://www.cairn.info/economie-de-l-apres-croissance--9782724617559-page-97.htm

[3] The Future of Oil Supply in the European Union: state of reserves and production prospects for major suppliers – Report from the Shift Project for the General Direction of International Relations and Strategy (DGRIS), French Armed Forces Ministry, May 2021 - https://theshiftproject.org/wp-content/uploads/2021/05/The-Future-of-Oil-Supply_Shift-Project_May-2021_SUMMARY.pdf

[4] Pitron, Guillaume (2017). The Rare Metals War: the dark side of clean energy and digital technologies, Scribe

[5] Mora, Camilo et al. (2017) Global risk of deadly heat, Nature Climate Change, https://:doi.org/10.1038/nclimate3322

[6] Raworth, Kate (2012). "A safe and just space for humanity: can we live within the doughnut?" Oxfam Policy and Practice: Climate Change and Resilience 8.1: 1-2

[7] Manifesto for a happy frugality. https://www.frugalite.org/en/manifesto.html

[8] Cassiers Isabelle (2011). Redefining prosperity, Routledge
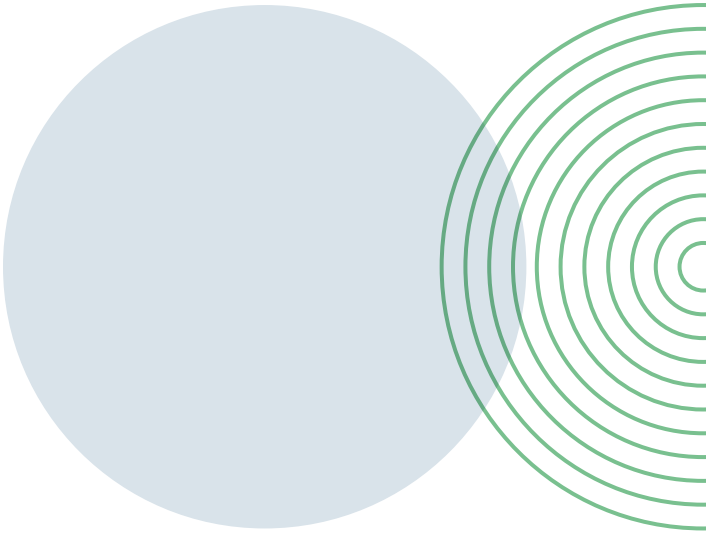
Acknowledgements

Thanks to all speakers and interviewees

- Patrick Bernard, Republic of Hyper-Neighbours
- Éric Bevillard, Gières
- Alain Bourdin, Paris School of Urban Planning
- Élodie Briche, Ademe
- Aurore Cambien, Cerema
- Stéphane Cordobes, Lyon Urban School and advisor to the National Agency for Territorial Cohesion
- Laurent Delcayrou, The Shift Project
- Ludovic Faytre, Paris Region Institute
- Chloé Friedlander, Banque des Territoires
- Camille Gautier, Elan
- Julie Lequin, SaluTerre
- Sébastien Maire, France Ville Durable
- Natacha Monnet, Ademe
- Sébastien Palluault, Ellyx
- Fabrice Patez, Yvelines department council
- Frédéric Pontoire, Grenoble Region Urban Planning Agency
- Christian Sommade, French High Committee for National Resilience

Thanks to the Lyon Metropolis Department of Foresight and Public Dialogue for kind permission to publish its work

Thanks to all those who took part in workshops

- Salwa-Ludivine Amdouni-Boursier, Resiliere
- Bruno Badoux, CEMEX
- Bruno Barroca, Lab'Urba, University of Paris-Est Marne-la-Vallée
- Hanane Bengualou, Croissy-sur-Seine
- Jean-Luc Bourget, SNCF
- Sophie Brasseur, Rethélois Country community of communes
- Carine Bryselbout, Yvelines department
- Mikael Buffetaut, Alençon urban community
- Florian Cezard, Agatte (Support Agency for the Transition of Territories and Businesses)
- Sylvain Chapon, Engie
- Elsa Charon, Comité 21
- Éric Chatelon, French National Fire Officers' Academy
- Nicolas Crinquant, Espelia
- Stéphane De Broux, SUMEC
- Sullivan Evrad, Resiliere
- Didier Felts, Cerema
- Bruno Fialho, EPT Grand-Orly Seine Bièvre Territorial Agency
- Jean-Max Gillet, Maintenance des Routes de France
- Hélène Gros, National Urban Renewal Agency (ANRU)
- Christine Guérif, Architect and Urban planner
- Valérie Hartmann, Cerema
- Markolf Jossou, University of Aix-Marseille
- Virginie Laurent, Seine Grands Lacs Public Regional Basin Authority (EPTB)

- Eddy Le Berrigaud, Nord department
- Antoine Le Bot, WWF
- Gilles Lefranc, Piémont Cévenol community of communes
- William Leung, Comité 21
- Sibylle Mazuel, Clermont Auvergne Metropolis
- Tom Merlier, Saint-Brieuc urban community
- Fiona Mille, Aristot
- Marion Nahant, Yvelines
- Christophe Neves, SS2E
- David Nicogossian, Cerema
- Fabienne Pit, Lacq Orthez community of communes
- Aurélie Pontal, WWF
- Amandine Raffard, idealCO
- Corentin Riet, The Shift Project
- Mathilde Rivallain, Colas
- Isabelle Robinot-Bertrand, Cerema
- Emilio Sarrat, Dordogne Departmental Directorate for Territories
- Karim Selouane, Résallience
- Lucie Smith, WWF
- Mickaël Soulié, Centre Ouest Aveyron Territorial and Rural Balance Cluster
- Charles Souques, Choisy-le-Roi
- Emma Tarer, Cap Excellence urban community
- Nadine Vilarrasa, Pyrénées-Orientales department
- Camille Waintrop-Boyon, France Ville Durable

Thanks to Group colleagues who have been involved in this work

- Yannick Antoine, Axione
- Clémence Chastan, Linkcity
- Michele Dominici, Bouygues SA
- Alexandre Feuga, Bouygues Bâtiment Nord-Est
- Alexandre Garcin, Bouygues Bâtiment Nord-Est
- Xavier Gauvin, Bouygues Construction
- Christine Grèzes, Linkcity
- Christelle Kouamé, Bouygues Bâtiment International
- Éric Lauroa, Bouygues Energies & Services
- Jean-Baptiste Leclerc, Bouygues Energies & Services
- Magali Le Coze, Bouygues Energies & Services
- Benjamin Lutz, Losinger Marazzi
- Romain Pavinato, Bouygues Bâtiment Nord-Est
- Fabrice Poline, Bouygues Construction
- Christophe Portenseigne, Bouygues Travaux Publics
- Antoine Ribaud, Bouygues Asia

Workshop facilitators and coordinators

- Anne Rumin, Auxilia-Chronos
- Anastasia Tymen, Auxilia-Chronos
- Elsa Favreau, Bouygues Construction

Crédits

Trend books

Shared **innovation**