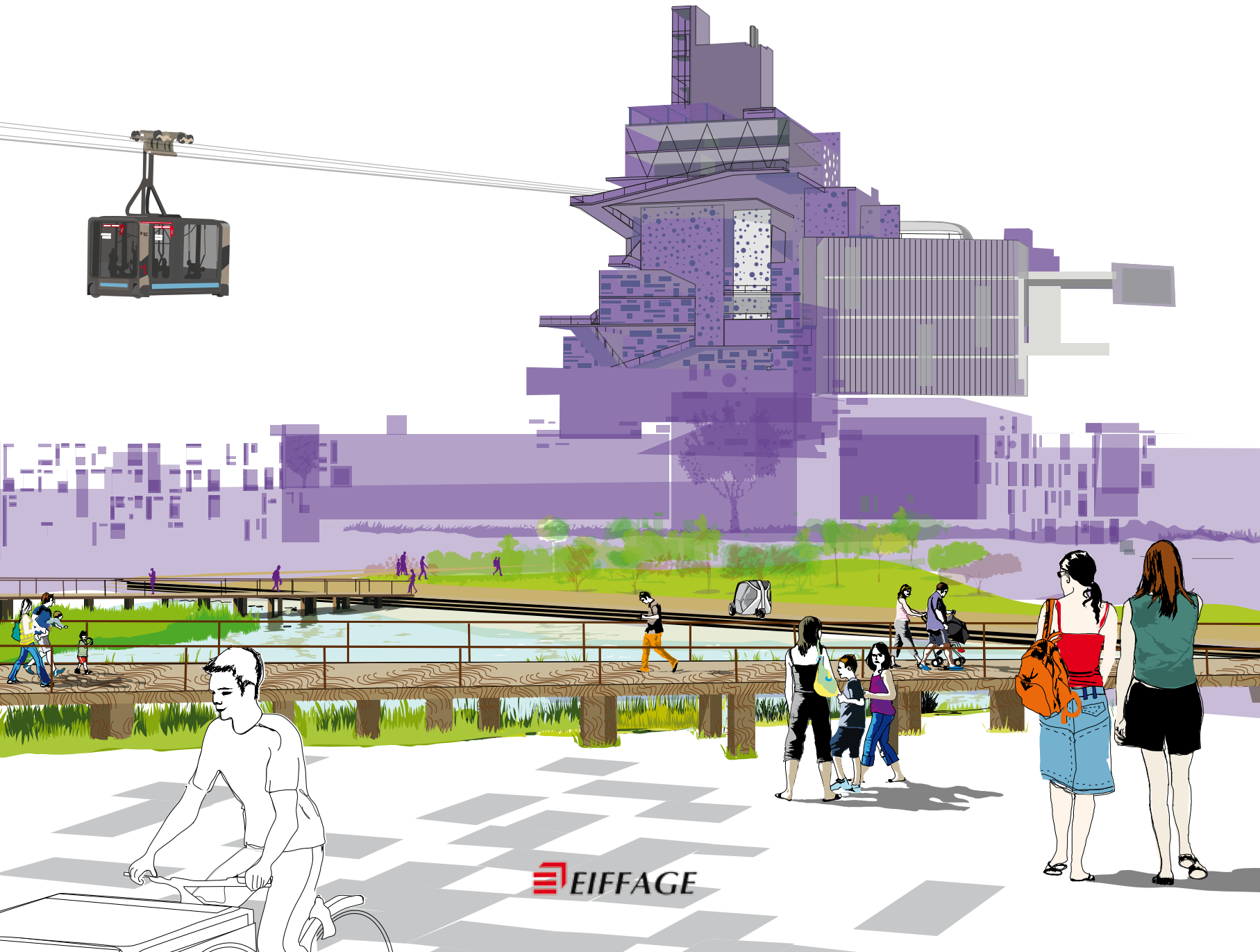
OF CITIES AND PEOPLE

CONTRIBUTIONS OF EIFFAGE'S PHOSPHORE LABORATORY TO SUSTAINABLE CITIES



EIFFAGE

OF CITIES AND PEOPLE
CONTRIBUTIONS OF EIFFAGE'S PHOSPORE LABORATORY
TO SUSTAINABLE CITIES

COLLECTION STRATÉGIES D'AVENIR
PUBLISHED BY EIFFAGE, DEPARTMENT OF SUSTAINABLE DEVELOPMENT

Art Direction and Illustration
Claude Valenti – www.clodevalenti.net
Desk Editor
Ulysse Badorc
Production
Terra 21, Nantes
Translation
Sue Alouche, Créativité Consultants

SECTION 01 / PHOSPHORE
THE ROADMAP OF THE LABORATORY

THE PROSPECTIVE CONTEXT IN 2030

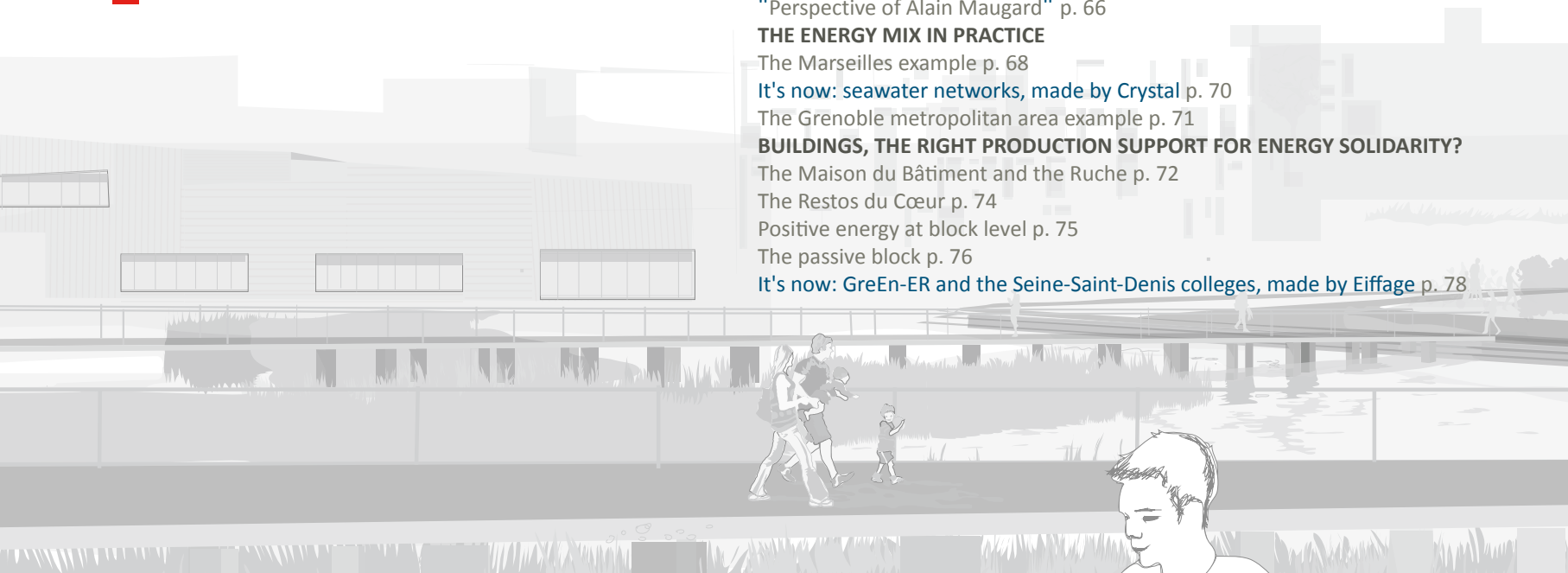
THE PHOSPHORE METHOD

3 VIRTUAL PLAYGROUNDS

SECTION 02 / CHALLENGES
FROM VIRTUAL R&D TOWARD REALITY

ECOMOBILITY

ENERGY SOLIDARITY®



NEW LIFESTYLES NEW WAYS OF BUILDING

URBAN ECOSYSTEM

OF CITIES AND PEOPLE

CONTRIBUTIONS OF EIFFAGE'S PHOSPHORE LABORATORY TO SUSTAINABLE CITIES

Under the direction of
Valérie DAVID, Director of Sustainable Development Department, Eiffage
With contributions from
Sarah LAVAUX, Project Officer Phosphore 2, 3 and 4, Eiffage
Nicolas MORONVAL, Project Manager Phosphore 4, Eiffage
Maxime PAIN, Project Manager Phosphore 3, Eiffage

Eiffage would like to thank **Pierre GAUTIER** (Pierre Gautier architecture et associée), **David CARVALHO** and **Frank AUFAURE** (Dassault Systèmes) for their faithful support. The exhaustive list of contributors to the Phosphore laboratory workshops, since its inception, appears on the last page of the book.

EIFFAGE

Pierre Gautier architecture & associée

DASSAULT SYSTEMES

POMA

Click back to the summary

EDITORIAL

"Imagine the sustainable city in 2030"

"Imagine the sustainable city in 2030": the subject never had, on the face of it, the likelihood to capture the resources of a public building and construction business firmly anchored in the immediate reality of its projects, for more than five years. However, the project called Phosphore, Eiffage's research laboratory for sustainable urban development has been operating since 2007.

Involving all the core businesses of the Group, Phosphore acts as a space of creative freedom that encourages engineers, architects and urban planners to unleash their thoughts and disrupt their traditional expert points of view to contribute to a sustainable city based on its uses, scalability or its resistance capacity when faced with natural risks.

This virtual exercise leading up to 2030 in effect, orientates us away from technical solutions only, and gives priority to analysis and systemic scenarios, respecting the urban ecosystem and the multiple interrelationships that define it.

Immediate applications already exist. Technical solutions from the Phosphore laboratory are now sufficiently proven to integrate the achievements of Eiffage: GreEn-ER, the school of future energy in Grenoble, l'îlot Allar at Marseilles or the "zero-energy" colleges of Clichy-sous-Bois and Noisy-le-Grand in Seine-Saint-Denis, are designed in line with the work of Phosphore and in compliance with the "High Quality of Life®" produced by the laboratory.

These already operational "Phosphorescences" shed light on the interest of foresight, essential to our understanding of the current city.

© Gérard Tordjman

Pierre Berger is CEO of Eiffage

Click back to the summary

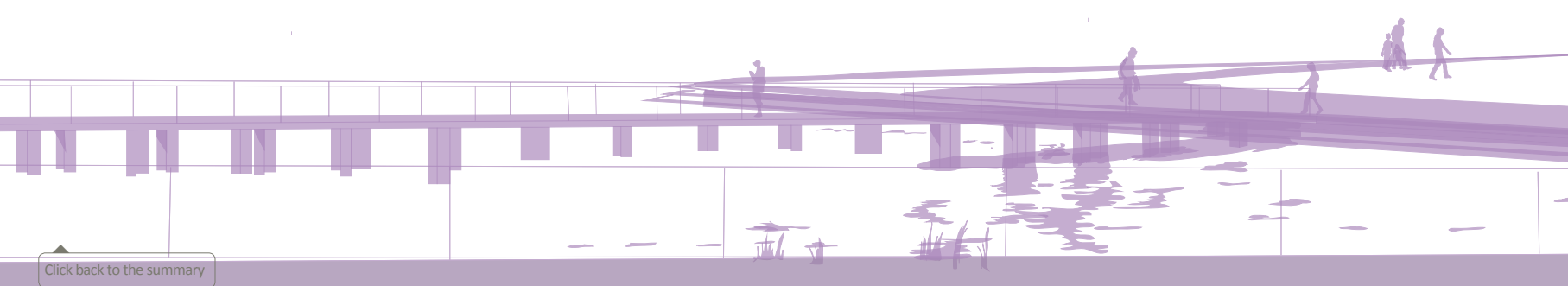
PREFACE

© Philippe Stroppa

Jean Jouzel is a climatologist, Director of Research at the Atomic Energy and Alternative Energies Commission (CEA) and Vice-President of the Intergovernmental Panel on Climate Change (IPCC). He is a member of the European Economic and Social Committee (EESC), in which he was co-rapporteur of an opinion on energy transition, and participates in the steering committee of the national debate on energy transition.

In terms of climate, the future is in our hands. There are certainties for our scientific community. Since the beginning of the industrial age, the amount of carbon dioxide in the atmosphere has increased by about 40%. It has gone up by almost 20% for nitrogen dioxide and more than doubled for methane. The use of fossil fuels and changes in agricultural practices including deforestation are largely responsible. These compound changes, called the "greenhouse effect", have led to a significant increase in the amount of heat in the lower layers of the atmosphere. True, they are not the only influence on our climate, but this additional heat has overtaken other causes of variations, whether natural, such as volcanic eruptions and solar activity, or related to pollution, by diverse aerosol emissions which rather have the opposite effect. That said, additional heating spells out increased temperature.

If nothing is done quickly to curb these emissions, the average warming could reach 4°C by the end of the century. This would cause a dramatic upheaval, as many climatic variables or phenomena would be affected, precipitations, winds, tropical cyclones, heat waves, snow cover, ice floes, glaciers, sea level, etc.



Click back to the summary

"Global warming is inevitable"

These changes would lead to risks of flooding in some areas, drought in others – particularly around the Mediterranean – a change too quick for ecosystems, accelerating the loss of biodiversity, ocean acidification, etc. They would have an impact on health, agricultural production and on almost all sectors. They would add risks of climatic surprises, irreversibility, and conflict-related displacement of populations. Many uncertainties remain about the magnitude of future global warming, its regional characteristics, the evolution of precipitations, extreme events, and of course, its many consequences, including our adaptability and the costs that it will generate.

However, we must accept the obvious: global warming is inevitable and the more greenhouse gases are emitted, the more important it becomes. Aware of the risks they will pose to their children and grandchildren, all countries on the Planet have, within the Climate Convention, committed themselves to the goal that the average warming, due to human activities, should never exceed 2°C.

It is a real challenge, which requires that greenhouse gas emissions start declining by 2020, would be divided by three by 2050 and continue to fall thereafter. It is a challenge we are struggling to cope with. At the heart of the problem, oil, natural gas and coal, whose use has never been greater than in the last ten years, represent nearly three-quarters of the increase in the greenhouse effect.

Click back to the summary

"Companies must be visionary"

A large proportion of fossil fuels contributes to heating our homes and travelling. In France, more than 70% of all energy consumption is related to buildings – residential and commercial – and transportation, with an increasing proportion in our cities and towns. Buildings are generally too energy-intensive and urban sprawl causes an endless extension of mobility needs. This poorly controlled development is accompanied by rapid over-use of natural areas and the weakening of the ecosystemic services they provide.

The objective that our country has set of dividing its emissions by four by 2050 – a 40% reduction by 2030 – is clearly part of this global challenge. It's a real headache, but I was able to highlight and suggest how to resolve these difficulties by my involvement in the Grenelle Environment Forum and the current debate on energy transition. In the framework of the European Energy/Climate change package, France is committed to improving its energy efficiency by 20% between 1990 and 2020. As recalled in a recent opinion of the Economic, Social and Environmental Council devoted to this aspect of "energy efficiency", the Grenelle Act has chosen to target efforts primarily in the construction industry.

Eighty-eight percent of this goal is to be achieved by the building sector as it consumes 44% of all energy, whereas transport was assigned a reduction target of 12% for a consumption of 32%. The environmental conference in September 2012 also focused on energy-efficient building renovations, agreeing to quantified commitments of ambitious energy standards for one million new and older homes per year, concentrating on the four million most energy-consuming homes. The outcomes from the debate on energy transition put the emphasis on sobriety. Even though this ambition in the building sector is essential regarding the objective for 2020, it will be impossible to reach the targets indicated for the longer term – in 2030, 2040 and 2050 – without an equivalent effort in the area of mobility. But this implies that urban

"This is a real revolution in terms of energy efficiency and ecomobility that we must collectively put into place, and it will only be possible if we are capable of both rethinking our cities and offering innovative solutions."

Click back to the summary

planning, including these two issues, takes resolutely into account the goal of significantly reducing greenhouse gas emissions. This is a real revolution in terms of energy efficiency and ecomobility that we must collectively put into place, and it will only be possible if we are capable of both rethinking our cities and offering both common sense and innovative solutions, especially in the building sector, whether it be for new-build or renovation.

"Attempt to start now a real conceptual and technical breakthrough in the city and not merely a process of continuous improvement"

In a world of change which, I sincerely hope, will move rapidly towards a low-carbon society, companies themselves must be visionary. Hence the interest in Phosphore, a laboratory for exploring new solutions in the context of the severe pressure caused by the interaction between climate change and the use of fossil fuels. The Phosphore laboratory seems to me the best way for Eiffage to envisage and respond to the worst possible scenario: to attempt to start now a real conceptual and technical breakthrough in the city and not just merely a process of continuous improvement.

Click back to the summary

SECTION 01 / PHOSPHORE

THE ROADMAP OF THE LABORATORY

The scientific and social consensus is now established on the environmental issues related to climate change and its consequences: it is now the responsibility of the industrial world to engage in a process of questioning the impact of its processes and finished products.

The issue is particularly significant for the building and public works industry, which has a significant impact on the ecological imbalance. Eiffage, a territorial actor and leading contractor in the city, has therefore chosen to anticipate and to orient its research not just towards new construction modes and processes with lower emissions, but equally towards a truly global approach to sustainable urban development. In this way, progress will not just be measured solely in terms of technological advances.

It's also about anticipating the adaptation of the city to the profound social changes that are gaining momentum and changing the type of housing and appropriate urban services: blended families, longevity, new working conditions.

Such is the ambition of Phosphore, the Eiffage's prospective laboratory for urban development.

Click back to the summary

THE PROSPECTIVE CONTEXT IN 2030 / HIGH TENSION ON CLIMATE AND NATURAL RESOURCES

More than 45% of greenhouse gas emissions come from urbanised areas in countries of the northern hemisphere. In question: housing and transport, totalling 75% of energy consumption in France and generating pressures on resources and natural areas. These two sectors resonate directly with all of Eiffage's activities: public works, civil engineering, roads and concessions, electrical installations, multi-technical services, metal structures, new constructions and renovations, property development – all the Group's businesses without exception – face these challenges.

The Phosphore laboratory has therefore imposed an extremely stringent prospective roadmap leading up to 2030 to meet the conditions, not for a process of improving the conventional practices of its business, but for a real breakthrough in proscribing the excessive reliance on fossil fuels by introducing a carbon tax deterrent. The amount has been arbitrarily set at € 1,500 per ton of CO_2, with the objective to virtually destroy the profitability of the building trade and public works as they are usually exercised. The collapse of the current price of a ton of carbon does not affect this working hypothesis, since, if the pressure on climate and energy were to intensify, the urgent need for action would activate fiscal leverage, market-based mechanisms requiring a period of maturation that we can no longer afford.

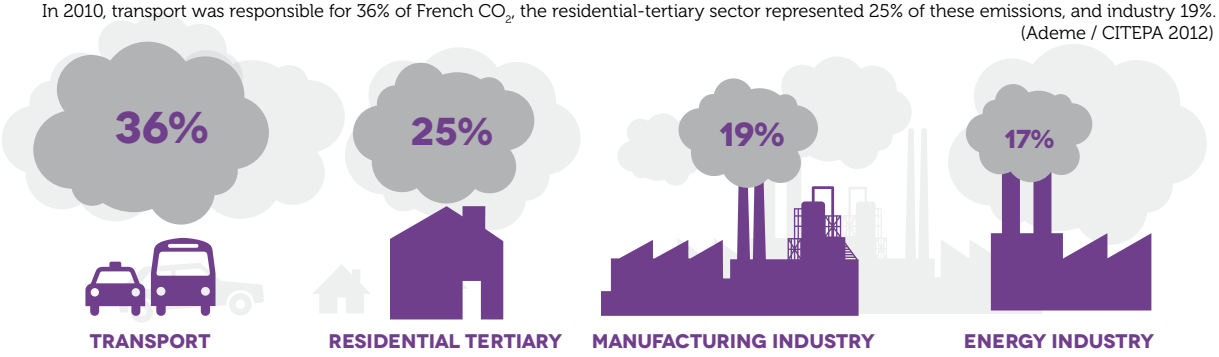
In addition to this deliberately alarmist virtual context, the Phosphore laboratory wanted to develop a credible climate forecast by calling upon the expertise of Météo France. If the climate, demographic and economic models employed do not have the ability to provide forecasts – this cannot be achieved over several decades – they can however produce scenarios of climate change. Three variants of changing temperatures and rainfall between 2030 and 2050 have been calculated for each of the successive laboratory "playgrounds": optimistic, pessimistic and median. Supposed to cover a wide range of possible futures, they allow us to take into account the uncertainties on the increase in concentration of atmospheric greenhouse gases.

Thus it is both in a context of greatly increased eco-tax constraints and a median climate-change scenario, based on studies from Météo France, that the Phosphore teams imagined a post-carbon future by 2030.

Click back to the summary

TRANSPORT AND BUILDINGS, THE PRIMARY SOURCES OF GREENHOUSE GAS EMISSIONS

In 2010, transport was responsible for 36% of French CO_2, the residential-tertiary sector represented 25% of these emissions, and industry 19%. (Ademe / CITEPA 2012)



CITIES, RESPONSIBLE FOR THE HIGHEST GREENHOUSE GAS EMISSIONS

In total, cities consume two-thirds of the energy generated and are responsible for around 70% of CO_2 emissions. (AIE, 2008)

LOCAL CONSEQUENCES OF GLOBAL CLIMATE CHANGE

Climatic simulations for 2030 in Strasbourg show a clear increase of minimum and maximum temperatures over the period 1971-2000. (Météo France, 2011)

CONSUMPTION INCREASINGLY FRENETIC ON NATURAL RESOURCES

Humankind annually consumes more resources than the planet can produce and the consumption expiry date is simply moving forward. (Footprintnetwork, 2012)

Click back to the summary

CITIES, BUT FOR WHICH HABITANTS?

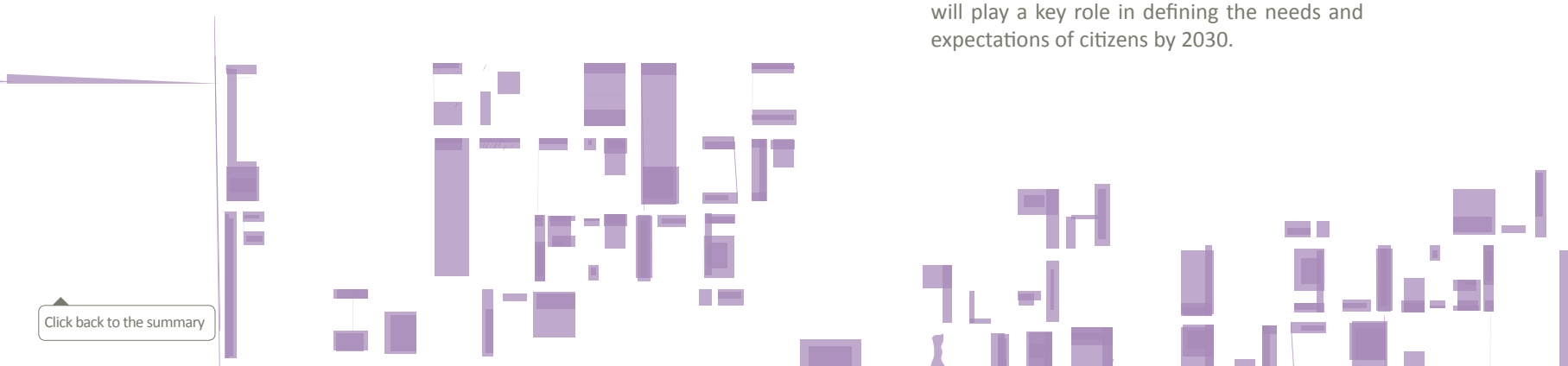
By 2030, the "homo urbanus" will have become the majority. What will be their characteristics and expectations? Sociology is able to provide a range of answers to the changes already in place today.

The ageing of the population alone would justify a reflection on sustainable cities. While life expectancy in good health – without disability – regardless of gender, has been declining since 2006, according to INSEE, the significant increase in people over 85 years old – fueled by the baby-boomer generation – may generate a rising number of "dependent" people that could reach 200 000 by 2020. In parallel, the trend seems to indicate that, at this point, half of the requests for places in dependent care homes may not be met.

In light of current and forecast statistics, the personal life path, like the professional one, will be less and less linear. Thus, with the divorce rate exceeding 45% since 2005, each divorce is the source of additional housing demand estimated at 0.7. Single parent families and blended families have become current models, with a direct impact on the number and type of housing desired.

How should these changes already underway be considered to determine the types of services, buildings and urban forms required? How should we evaluate the impact of these emerging trends like new forms of work organisation – teleworking, professional nomadism – or the recent phenomenon of intra-European migration by wealthy retirees? Working out concrete and credible responses to these needs requires examining population evolution, and integrating a reflection on behavioural patterns.

If the precise influence of the explosion of digital technologies is difficult to evaluate for the period up to 2030, due to the rapid and transient changes in question, there are already the outlines of an ultra-communicating society dominated by networks and "multi-membership". One can presume that social contacts will be easy but fragile, and that immediate and tailor-made requirements will be made possible by the multiplication of business providers via various digital interfaces. All these sociological and behavioral changes will play a key role in defining the needs and expectations of citizens by 2030.



Click back to the summary

"The meeting place of imagination and action"

Virtual worlds are the meeting place of imagination and action: a mode of representation and interpretation of the world that allows you to navigate in time and space and help create the future. They are at the heart of the third industrial revolution and the development of the intangible economy that places value on relationships and not just on products.
This is the purpose of Dassault Systèmes: to create virtual universes to imagine sustainable innovations capable of harmonizing product, nature and life.


© Xavier Granet

Bernard Charlès is the President & CEO, and a member of the Board of Dassault Systèmes, "the 3DEXPERIENCE Company", world leader in 3D design software, 3D Digital Mock-Up and Product Lifecycle Management solutions.

The city is a privileged field of research, expression and innovation. The city is a question of harmony: the challenge is to propose a life experience resonant and coherent with those who live there and make it alive – a real quality of life. Cities are the laboratory of our future and the urban experience of tomorrow is left to imagine.

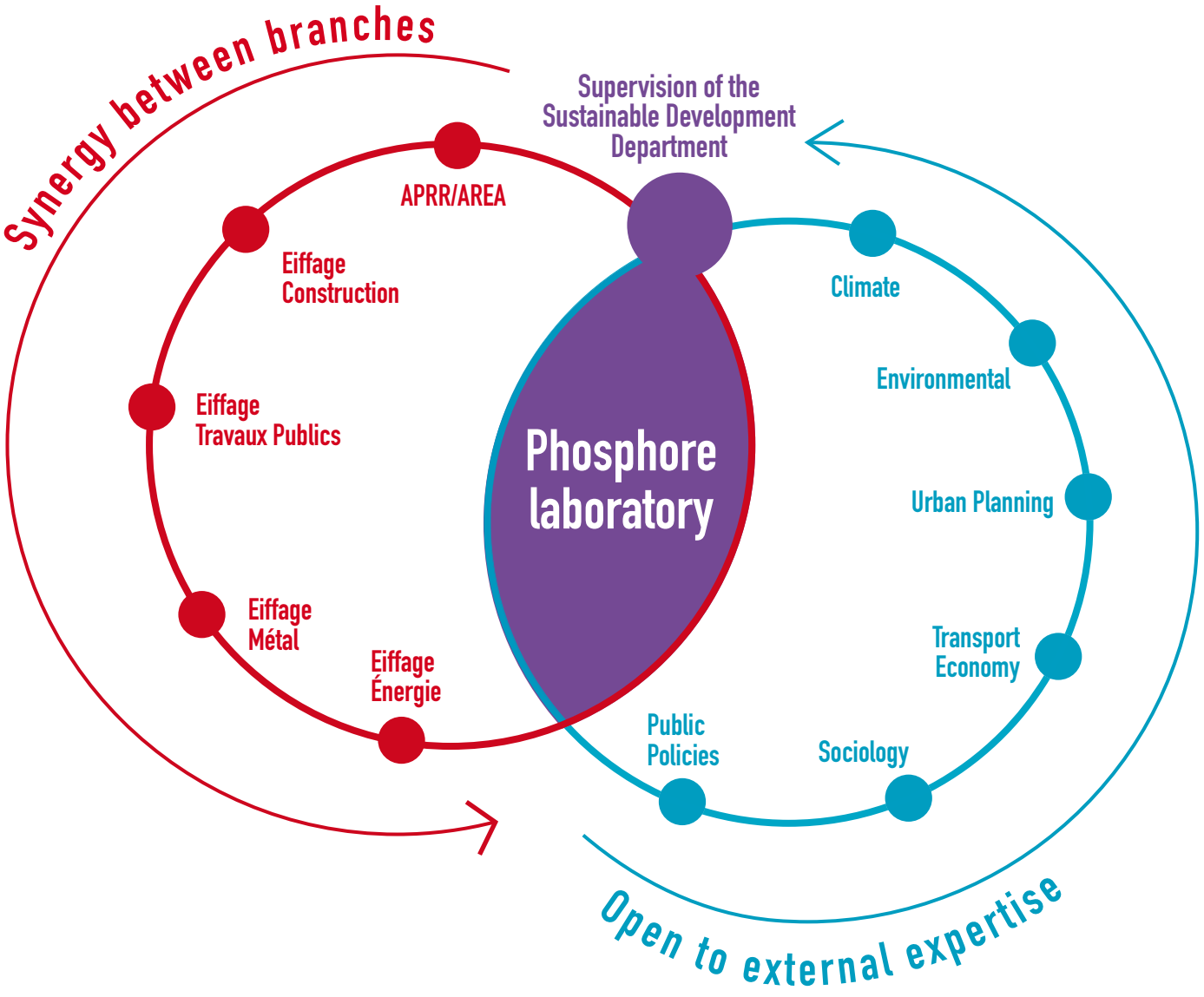
It is Phosphore's ambition, combined with the sense of commitment from Dassault Systèmes Design Studio in the project: to think about the city holistically and therefore sustainably without dissociating the attractivity and competitivity of the territory and the quality of life for the inhabitants. Anticipating the possible future of our cities is in essence a design approach: creating objects, spaces and experiences, through the help of digital tools and around a 3D collaborative and "experiential" platform.

This design method offers a systemic approach, in context, and in the making, combining art, science and technology. It focuses on experience and usage, drawing life scenarios that simulate interactions between the urban environment and the people who live there. In the words of Albert Camus, the right way to get to know a city – and build it – is to look at how you work in the city and how you love in the city. Our approach also brings together and connects all those – engineers, planners, artists, politicians, citizens, etc. – who are asked to think of the city of tomorrow. Finally, virtual environments, making things visible, give meaning and life: they have an unbeatable value for supporting decision-making and communication. Virtual experiences, participatory by nature, open a new order of social experience in conjunction with citizens.

The city will evolve through its virtual twin exploring all dimensions of reality, space and time: the past, like Paris 3D Saga revives 2,000 years of heritage, and the future, as in 3DEXPERIENCity for planning...
I believe that, tomorrow, not a single city will be designed and managed without use of virtual worlds: cities will be better integrated, better received and conceived in the context of a truly human project. Think of the city as a whole, which integrates itself into a larger whole. Virtual worlds have, in effect, for me, a humanist and citizen-oriented purpose – because they are vectors of harmony and transcendence. Harmony by their essentially systemic function. Transcendance by their growing potential for action and imagination. The Virtual has this paradoxical virtue of allowing us to be even more present in the world.

We are only at the dawn of the great discoveries which can lead us into all areas of industry, economy and life. Let's continue the exploration of these new possibilities.

Click back to the summary



Click back to the summary

THE PHOSPHORE METHOD

A breakthrough approach, conceptually and technically

The Grenelle Environnement Forum called for a revolution in planning practices, urban in particular. The challenge is twofold. On the one hand, enter an era of systemic analysis of the city, including all sociological, socio-economic and environmental issues, which have an impact on cities. On the other, imagine solutions to challenges both very different, but interdependent: the fight against all forms of pollution and the consequences of climate change, energy conservation, health compliant materials and environmental quality, recycling rubbish, preservation of biodiversity and protection of water resources, promotion of short distribution chains, development of "soft" modes of transport, functional diversity and sharing spaces.

In order to imagine and develop innovative and sustainable solutions in all respects, the Phosphore laboratory sought to bring into being the conditions necessary for optimum creativity. A space in the daily operations of Eiffage was thus born, based on the following principles.

Bringing together all the core businesses of the Group from the different branches of Eiffage to create a large pool of skills appropriate to a systemic view of the city, in order that these skills are mutually enriching. This includes anticipating 2030, with one constraint: a highly alarming extreme pressure on climate and energy. In return, the laboratory has complete freedom to invent the conceptual and technical breakthrough for tomorrow, without financial feasibility censorship or a legal straitjacket.

The laboratory must confront all evidence and submit the engineering research work – the proponents of natural science – to social sciences and humanities. Environmental scientists, urban planners, economists, sociologists, public policy experts – elected officials, social landlords, senior executives with local governments among others – many qualified people were invited to share their views freely on the most ideal city.

This is the condition to benefit from a favourable work environment, that's to say a managerial "space" multi-generational and multi-disciplinary and anti-hierarchical. These meetings, very unlikely in the traditional corporate system, were possible because of a favourable work environment, that is to say a management approach.

In order to be consistent with the methodology of the laboratory, the Phosphore teams gave an overview of the state of the art research in these areas and proposed a comparison of eco-neighbourhoods in Europe and the world. Referring to proven and recognized criteria, they also made an in-depth study of qualitative evaluation systems for building, including HQE®, BREEAM® or LEED[1].

While considering it relevant to integrate the methods and targets constituting these standards, they also found limits in their correlation with the nature and size of the Phosphore project. They agreed on the necessity to supplement them with a truly systemic approach to needs and solutions, which is the key conceptual brand of Phosphore.

1 HQE®: High Environmental Quality, BREEAM®: Building Research Establishment Environmental Assessment, LEED: Leaderhsip in Energy & Environmental Design

Click back to the summary

THE HIGH QUALITY OF LIFE® REFERENCE SYSTEM

Or how to promote a systemic and human approach for all urban projects

Based on its own multidisciplinary work and operational experience from branches of Eiffage with city stakeholders, in 2009 the Phosphore laboratory created a reference system in sustainable building called High Quality of Life® (HQLife®) designed to integrate the highest standards of sustainable development covering all essential dimensions of the city and placing the human dimension at the heart of its projects. It is this High Quality of Life® reference system which offers and then ensures consistency between the different solutions devised by Phosphore in Marseilles, Strasbourg and for the Grenoble metropolitan area.

The reference system HQLife® unfolds in a matrix of three dimensions

The HQLife® principles reflect the philosophy and vision of Eiffage in terms of sustainable urban development. Interdependent and united, these five principles are the backbone of the reference system and can be applied regardless of the nature and scale of the urban project considered.

The fields of analysis represent all the urban project components identified by the contracting authority and vary according to each project development depending on the specificities of the territory and its actors. Each field is analysed through the prism of the principles HQLife® to give concrete guidelines in terms of development and sustainable construction.

Finally, the scales vary according to the nature of the urban project: building, block or neighbourhood. Different methodological and technical solutions offered by Eiffage in the area of mobility, construction and accommodation are associated with each of them.

In fact, the HQLife® reference system ensures a global and comparative approach of sustainable development to all development projects, whatever the programmes and geographic patterns. Through this system, the Phosphore laboratory focuses on and accurately reflects the complexity of environmental issues and social projects, while providing a framework, methodology and readable indicators.

Both a conception guide and a decision making tool, the High Quality of Life® profile allows different players of an urban project – elected officials, planners, developers, builders, maintainers and operators, but also residents – to assess its position in terms of sustainable development performance. It is fully compatible with existing standards such as HQE®, BREEAM® or LEED.

Click back to the summary

High Quality of Life® – the five principles

Respect of the land and ground engineering
Consideration of the physical, natural and cultural features of the site to the definition, the urban and architectural makeup and the positioning of the buildings, the infrastructure and the spaces.

Rational management of flows and mobility
Systemic approach of flow management and related outputs in order to optimise the functioning and the connection of the buildings, the infrastructure and the spaces, meanwhile reducing the related nuisances.

Intensification and evolutivity of uses
Design and construction processes applied to buildings, infrastructure and spaces in order to maintain their durability and their capacity of evolution in the short and long run.

Cohesion, health and well-being
Set of processes helping to match the expectations and the needs of users.

Prevention of risks and resilience
Set of processes and procedures aiming to reduce the vulnerability and to develop the resilience of the buildings, the infrastructure and the spaces.

Fields of analysis

Physical and natural environment

Human development

Energy

Resources and materials

Water

Economy

The scales

Building

Block

Neighbourhood

Click back to the summary

"The city of the future is a question of dynamic approach"

Urban planner Pierre Gautier insists on the fact that the sustainable character of the city of tomorrow begins with the organisation of physical or virtual mobility, and access to that mobility.

What is your experience of Phosphore?

I acted as outside consultant on the topics of architecture and urban planning. Our expertise met the skills of the best engineers of the Eiffage group in this laboratory and we worked on issues related to the construction of the city. Specifically, we worked on an experimental basis for the city of Marseilles, the urban area of Strasbourg and that of the Grenoble metropolitan area. Together, we projected ourselves by using a transversal approach. The principle of Phosphore is to go beyond traditional frameworks and integrate diverse subjects such as energy issues, solidarity, programming and urban integration, demography and mobility.

© Daisy Reillet

Pierre Gautier is an architect, engineer and urban planner, a graduate of Delft University of Technology. Among his recent projects he has been honoured for his work on mixed developments Le Monolithe – Lyon Confluence.

What definition of a sustainable city emerges from this approach?

The sustainable character of the city of tomorrow lies in its ability to plan for changes in land use and to adapt over time to a scalable offer in terms of collective transport. The city of the future is a question of a dynamic approach, adaptability, resilience. It adapts to new demands: that of local shops jostled by e-commerce and that of living and working places. What is a workplace today in the tertiary sector? Probably a table, a chair and a connection! To build a city we have to network these uses and think interconnectivity. The city yesterday was frozen in time and space. Today, we must build for very short periods of use, everything must be progressive or evolutive. We studied the concept of the evolutive building: an envelope and programming that evolve over time. This building structure would be built in a tertiary context firstly, then it would focus on housing afterwards, and lastly on education. It's an attempt to respond to the concept of life cycle from construction to demolition.

Isn’t the city facing some priority issues?

The organisation of mobility is a priority. It goes along with density. Public transport will not solve everything and its cost is still expensive for the community. Urban density is a solution against urban sprawl for both the government and the people. Our work also addressed those excluded in the city of tomorrow: the person who does not have access to physical or virtual mobility. The city will have to organise new centres to connect the largest number. It will no longer be monocentric – a historic centre and a suburban perimeter – but become polycentric with a plurality of life centres combining housing, services, shops and activities. To qualify the in-between and neglect no-one should be our main concern.

Click back to the summary

"The designer delivers an anthropological vision of city use"

David Carvalho, who participated in the entire Phosphore cycle, brings his regard and his design reflection in the project of the future city, which will no longer be conceived from the buildings but from the quality of life.

What is the contribution of design applied to the world of architecture and urbanism?

David Carvalho is Designer and Co-founder of 3E OEIL studio (design and communication specialising in new technologies), currently Design Director at Dassault Systèmes following its takeover during the summer of 2011.

The designer delivers an anthropological vision of the use of the city. Positioned between the architect and the building developer, he accompanies them in the scenario and refines the representation of the city they model. Industrial designers work primarily from a specification and an economic rationale, to design a product or service on a logic predominantly related to functions and market. The designer's place is becoming more and more legitimate in the world of building and public works which focuses more and more on usage scenarios. He considers the relationship between use and social identity in the vision which is expressed in an original way in a neighborhood, town or facilities.

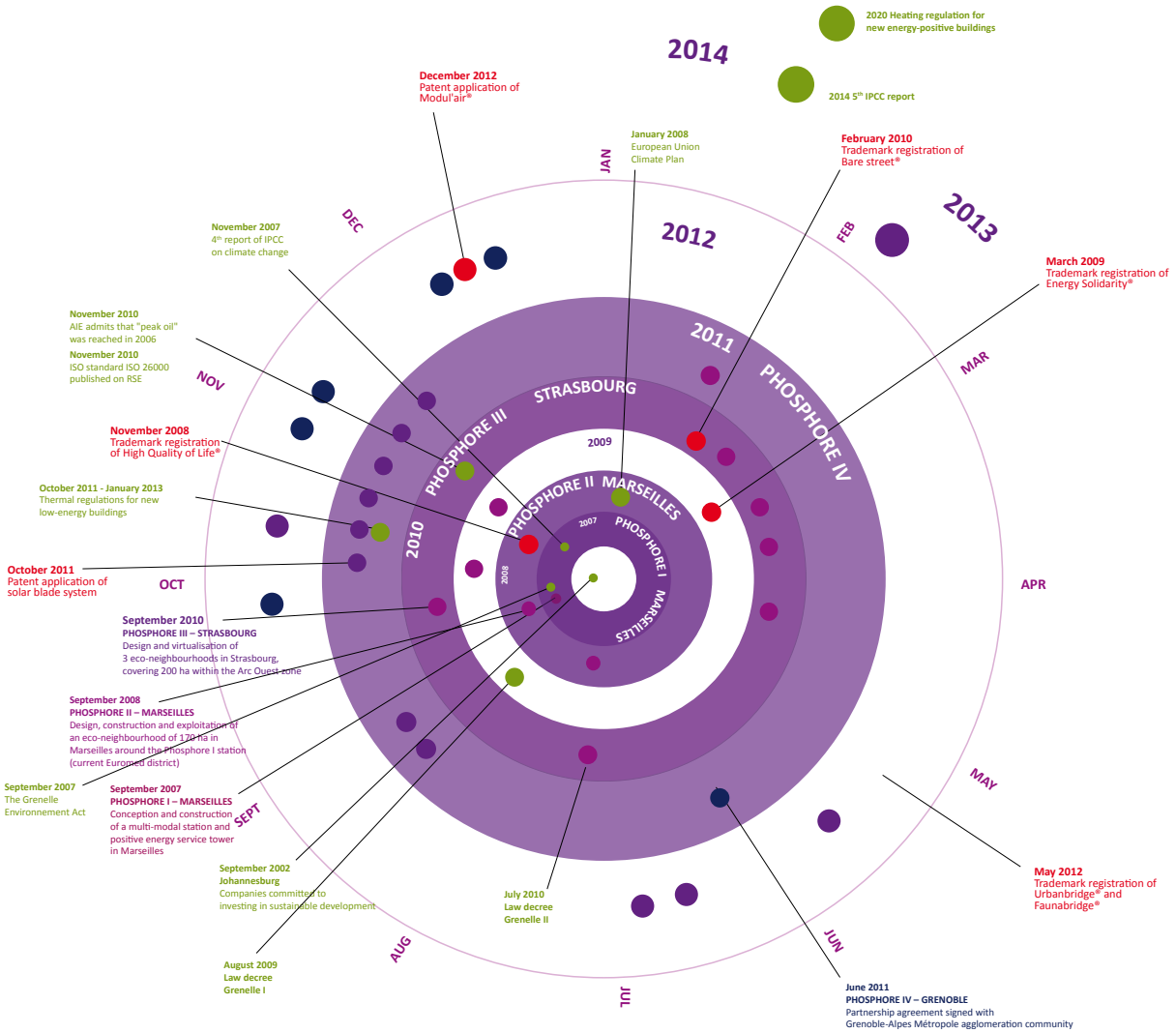
What is your experience of the process Phosphore?

I personally participated in the whole cycle and saw the steady progression of Phosphore. During the first session, we were confined to the building aspects with the desire to adapt Eiffage's construction methods to the specificities of the place, of natural spaces available, to the capacities of the territory and its history. We also wanted to develop a project with an original signature, in line with sustainable development issues – demography, natural resources, and quality of life. In the second session, we were committed to expanding the point of view, so rather than starting with the building aspects, we started with quality of life. We then had to focus on the user of the city, whose perceptions and experiences became the heart of our work. The force of Phosphore was therefore to propose a commitment on the territory, on what could be a city which would accommodate new lifestyles. The systemic and holistic approach is in perfect harmony with our design approach. Today, there are many benefits for the company, which are reflected in its strategic choices. For me, sessions 3 and 4 have deepened these innovations and widened the audience with outstanding feedback quality.

In what city will we live tomorrow?

Our challenge is no longer to imagine a city that is in phase with the current generations, but to invent a city that grows freely, depending on the economic or environmental data, demographic fluctuations or new future changing activities. The daily life of people changes with the seasons, their professional and personal activities, community events, notably cultural. The 3DEXPERIENCE platform used in the Design Studio of Dassault Systèmes will prove instrumental in following the rhythms of the city of tomorrow. Our role is to finally reveal these new behaviours and practices to the territory. The city will then become a scene of permanent expression of its inhabitants, its actors.

Click back to the summary



- July 2008: Phosphore I film and brochure published online
- 8-9 October 2009: INTA 33rd World Congress in Taïwan (China)
- 13 November 2009: Phosphore II interactive tool "Zero carbon virtual eco-neighbourhood" published online
- 12 February 2010: Seminar "Towards a post-carbon city" organised by MEEDDM
- 5 March 2010: Angers-Loire-Métropole agglomeration community
- 16 March 2012: EPADESA
- 7 April 2010: MFQM in Nantes
- 4 October 2010: INTA 34th World Congress in San Sebastian (Spain)
- 21 January 2011: Conference "Vision of the future city" organised by CGDD
- 22 August 2011: Phosphore III interactive tool published online
- 30 August 2011: Summer School at the EIVP (engineering school)
- 13 October 2011: Capital Meetings of Marseilles "What will a sustainable city be in 2030?"
- 14 October 2011: Conference "Sustainable transition of the City" in Aix-en-Provence
- 17 October 2011: Phosphore received the Fimbacte award for "Innovative Projects"
- 24 October 2011: Master "Urban Planning and Developement" at the University of Paris 1 Panthéon-Sorbonne
- 10 November 2011: CETE of the East in Nancy
- 13 November 2011: INTA 35th World Congress in Grenoble
- 15 May 2012: AFTES
- 14 June 2012: 8th ENVIRONORD show in Lille
- 28 june 2012: 8th National Meetings of SCoT in Nantes
- 28 September 2012: 60 years Convention of the Belgian Road Research Centre
- 17-18 October 2012: 4th Forum of Sustainable Neighbourhoods in Saint-Ouen
- 8 November 2012: Urban Project Forum in Paris
- 19-21 November 2012: Urban Planning Agencies National Meeting in Bordeaux
- 5 December 2012: Master in "Territorial Science" at UPMF in Grenoble
- 14 December 2012: Greater Lille Committee
- 6 February 2013: "Centre" neighbourhood council meeting in Strasbourg

Click back to the summary

3 VIRTUAL PLAYGROUNDS

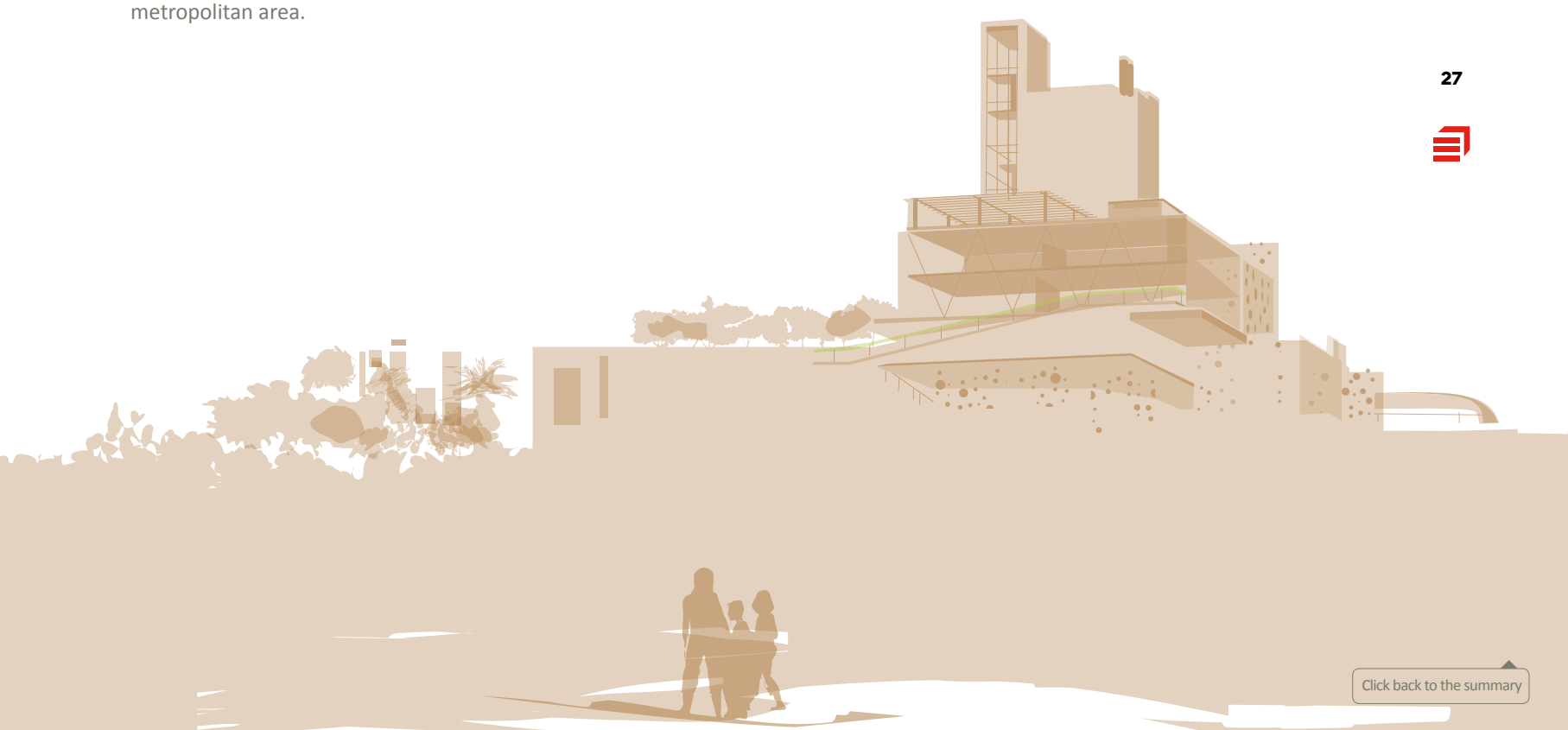
The Phosphore "sandbox"

In its various virtual exercises leading up to 2030, Phosphore has always deliberately diverted away additional technical and technological solutions, which, alone, will never constitute a sustainable city.

Priority is given to systemic analysis, respectful of the urban ecosystem's multiple interrelations, as well as the emergence of proposed solutions extending the understanding of geographic, socio-economic and cultural site specificities. This is what Phosphore means by compliance with territorial engineering, in the etymological sense of the term.

De facto, the virtual work of Phosphore should confront host territories in order to, on the one hand, grasp their concrete reality and, on the other, deliver proposals plausible in all respects.

That is how Phosphore got successively involved in Marseilles, Strasbourg and the Grenoble metropolitan area.



Click back to the summary

PHOSPHORE I & II / MARSEILLES

Revealing the advantages of a territory

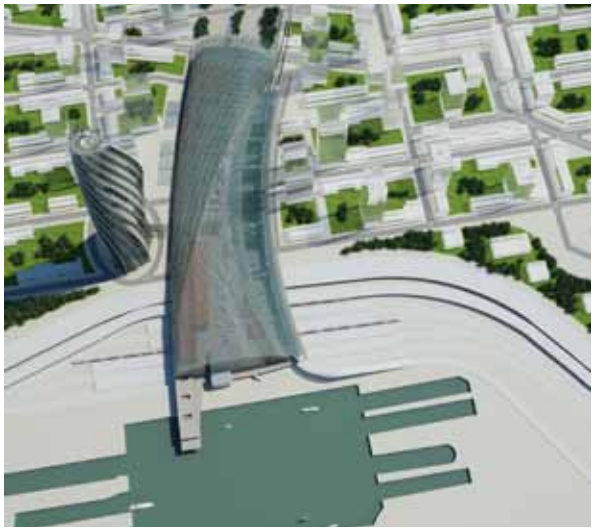
It is in the Arenc zone in Marseilles that the first two Phosphore laboratory sessions made their home, at the invitation of the Eiffage Construction Méditerranée teams who saw this site as a place of particularly rich experimentation: the territory's exceptional advantages in terms of local renewable energy, the potential for an urban requalification programme combining new builds and renovations, an attractive project in terms of transit networks extension, etc.

The first phase of project research, undertaken between September 2007 and June 2008, took the original form of a response from Eiffage for a virtual Public Private Partnership concerning the design, construction and operation by 2050 of a multimodal station and service tower. The wave-shaped envelope of the station forms a vast hall 450 metres long, which opens onto the eastern side of a square and a park giving access to the Canet district, and at the west to the harbour basins. It is designed as a skin whose metabolism ensures exchanges, including thermal and luminous air handling, with the external environment. The station and the tower, which has a vertical declination, feeds the neighbourhood with clean energy, introducing the concept of Energy Solidarity® (p. 65) in with other applications to be developed in the following Phosphore sessions.

The second phase of the project fuelled in 2008 and 2009 and boosted by the aftermath of the Grenelle Environment Act, expanded the initial investigation of designing an eco-neighbourhood connected to the station. In 2030, a virtual neighbourhood area of 170 hectares situated by the sea will welcome 32,000 people – compared with 4,000 today – and a proportionate increase in new jobs. The multimodal station, forerunner of the multimodal hub (p. 43), is at the intersection of metro, tram and commuter rail transport. Circulation of combustion vehicles is banned within the eco-neighbourhood. The station organizes the breaking load and distributes access to a range of clean transportation. Favouring a lively shared public space, the concept of Bare Street® (p. 92) makes its first appearance.

Compliance with territorial engineering, the fundamental principle of Phosphore's analyses requires that the energy needs of the eco-neighbourhood buildings are covered by an "energy mix", drawing heavily on local resources particularly generous in Marseilles: the sun, the sea and the mistral. The buildings imagined meet the bio-climatic requirements of Energytecture®, consisting of combining architectural excellence and energy performance. They also develop other qualities: hybridity and upgradability. Whether with a central patio, multi-patio or tree structure, typologies proposed in eco-neighbourhoods inaugurate Phosphore's use intensification and functional diversity to respond to mutations in the second phase of the project in 2008 and 2009, stimulated by sociological approaches.

Click back to the summary



The station, the tower and the eco-neighbourhood of Phosphore 1 et 2 in Marseilles
©Sustainable Development Department / 3e-œil.com studio / Pierre Gautier architecture
©Buffi Associés – Eiffage – 3eOeil

Click back to the summary

PHOSPHORE III / STRASBOURG

Three eco-neighbourhoods in the heart and the gateway to the city

After Marseilles, in 2010, the Phosphore laboratory chose a new playground: 200 hectares in the West Arc zone in Strasbourg, a European city characterised by a deteriorated oceanic climate, with wide temperature variations. Based on their reflection conducted on the scale of the entire city, Phosphore teams virtualized three eco-neighbourhoods in compliance with the High Quality of Life® requirements.

Located in the heart of the city, the area known as "Gare Basse" is now a run-down area, surrounded by a series of natural and constructed obstacles: a highspeed train station and railroads to the east, ramparts of the city, an arm of the river and the A35 highway to the west. In 2030, the Phosphore teams aim to reduce the use of land area and the nuisances associated with transport infrastructures while recreating the link between the city centre and its suburbs. A multimodal hub for transport associated with a diverse range of services make it a living and meeting place that will revive the neighbourhood.

The area called "Wacken" was revisited from a double perspective of a mixed urban approach and respect for its specific features. The presence of family gardens in the north, the Kléber highschool in the south and the capacity for resilience of this zone subject to flooding significantly influenced the choices made in the development of this area.
In 2030, a large area of green spaces will host retaining and phyto-filtration basins for rainwater and road runoff water. A natural swimming pool will play a multiple role of flood prevention and phytopurification of rain water, while offering families a place for recreational activities. The neighbourhood will welcome individual and collective housing units, designed according to an evolving construction mode, and teaching center specialising in trades involving water.

Third study site, "Haguenau square" forms one of the main gateways of Strasbourg's metropolitan area with its muddle of railroads, a canal, roads and highway exit and entrance ramps. The building called "Maison du Bâtiment" (p.73) dominates from above the central island developed as an urban park and used as a vast circle for traffic between the center and the periphery. In 2030, Phosphore teams propose to enhance the character of this complex but functional city entrance landscape. A full programmatic and energy requalification of the "Maison du Bâtiment" will extend its life while a new evolutive construction, the "Ruche" (p. 73) will create higher density in the central square, maintaining its function as regulator and as an urban park.

Three eco-neighbourhoods Phosphore 3 in Strasbourg, before and after virtualisation

Click back to the summary

Click back to the summary

"We live in a time of great urban inventiveness"

Because metropolitan areas have become experimental places and are actively involved in the research on eco-innovation, they have a cross-cutting approach to sustainable development. This cross-cutting approach is a real challenge for politicians. A challenge which can only be met if people are closely involved in shaping the future of their city.

© Ernest Laemmel / CUS

Catherine Trautmann is Vice President of the Urban Community of Strasbourg, responsible for academic affairs and economic development, and MEP. She also served as Minister of Culture and Communication.

How can we better address the sociological issues, especially in urban renewal projects?

Issues of housing affordability, accessibility to the city, socio-professional distribution, intergenerational stakes and at the same time urban functionality force us to anticipate changes in lifestyles and work patterns. These sociological changes are known: the multiplication of family models, the development of single-parent families, the need to follow a path which allows tenants to own their homes at a given point, and finally dependency. When I was elected Mayor of Strasbourg in 1989, I was committed to implementing the principle of urban equality: to ensure that all young people go to school, and before that to the nursery; for all active, retired, sedentary or mobile people, to find a response to their everyday needs in the city.
This principle of urban equality became my motto. Attentive to those with multi-disabilities, I was aware of all phases of life and its challenges: to use public transport with a pushchair without difficulty, to integrate disabled people or those experiencing visual problems. The question of employment, finally, is difficult since we know it is a real challenge to bring jobs closer to homes. On the one hand, we develop public transport from one point to another. On the other, our transport system does not reach people who have chosen to live further, outside the city, in villages with cheaper housing.

In the scope of responsibility of locally elected representatives, does one have the right tools to think out and develop tomorrow's city?

I think we need to involve people in the construction of the city, involving them at all stages of the urban projects. It is sometimes complicated, debates can be harsh, but it is essential for the emergence of shared understanding. The inhabitants have their own interests and understand how they can be combined with a set of objectives. Our responsibility is to make the city desirable. It's not that simple either to achieve the right balance between urban intensity and metropolitan functions and local services. The return of the city requires a more natural approach with consideration to biodiversity, agricultural short circuits and breathing spaces. Planning tools should help us search for the city density and loosen it in a certain way to change scale. This is true for urban time – the city 24/24 – and also for space: we no longer have the right to waste space and we must preserve friendly places.

Click back to the summary

How can urban development integrate effectively, and not only at the margins, the increasing constraints in terms of depletion of natural resources and climate pressures?

In the everyday lives of people, what I think is important, is the guarantee of ecological and sustainable mobility for all. It is an essential feature in this new organisation of urban quality which includes easy access to isolated neighbourhoods, the possibility of reducing automobile use, the development of "soft" modes of transport, the supply of suitable housing, a balance between new and renovated housing and economic development.

It is imperative that cities are recognized as a catalyst for innovation. This is evident in the implementation of a climate plan with new modes of supply, distribution and energy consumption. With the aim of reducing emissions of greenhouse gases, we must work at the neighbourhood level to find autonomous solutions for consumption and energy production.

"It is imperative that cities are recognized as a catalyst for innovation."

New buildings are not necessarily the solution, but one must not hesitate to destroy in cases when there is too much energy loss. Reducing the environmental footprint of the city should be a priority, in line with the négaWatt approach (saving power at the plug end): sobriety, efficiency, and conversion towards renewable energy. Programming urban renewal projects can integrate and combine all of these parameters.

Isn't it difficult to have a cross-cutting approach?

With the tram and the urban transport plan in the 80s and 90s, I first thought of the mobile city: how to move, connect neighbourhoods, transform the use of the city and upgrade public spaces through mobility? Today, the city must be designed with two types of networks: communication and energy networks. We must reintroduce into the city new forms of quality of life through transportation, energy and high speed broadband. This type of development helps to organise the city, improve public services and give greater accessibility, regardless of age, personal situation, physical condition or wealth.

Finally, we must project ourselves into the future. With Phosphore, I appreciated the ability to go much further in time and look for modelisations. We modelled climate risks, torrential rains, floods, heat wave periods in urban development. We have to ensure that the city adjusts to change and that it is prepared to respond with resilience through the systematic anticipation of its methods of functioning. We live in a time of great urban invention and I am delighted.

The problems posed with the objective of reducing GHG emissions but also anticipating climate risks and sociological trends, show that one does not need to see the city as an engineer. We must have the ingenuity of the assembler and master the composition of the urban project. We are now in the "organisation".

Click back to the summary

PHOSPHORE IV / GRENOBLE

Five "zooms" for an urban community

In 2010, after the third research session had started in Strasbourg, Grenoble Alpes Métropole agglomeration community called the Phosphore laboratory with a clear and ambitious goal: to help with a prospective analysis in the run up to 2030 for all the 28 municipalities, a total of 31,000 hectares and more than 400, 000 residents. With this new virtual playground, the challenges and areas of analysis were once again widely renewed for Phosphore 4.

Nestled at the foot of the Vercors, Chartreuse and Belledonne, the territory of Grenoble is characterised by a semi-humid continental climate. It sits above a sub-cropping water table, a source of drinking water of excellent quality, so its preservation calls for great caution.
This urban area, dense and very dynamic is marked by the historic presence of industry, which has developed strong links over a long time with the world of research and training. While issues such as mobility and energy require reflection at a city scale, other themes, on the contrary, are more relevant on a municipal or neighbourhood level. Within and in connection with the urban community, five study "zooms" have been selected for their concrete qualities on topics involving new ways of living and building and new modes in the areas of industrial ecology and ecological services.

With the last two zooms, Phosphore explores cases as interesting as they are complex. The laboratory examines the possibilities offered by a new neighbourhood in a mountainous area limited and dense, located in an area of medium-altitude. It addresses issues of renovation and urban densification on a zoom of Grenoble city centre, a sensitive urban area.

The three doors of entry to the city, areas prone to reflection on congestion and modal split, host the three multimodal hubs – infrastructure now indispensable – developed by Phosphore 4. One of them is in the north-west zoom in the municipality of Fontanil-Cornillon. At Domène, the north-east zoom focuses on a mixed fabric of housing and industries. Just like the first zoom, it is subject to the risk of flooding, making it the basis of a reflection on the resilience of the city, complimentary with that conducted on the Pont de Claix zoom, which hosts an important chemical platform.

The five zooms of Phosphore 4 in the Grenoble metropolitan area after virtualisation © EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

Click back to the summary

"A new urban culture"


© Thomas Sanson - mairie de Bordeaux

Alain Juppé is the Mayor of Bordeaux and former Prime Minister.

In your view, what will the city look like in 2030? Or should we rather ask what will the "homo urbanus" look like in 2030?

The city of Bordeaux in 2030? It will finally occupy its entire territory, with the development of 600 hectares of mutable land available, along what I call the arc of sustainable development in the city, which has enabled the construction of nearly 50,000 homes in order to host 100,000 additional inhabitants which Bordeaux can and must accommodate. It can do so without excessive heights or densities, it must, if Bordeaux wants to become a millionaire metropolis and figure in the list of European competitive cities in the globalised world. But the city and city life are not just a matter of numbers. The "homo urbanus" in Bordeaux in 2030 is without doubt definitively urban. This means to me that he has cut ties with his rural origins or semi-urban habits. He will, without doubt, not have two cars but one, or none at all. In this case he will rent a car for long journeys, and use public transport or the equivalent to "Autolib'" in Bordeaux. That is why I welcome the proposal that Vincent Bolloré just made to me, to implement in Bordeaux, that, which works beautifully in Paris.
The Bordeaux resident will stay in Bordeaux at the weekend in 2030 – this is what he will have been doing in recent years – because here he will find all that is necessary for his personal development and his family in terms of culture, entertainment, shopping and walking. In short, he can breathe freely in Bordeaux. In 2030, Bordeaux residents will, at least I hope, be in perfect harmony with the city, in the sense that they will have proactively participated in its transformations, there will have been proactive participation. They will be the first ambassadors of the city. Beyond the tangible transformations of Bordeaux, they will give the city its tone, style and dynamism. We must never forget that the local authority can only create the conditions for the development of a city. It is the people and the broad spectrum of players in the city that do all the rest, that is to say a lot.

How can urban planning integrate effectively, not only in the margins, the increasing constraints in terms of resource depletion and climatic pressures?

In this time of urban development, our first priority is to develop "good mobility". It is no longer possible to slow down mobility because it is the hallmark of our society and very often a condition of gaining training and employment. Virtual mobility cannot completely respond to everything. The issue of public transit, in Bordeaux, is a constant preoccupation. But it has evolved a lot over the past ten years, and the answer to the imperative demands of mobility is no longer just the tram. We take it for granted, but mobility is now multimodal: it must be closely tied to municipal policy with respect to local facilities, it must be integrated within the city's urban project, it must go far beyond just quantitative analyses. The second objective relates to the use of renewable energies. It is the main challenge for the years to come, even greater if we create entire neighbourhoods from scratch. In Ginko, a new neighbourhood in the north of the city, a wood boiler allows it to function with 30% renewable energy. Closer to the centre, the district of "Bassins à flot" will have 70% renewable energy. Future districts will be claiming that they are energy autonomous.
This is, of course, a goal to achieve. We are all aware of the difficulties. Already, the City has constructed a solar farm that provides 50% of municipal spending on public lighting. The third objective concerns obviously the field of construction. There are important developments in this context. All our buildings are now low-energy buildings and our future city municipal building will be energy-positive. Companies and project managers make continuous and laudable efforts although much remains to be done. The role of the local authority is fundamental, whether in its urban planning, or in the objectives it sets in the design of future neighbourhoods – in terms of accessibility, proximity and density to centres of employment, etc. – and of course it must exercise control because, let's not delude ourselves: spontaneously virtuous behaviour is rare.

Within elected local representatives' scope of responsibility, do they have the necessary tools to think about and achieve this city of the future? In particular, how to enhance the global and systemic approach in a context of legal, financial, technical compartmentalisation of orders?

I am not convinced that specific tools are required to think of the city of tomorrow. Of course, the complexity and the inextricable web of laws, regulations, standards of all kinds are a drag, sometimes exasperating. But I still believe that, in the field of urban development

Click back to the summary

projects the intuitive vision we have of a city we love, reinforced by an urban project and driven by a persistent, continuous and strong political desire, can counteract the delays and everything that contributes to paralysing urban development policies, too often in France. Let's be optimistic. In Bordeaux, I think we'll have in the coming years a less rigid local urban plan, open to urban development. And our urban planning experience of the "Bassins à flot" district, unique in France – which for the first time in our country has been fully negotiated with funders and developers – opens the door, I hope, to a new urban culture.

Is it utopian to want to offer a lifestyle that can adapt to rapidly changing lifestyles, work, production and consumption? What do you think is the desirable temporality in urban development?

Mutations are now so fast that the first answer that comes to mind is of course negative. The digital revolution is undoubtedly in its infancy and it's the same, therefore, for the cultural revolution that goes with it. But human nature is immutable and basic human needs change very little: they are focused on security, education, housing, health and employment. The urban revolution, these last two centuries, information development, knowledge sharing, the continuous rise in the standard of living in Western countries, have forced public policy-makers to address what have become the requirements of the residents: culture, nature in the city, sport, leisure.

It is partly to meet all of these needs that I proposed to the inhabitants of Bordeaux a third urban project entitled "Towards Bordeaux 2030: from the crescent moon to full moon." Bordeaux full moon means that, for the first time in its history, Bordeaux will be built on both sides, thus drawing the shape of a full moon, but a moon whose centre is occupied by a vast natural area consisting of a river and its banks, and thus offering 10 kilometres of promenade and gardens. With an immense, real route to fitness in the town centre, it is surrounded by five major facilities of collective interest, in the fields of sport and culture. These are: the new stadium and the Centre of Wine Civilizations to the north, the Rocher de Palmer cultural centre at the east, the MECA which will bring together FRAC (regional contemporary art collection) and cultural agencies in the region to the south, and the Floirac future concert hall at the end of the Jean-Jacques Bosc bridge. We will then be in 2030, that is to say, tomorrow.

Beyond that, I confess, it is really difficult to predict investment or facilities to respond to changes in society.

In Europe, our population is stabilising, but is growing older, with high inequality in terms of ageing, between the retired hyperactive and the elderly with frail motor or cognitive autonomy. How can elected representatives integrate these sociological changes with their very unequal societal translations?

The ageing population is a subject much talked about, feared by everyone, but which is very inadequately addressed by public policies. It obviously affects firstly the issues of mobility and is thereby linked to questions we must resolve on disability: access for all to public buildings, public transport and shops. We are working on this. The housing issue is much more complex because it is multifaceted. The category "old" does not exist. There are people more or less old, more or less able to, more or less dependent. We must therefore try to offer ergonomic housing of course, but avoid putting together people who do not necessarily want to, we are far from that, living together simply because they belong to the same age group.

From this point of view, I am following carefully the intergenerational themed projects being created by the social enterprise Logévie, one of whose characteristics is to ensure that the landing area becomes a meeting place. Staying home when you get older is, as we know, the best treatment against the effects of ageing. Yet it must be made possible economically speaking. Therefore one must innovate by using all the tools at our disposal.

I hope that our future local urban plan allows owners to build houses at the bottom of the plot or small studio apartments which will be an additional income and which will, if necessary, allow the person becoming older and less financially comfortable to leave a house becoming too large and too expensive for a smaller home without actually moving. Similarly, the new housing developments with a double landing door can allow a household to offer an aging parent to live close-by while protecting individual privacy. Developers and architects have an important role to play in helping us to address all these issues with serenity and pragmatism.

Bordeaux has an active senior policy, ensuring the implementation of versatile homes able to accommodate for a variety of activities in each district. The city has developed a senior card with multiple cultural benefits and offers a range of local senior residences or sheltered retirement homes, ensuring a balance between the types of homes. We all know the average amount of a pension in France and the difficulty many people becoming dependent have in finding a property corresponding to their financial possibilities.

This major project is only in its infancy. It is certainly a key challenge for the coming decades.

Click back to the summary

Click back to the summary

SECTION 02 / CHALLENGES

"SUSTAINABLE CITY" CONCEPT SEEKS PRACTICAL SOLUTIONS

He who says "needs assessment" says "search for solutions".

The organisational or technical proposals presented have all been studied in the light of multiple and interconnected criteria such as the carbon footprint, the pressure on natural resources, the adequacy of responses to changing lifestyles and work and the potential reversibility in cases of change of use.

This 360° analysis has sometimes undermined certain areas of work, or, on the contrary, has validated others. Also, the proposed solutions are drawn from a range of possibilities, without claiming to be exhaustive, or exclusive.

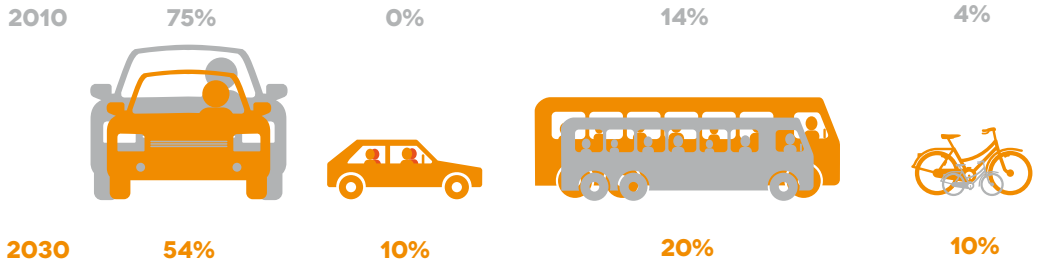
Their application is equally diverse: it may be immediate or on the contrary it may require further development work. Thus, "Phosphorescences" – the technical solutions from the Phosphore laboratory – have already been integrated into Eiffage's projects.

Exposed in dedicated focus reports, the already operational Phosphorescences shed light on the importance of the prospective method, essential to our understanding of the current city.

Click back to the summary

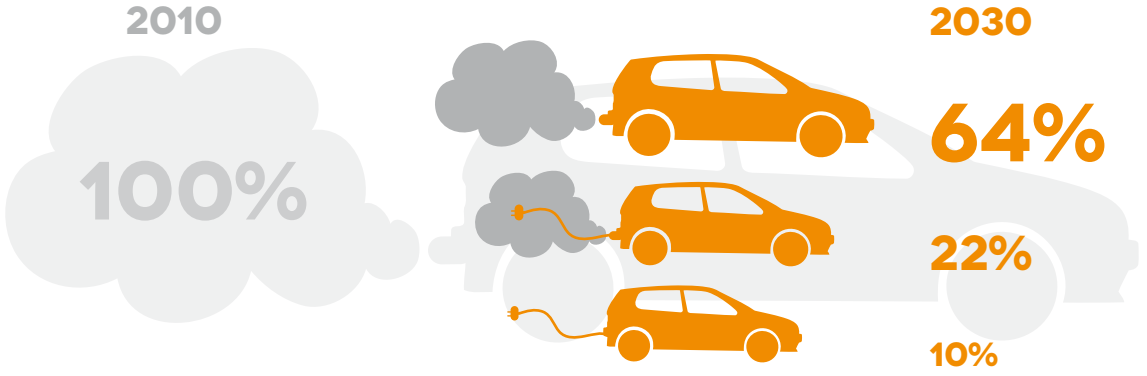
TRANSPORT: LESS INDIVIDUAL VEHICLES, MORE CAR-SHARING

In France, between 2010 and 2030, the proportion of individual vehicles will decrease from 75 to 54%, whereas car-sharing in urban areas will increase from 0 to 10%. (ADEME)



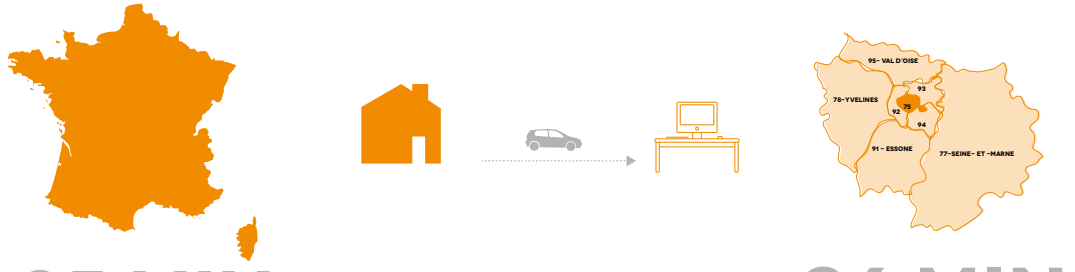
USE OF COMBUSTION ENGINES IN DECLINE (BUT TOO SLOWLY)

In 2030, combustion engine systems will be used in 64% of vehicles as opposed to almost the entirety in 2010. (ADEME)



COMMUTING DISTANCE "WORK-HOME" IN QUESTION

In France, one active person in five is not satisfied with their commuting time from work-home. Amongst them, three quarters are willing to re-consider their job in order to reduce their commuting time. (IFOP for *Métro*, feb. 2013)



25 MIN

36 MIN

Click back to the summary

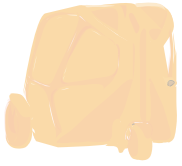
ECOMOBILITY

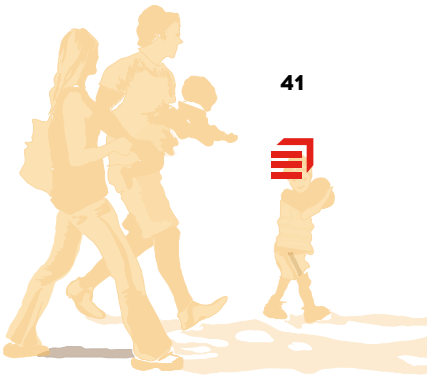
Gateway to the sustainable city

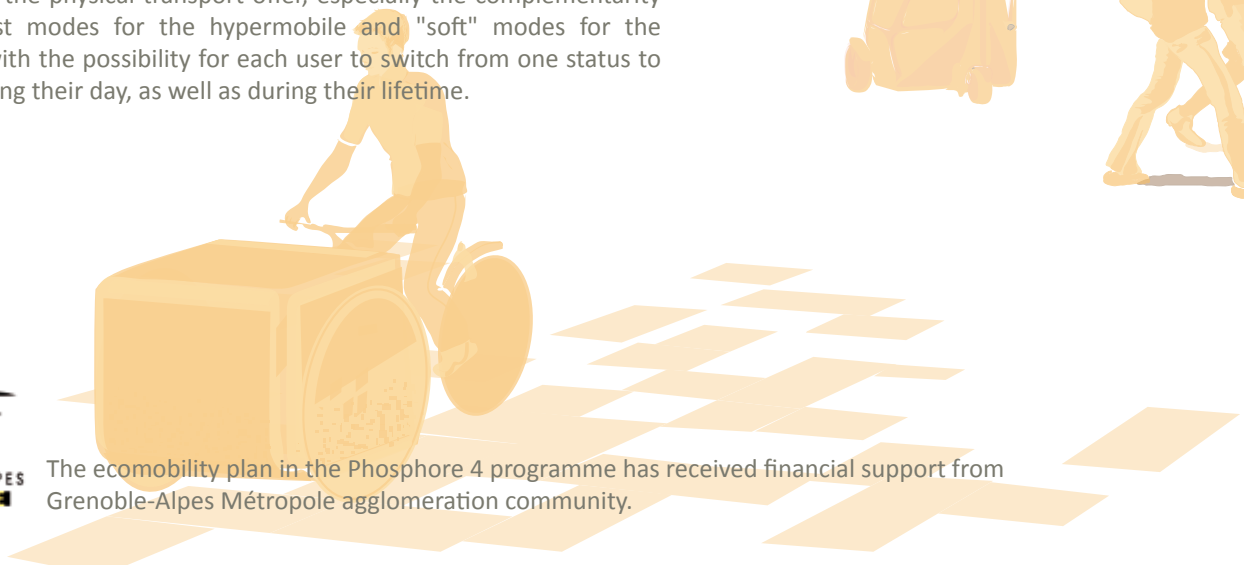
In modern societies, time has established itself as a limited resource, rare and precious, not producible and non-storable. Time management means, and will mean even more tomorrow, being able to control the mobility offer, whether physical or virtual through new information technologies.

Now a cultural fact, mobility is no longer marginal, or secondary in lifestyles: it is now central and could well become a lifestyle in itself. It is a relation to time and a harmonious space which determines the participation of all individuals in and for the society, to the point that immobility is now an exclusion factor. The evolution of mobility in the coming decade is indeed at the heart of social cohesion issues: integration, better employability, facilitated access to education, culture and recreation.

During its work on ecomobility, Phosphore has always pursued a triple objective. To control the negative externalities that conventional carbon mobility has engendered: pollution, congestion, degradation of building space and urban sprawl. To think about the attractiveness of modal shift, especially by applying a distance scale, "300 metres by foot", and beyond that by systematically offering clean forms of transport. To boost the efficiency of the physical transport offer, especially the complementarity between fast modes for the hypermobile and "soft" modes for the sedentary, with the possibility for each user to switch from one status to another during their day, as well as during their lifetime.







The ecomobility plan in the Phosphore 4 programme has received financial support from Grenoble-Alpes Métropole agglomeration community.

Click back to the summary

The multimodal hub
of Phosphore 2
in interior view
© EIFFAGE Sustainable
Development Department /
3e-oeil.com studio /
Pierre Gautier architecture

Click back to the summary

ECOMOBILITY / DECONGESTING THE CITY

Urban expansion and the explosion of individual mobility have resulted in traffic congestion in city centres with effects on the environment and the health of citizens. This phenomenon has its origin in the limited capacity of the infrastructure, now outdated, and in a culture that promotes the use of the personal vehicle – seen as an extension of private property or social status. As with all complex problems, the search for solutions is a communal issue and should respect the land engineering plans of the territory concerned. Phosphore proposes a duo consisting of a multimodal hub and a universal hall (p. 47) to deliver ecomobility solutions in the post-carbon city.

MULTIMODAL HUBS

Filters, logistics platforms and low-carbon mobility nodes

Traffic congestion occurs mainly in city centres where, in centralised urban design, most of the transport infrastructure is found. It is therefore very tempting to concentrate the modal shift on these restricted areas. Phosphore nevertheless considers that congestion must be addressed upstream, where flows are still clearly identified and easy to capture. Thus, throughout the various work sessions undertaken by the laboratory, the multimodal hubs have emerged as a core element for ecomobility.

The key to their effectiveness lies primarily in their strategic location. In the immediate vicinity of city centres, they are not attractive because they are too close to the final destination for motorists. Too far from the peri-urban fringe, they are no longer in contact with capacitive transport networks. In both cases they are reduced to mere parking facilities. To fulfil their primary function of modal shift multifunctional infrastructure, they must occupy the interface between urban and suburban areas, at the crossroads of major communication and transportation networks that serve city centres massively.

Multimodal hubs also have a logistical function of transporting goods to cities. Now free to mingle with local traffic, goods vehicles entering the heart of the cities participate actively in their urban congestion. To organise a last mile logistics rational and less emissive, freight transport is also subject to breaking loads and differentiated modal shift depending on the volume and the nature of goods. Multimodal hubs are designed as real gateways to post-carbon cities for people as well as for goods.

The morphology and functionality of multimodal hubs need to be adaptive. They must take into account the inherent speficities of the area served, the roads covered and the characteristics of the fleet concerned.

Click back to the summary

In the district of Arenc in Marseilles, the envisioned multimodal hub in Phosphore 1 and 2 is located at the junction between the end of the entering motorway and the sea to serve the cabotage infrastructure. In the virtual exercise in Phosphore 3 in Strasbourg, the presence of several radial motorways, a train freight platform and the TGV railway station led the laboratory to duplicate the multimodal hub by dissociating the "people" and "goods" functions.

Equally unique, the territory analysed in Grenoble by Phosphore 4 is dominated by the presence of three alpine mountains encircling the metropolitan area. The resulting "Y-shaped" configuration is a major constraint and one of the causes of traffic congestion in the hyper-centre. In this particular case, Phosphore proposes to combine two solutions: firstly, three multimodal hubs positioned at each gateway to the centre, secondly, a tangent road in place of the left lane of the urban motorways.
Hubs intercept vehicles from the entering motorways and goods circulating on rail routes before they intersect in the heart of the city, offering high capacity logistics and parking. They are directly connected to low-emission transport networks or "soft" modes: TER (regional train), urban cable transportation, tram, bicycles and car-sharing electric vehicles, etc. They are intended to make life easier for modal shift users and for those who live or work nearby. They offer a range of complete and efficient public and private services: convenient shops, goods collection points, co-working multimedia spaces, etc.

As is also the case in other cities, the motorway network of the Grenoble metropolitan area accumulates traffic flow: collection and distribution of vehicles to and within the centre, bypass routes from periphery to periphery and more or less long distance transit. The combination of these functions, whose origins, destinations, speeds and motivations are divergent and even conflicting, participates unquestionably to the congestion of the existing network. In view of the negative perceptions of today's situation, the Phosphore laboratory offers to reconfigure and reallocate the existing routes.

Located on the left, the tangent road collects and directs all flows: flows out of the agglomeration, flow through the periphery to periphery and the public transport flows. This creates a traffic "vacuum" from each multimodal hub, channelling the vehicles towards a unique exit and improving traffic fluidity. The speed on this dedicated exit lane is limited to 70 km/h. Vehicles have access to it through evenly set entry points on the linear because it is physically separated from the rest of the infrastructure which has been converted into an urban boulevard circulating at 50 km/h.

View of exterior of Phosphore 3 and 4 multimodal hubs in Strasbourg and the Grenoble metropolitan area © EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture © EIFFAGE / Grenoble-Alpes Métropole City / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

Click back to the summary

Click back to the summary

THE UNIVERSAL HALLS

The Second key element of ecomobility facilities is the universal hall, a multifunctional facility that acts as a local relay station in the decongestion scheme put in place at the gateways to the city through multimodal hubs.

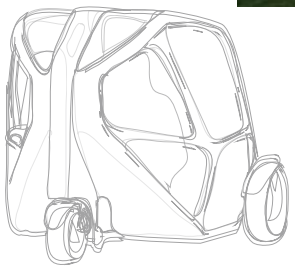
Thus, the universal halls are located on a distance scale designed to offer low-carbon mobility and urban services always accessible within a five minute walk. They operate as a network of public transport relay stations – trams, buses, urban transport including cable – and are used to guide pedestrians and cyclists alike for the final stage of their journey. With reference to the traditional village halls, the universal halls represent new radiating centralities which bring diversity and vitality to neighbourhoods.

These venues are strategically located at the nodes of urban communication attracting many urban or suburban citizens in daily transit. Significant attendance makes it possible to offer, as in multimodal hubs, but on a smaller scale, a common core of shops and public and private services related to education, health, sport or culture – post office, nursery, medical centre, library, internet cafe or meeting room rental. Depending on their location, these basic services may be supplemented by a specific offer which then gives the universal hall a dominant function, as is the case for the "recycling hall" (p. 106), the "market garden hall" (p. 110) and the "relay-hall" (p.111).

The universal halls are also an essential link in the distribution of goods and waste transportation in the city centre. Their network does not only benefit travellers, as each hall ensures collection and delivery of freight and waste in its catchment area. The intensification in the use of existing means of transport, and even more so their substitution by low emission modes of transport or vehicles – as is the case of urban cable transportation lines – thus allows for efficient and clean logistics from multimodal hubs directly to the universal halls, which optimises the last mile management. The continual intersections of goods and passengers in the universal halls is particularly suited to power a set of counters for the deposit and withdrawal of packages as an alternative to home delivery in anticipation of the growth of e-commerce.

View of exterior and interior of the universal hall Phosphore 2 at Marseilles © EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary



Urban cable transportation of Phosphore 4 in the metropolitan area of Grenoble © EIFFAGE / Grenoble-Alpes Métropole / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

ECOMOBILITY / MAKING MODAL SHIFT MORE ATTRACTIVE

If multimodal hubs and universal halls have been designed as powerful levers of urban decongestion, they will fully fulfil their role if the public transport and "soft" mobility networks associated with them are themselves attractive, capacitive and widely deployed.
Thus, the modes of public transport – trams, urban cable transportation, buses offering a high level of service, car-sharing – and the vehicles of the future – Modul'Air® (p. 53), electrical modulo (p. 54), delivery tricycles – designed by the Phosphore laboratory, all contribute to this goal: to enhance the attractiveness of modal shift.

In collaboration with the company POMA (Isère, France), the fourth session of the Phosphore laboratory has envisioned the future of urban cable transportation. While it is historically associated with ski resorts, its urban use does not yet have a true acculturation in France, unlike other countries where it has already been widely tested.

Phosphore's work then endeavoured to demonstrate the ability of cable transportation to supplement the existing supply of transport, including tram and bus, by answering two types of needs. Urban cable transportation can be used to extend, by the cable, transport infrastructure on the ground like a tramline, which represents significant investment. For some sectors which are today under-served or excluded from mobility perimeters, it can be a quick solution to implement and less expensive. Installed on the median strip of an ordinary street, it can also "double" modes of ground transportation and intensify the use of land already used by individual mobility.

The opportunities offered by urban cable transportation go far beyond the mere service of transporting people. Its air travelling system makes it fully compatible with the existing networks. It can carry up to 5,000 passengers per hour, and also carry, in dense urban areas, goods and waste in cabins designed for this purpose. Optimisation of operating timeslots results in making this new infrastructure even more efficient.

On the environmental side, the picture is attractive. Propulsion power does not emit any pollutants and preserves the quality of the air. The equipment is composed of 98% recyclable materials. The ground space needed frees acres of urban land, offering many opportunities for urban development such as the implementation of dedicated bicycle paths, or the application of a voluntary policy of soil restoration – the first step towards the introduction of future urban greenways. Whether technical, social or environmental, the intrinsic qualities of urban cable transportation explored by the Phosphore laboratory coincide fully with the growing needs of shared, sober and effective mobility.

Click back to the summary

"Cable transportation is the link!"

With its reintroduction, cable transportation has become a preferred solution to meet the challenges of sustainable mobility in the city.

© POMA

Jean Souchal is CEO of POMA.

What are the advantages of urban cable transportation compared to other solutions of public urban transport?

Cable transportation is an old solution which, like the tram in the 90s, has made a comeback in our cities since the 2000s. Specifically, this solution was reintroduced in South America. It returns to us today because it is obviously economical and urban. Transport by cable adapts to any geographical context, its cost is low and it is quick to implement. It symbolically connects different parts of the urban territory, it connects populations which live there and it naturally complements existing infrastructures.

Is there a South American specificity for AirMetro?

In Medellin or in Rio, this mode of air transport has been implemented in large urban renewal projects where the issue of services to residents was not limited to mobility. These operations addressed the themes of public safety, social and education services and living conditions in general. In Rio, the cable represents about 10% of the total investment in the Alemão district. Air transport, by its visibility, connects the city to its residents. This societal and social component is fundamental more than the cabins themselves! The cable is the link, and not just in Colombia or Brazil.

Is cable transportation a preferred solution for our Western cities today?

Needs are specific to each country, but the issues are very similar. We must consider mobility in our cities: how to move from one point to another, from one mode of transport to another with multiple motivations – leisure, work – without generating more congestion, environmental pollution at a reasonable cost? We have more and more difficulty to finance new tram or metro lines. We must seek other multimodal solutions specific to each area: the funicular in Grasse – ground cable transportation system – to connect the station to the historical centre, the aerial tramway in New York to link Roosevelt Island to Manhattan, or the urban gondola cableway in Nizhny Novgorod, Russia to cross the Volga are responses to these issues. The future of our cities requires these more eco-responsible not only for environmental purposes but also at an economic level with a high return on investment.

Do you consider yourself as a player of the sustainable city?

We participate in the Phosphore laboratory's project on the city of tomorrow. We appreciate their openness and reflection in the medium and long term. From our perspective, we are only at the beginning of a revival on a global level with the emergence of "soft" transport developed by our company. There is a real demand from megacities which will intensify and from Grenoble, we are responding to it!

Click back to the summary

IT'S NOW
COMPLEXO DO ALEMÃO

POMA creates the longest urban cable car in the world

Opening up no less than six suburban areas in Rio de Janeiro, located on the hills, by connecting them to the public transport networks of the city centre: such was the aim of this huge and pioneering undertaking. After New York, Taipei and Medellin, Rio opted for the low impact environmental aerial tramway proposed by POMA. The cabins are synchronised and autonomous thanks to solar panels which power the interior lighting and radio-communication. Some key figures: 3.5 km of line connected to the urban rail network, with a capacity of 2,880 passengers per hour and per direction, 6 stations, 152 cabins, average speed of 5 m/s.

Commissioned in the summer of 2011, the Alemão urban cable transportation has profoundly changed the social representation of northern Rio and contributed to the dynamism of the Favelas. Jorge Mario Jáuregui, Argentinian architect and urban planner based in Rio, bears witness to the transformation of the neighbourhood of Alemão over a few months.

What are the peculiarities of the Brazilian city?
The South American city is divided. On the one hand, you find a formal and organised part, on the other, informal spaces representing at least 30% of the city. In Rio, these territories are located at high altitudes. The people living in these areas suffer from lack of urban structures and facilities. This reality generates accessibility problems that lead to many pitfalls: insecurity, discrimination and poverty.

What are the tools available to us to think of the city of tomorrow?
We lack concepts and method. We therefore must develop some to address these issues and project ourselves. The urban challenge is to connect these fragments to better articulate the various pieces of the city and the lifestyles of its inhabitants.

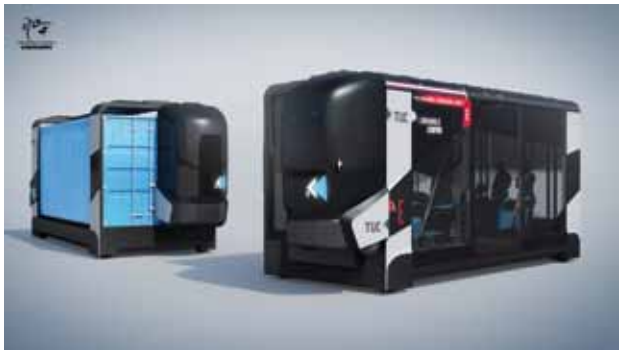
VIEW FROM RIO INTERNATIONAL AIRPORT (NEW ARRIVAL) LOCALIZING COMPLEXO DO ALEMÃO IN THE LANDSCAPE

We must look at the territory by understanding its flows, its shortcomings, by listening to the needs of the residents. Taking into account the social dynamics is at the heart of these new centralities that we put into place. They mainly relate to the connections with the environment and accessibility conditions.

How urban cable transportation embodies the transformation of this area?
Urban cable transportation has allowed the most inaccessible places to become accessible! We were looking for a mode of mass transportation that did not exist in this city or in our country. The pioneering experience of Medellín, Colombia, helped us to project ourselves. Today, the decision to implement urban cable transportation seems most appropriate. It was very well accepted by the local people who live in the heart of the favela and the surrounding area. The nature of the place was reversed and this development is now visible to all, even from the international airport of Rio. Alemão is no longer secluded and hidden. It has become a place to visit, an attraction to other Cariocas. Urban cable transportation and its accompanying projects – vocational school, shopping centre, hospital, public lighting, etc. – today symbolise the success of this repossession of the city by its residents.

The aerial tramway of Rio produced by POMA ©POMA

Click back to the summary



Click back to the summary

THE MODUL'AIR®

Or how to offer users a transparent breaking load change?

The growing attractiveness of public transport, notably trams, largely due to the ergonomic and aesthetic qualities of the rolling stock, does not overcome all reservations relating to poor recurrent connections or modal breaks, real or alleged, imposed on their users. This observation is also valid for urban logistics and the last mile management, where the breaking load change should be avoided because it is a large contributor to traffic congestion in the city.

Phosphore teams, in association with POMA and Dassault Systèmes have therefore worked on this obstacle to the attractiveness of public transportation by pushing the technology of cable transportation further, in its plausible evolution leading up to 2030, with regard to the necessary intensification of use of existing infrastructures. The result is called Modul'Air®, an innovation in public transport, where it is the vehicle that is subjected to where the load change is imposed on the vehicle and no longer the user.

As a result of a functional design, two versions of the Modul'Air® are available. A public transport cabin able to receive up to 35 passengers, complying with the rules of ergonomy and optimal comfort, combined with digital technology, and a cabin dedicated to freight or waste. It is all about how to provide users with a transparent load change.

The scenario is as follows: the Modul'Air® runs on a line of urban cable transportation. Ultimately, it is released from the cable to connect to the existing tram network, behaving as a non-motorised trailer.
Whether it is suspended from the cable, taxiing and provided with a driving module assembled with other cabins in the form of a Modul'Air® "train" or towed by an external driving force such as an external tram, the vehicle is designed to be compatible with other modes of public transportation, seamless and transparent for its occupants.

The Modul'Air® of Phosphore 4 in the Grenoble metropolitan area, view of interior and in passenger or freight versions
© EIFFAGE / Grenoble-Alpes Métropole / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

MODULOS AND BIKES OF THE FUTURE

When ecomobility meets design

With the idea of making ecomobility more attractive, Phosphore teams have developed, in partnership with the Strate College Design, the modulo, an electric, modular and non-polluting vehicle, with a view to reducing the number of powered vehicles by optimising its use, at any time of the day. Depending on the needs, the cabin and its arched-supports can be equipped with a passenger module, goods container, waste skip or even mobile facilities for mobile shops.

In the same spirit of modularity, the delivery bike of the future was designed to carry light goods in a removable box. The flexibility it brings to its users multiplies the possible uses and makes it extremely useful, especially in view of the implementation of centralised delivery points for parcels addressed to individuals in the universal halls.

Electrical modulos of Phosphore 2 in Marseilles

Click back to the summary

IT'S NOW
MODAL SHIFT ON THE GREEN-ER CAMPUS

In the future university campus called GreEn-ER (p. 78), an operation won by Eiffage under the Campus Plan, the modal shift incentive is accompanied by a genuine offer of alternative modes of transportation instead of the individual carbon vehicle, in line with the High Quality of Life® reference system from Phosphore.

Ideally located in front of a tram stop opposite the mobility centre of Grenoble's Presqu'île, GreEn-ER will welcome some 2,000 people who will be offered 600 bicycle spaces sheltered by solar-powered shade structures inside the school grounds.

The future building of GreEn-ER in progress by Eiffage © Groupe6 / Jacobs / EGIS

Click back to the summary

Distance scale

Click back to the summary

ECOMOBILITY / IN THE CONTEXT OF HIGH QUALITY OF LIFE®

High Quality of Life® developed by the Phosphore laboratory, can be adapted to the scale of a building or a neighbourhood block. It also defines a set of guiding principles applicable to ecomobility. Thus, in respect of the right to a so called slow mobility, calm and physically disconnected from the existing roads, the inter-neighbourhood plan and the Urbanbridge® constitute the keystones of the HQLife® mobility reference.

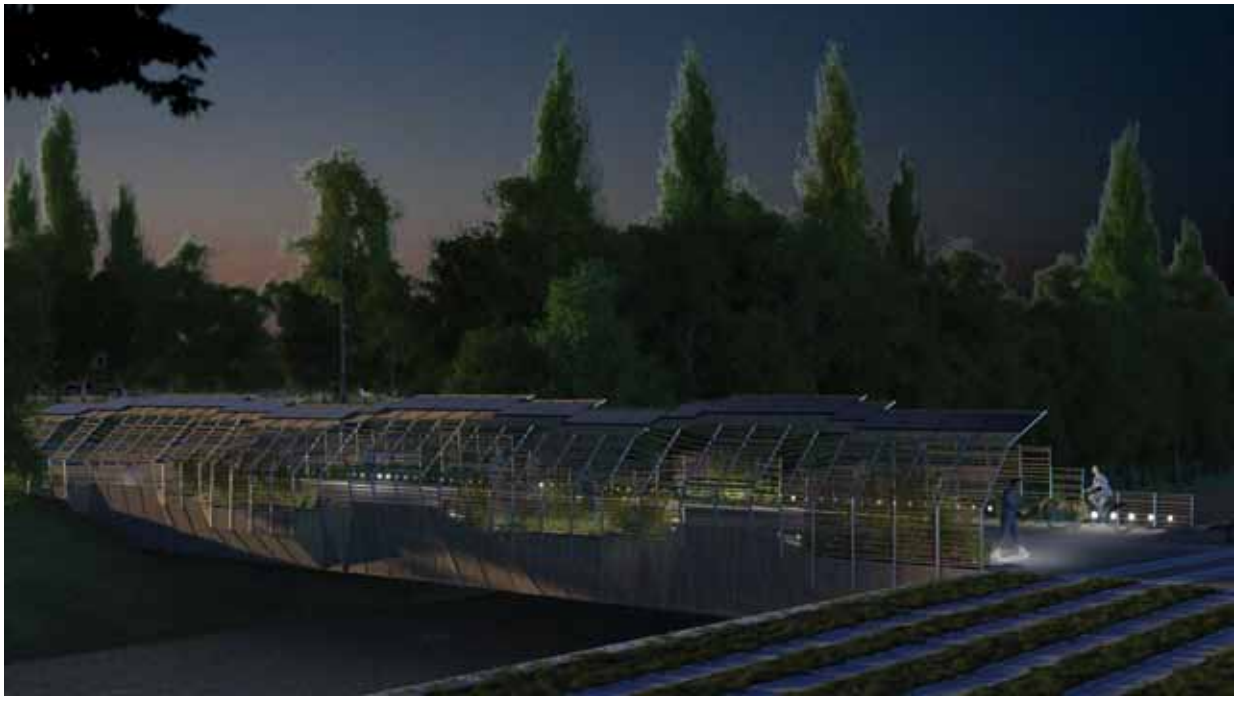
After thinking in terms of scales and distances and promoting soft and diffuse mobility, the Phosphore teams have defined a multimodal transport infrastructure, the inter-neighbourhood plan, which follows paths organized around the central points, which are the universal halls.

The inter-neighbourhood plan combines on the same ground space pedestrian paths, cycle paths and exercise paths, a cable transportation line on the ground, electrical buses with a high level of services and a green corridor. The aim is to provide, within a width of less than 10 metres, several modes of "soft" and clean transport which can co-habit without intersecting and are in all cases given priority over others. The land use can perhaps be intensified by the installation of a multi-network underground gallery. This solution makes sense as the Phosphore laboratory plans to have a multiplication of urban thermal networks and smart grids under the concept of Energy Solidarity®.

At a city scale, the inter-neighbourhood plans ensure landscape continuity with overall visibility of the whole territory through all-weather roads, identifiable to all. At a finer scale, the inter-neighbourhood plan recreates a physical link between sectors that may be close, yet ignore each other. It encourages the connections between neighbourhoods by creating contextual mobility links.

The inter-neighbourhood plan of Phosphore 2 Marseilles © EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary



Click back to the summary

THE URBANBRIDGE®

In response to the growing demand for multiple forms of mobility in the city, Phosphore proposes to multiply soft routes whose concept is borrowed from the international movement "Slow Cities"[1].

Combining the know-how of Eiffage Métal, Eiffage Énergie and Eiffage Travaux Publics, the Urbanbridge® is a quick-assembly modular bridge allowing multiple crossing points dedicated to the safety of pedestrians and cyclists.

This urban version of the Unibridge®, is a metal bridge structure made of factory prefabricated boxes, assembled on site in less than 72 hours. Due to the simplicity and stealth of the assembly operations these structures are meant to be inserted into urban areas, to facilitate the crossing of an artificial or natural barrier or temporarily absorb traffic generated by a one-time event. The Urbanbridge® encourages a modal shift towards silent and non-polluting active journeys. This also helps to strengthen the supply of low-carbon mobility in rapidly changing and dense cities.

With the comeback of "soft" mobility and urban densification, the Urbanbridge® represents a flexible, safe and reversible solution, being already developed within Eiffage.

The Urbanbridge® is eco-designed and uses renewable energy and materials. Its steel structure is partially recycled, but totally recyclable. Its coating is a plant-based binder mix Biophalt® which reduces the carbon impact of the equipment. Just like its geometrically variable wooden coating which provides shade during the day and supports photovoltaic cells covering the energy needs of the LED markings at night. In compliance with the principles of sensible public lighting, the system facilitates the autonomy and energy efficiency of the equipment. Finally, the use of wooden urban furniture and vegetation in parapets contribute to the integration of the project in the local environment.

The Urbanbridge® of Phosphore 3 at Strasbourg (day and night)
© EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

1 The label "Slow Cities" ("Cittaslow") is open to towns of less than 60,000 inhabitants that undertake to adopt coercive measures towards human urban planning.

Click back to the summary

IT'S NOW PHOSPHORESCENCE AS A PROTOTYPE

The Unibridge® is a metal modular bridge, which is quickly assembled, developed as part of a joint project between Eiffage and the company Matière. Dedicated to the emergency repair of roads destroyed as a result of natural disasters or armed conflict, it is entirely made in France. Since 2009 the Fos-sur-Mer plant, located in the Bouches-du-Rhône French département, has produced 350 bridges, more than 1,800 boxes and 22,000 tons of steel, all destined for export.

Based on the specifications provided by the Phosphore laboratory, a full-sized prototype of the Urbanbridge® is currently being manufactured by the Eiffage teams, as an urban version of the Unibridge®. Equipped with higher and more covered side cladding, with benches and side pots for vegetation, it has, in place of steel decks, wooden panels and grills which support solar panels on the upper side.

In the process of being finalised, the prototype has brought together, in addition to the Phosphore laboratory, a multidisciplinary team: Eiffage Construction Métallique in Fos-sur-Mer for the structure, Eiffel Industrie Provence for the parapets and Eiffage Énergie Marseille for the photovoltaic and lighting installation.

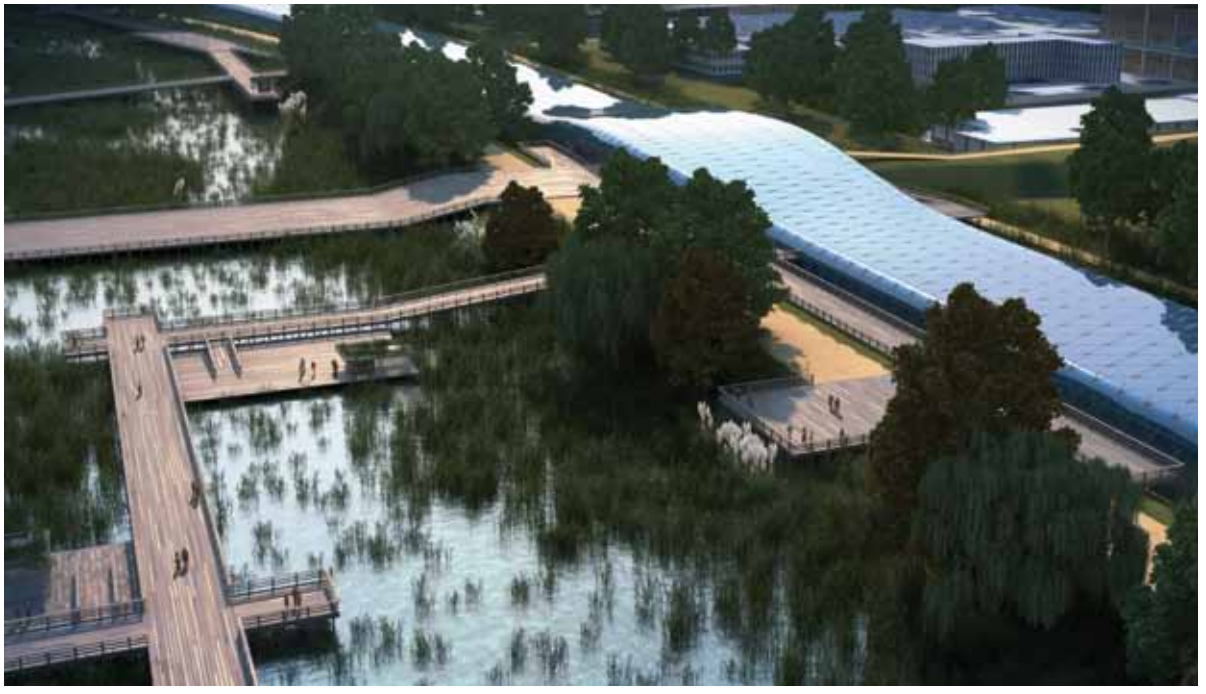
The Urbanbridge® prototype in construction at Fos-sur-Mer © Eiffage Metal library

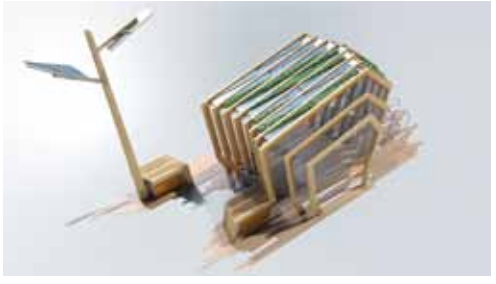
Click back to the summary

Beyond the necessity to reduce the source of its energy needs, the post-carbon city will have to diversify its local supply channels and seize every opportunity to produce renewable energies, particularly by increasing the use of areas already artificialised.

To do so, micro-deposits will play an important role, especially if they provide autonomy for the schemes concerned. This could be, for example, the energisation of the Modul'Air® with photovoltaic panels – already tried by POMA in Rio de Janeiro – and street furniture, to cover their own needs for lighting and radio-communication. It could also be the recovery of gravity energy on certain urban cable lines used on steep slopes with a lot of commuter flows.

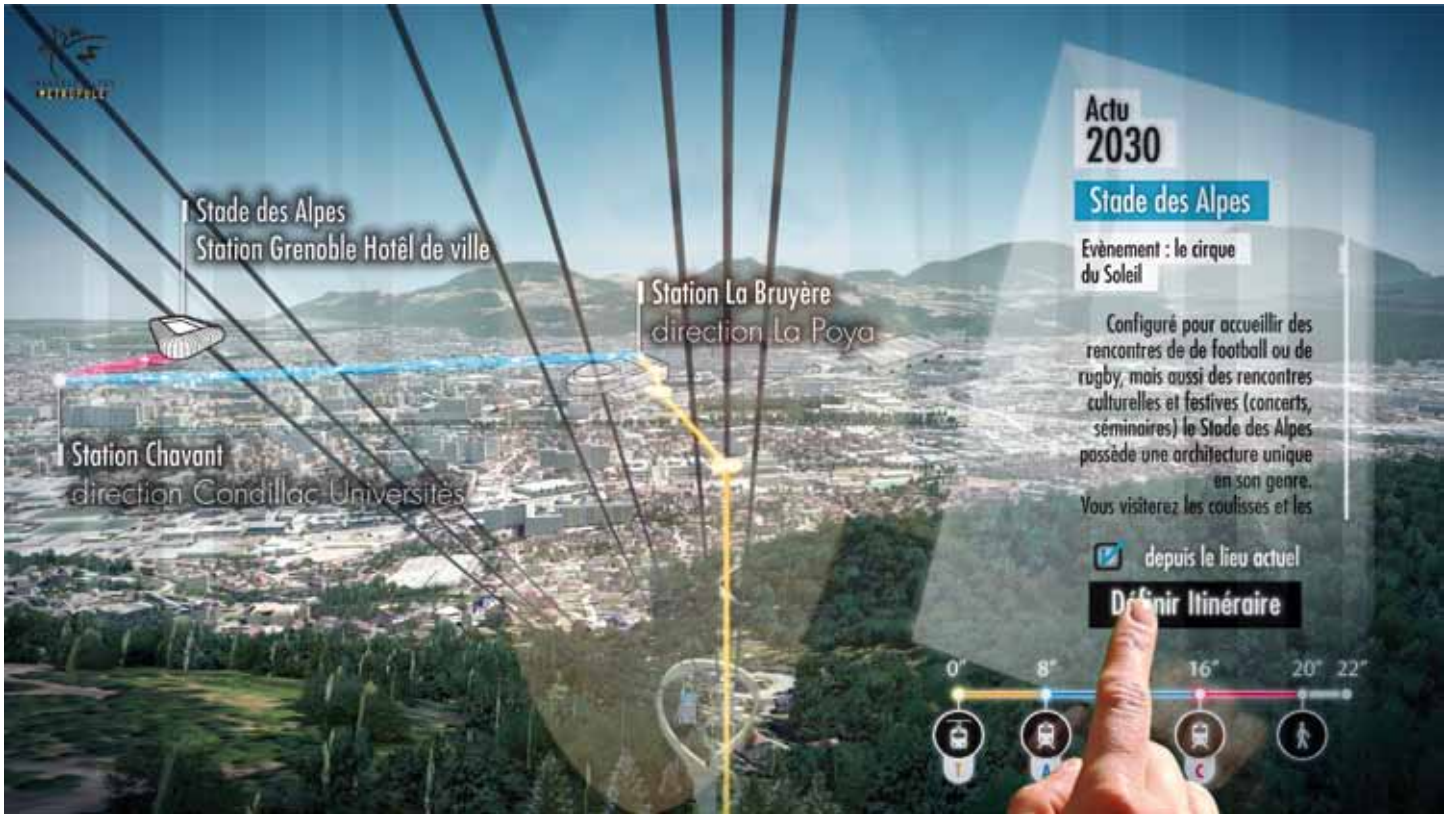
On a completely different scale, the covering of parts of urban highways with photovoltaic panels, which represents hundreds of thousands of square metres of land that could be allocated for other purposes, constitutes a huge potential for electrical production that will combine energy benefits, reduced visual and noise pollution, inherent to road traffic – even if it becomes predominantly electric. The batteries of electric vehicles stationed in hubs will also contribute to the daily storage of electricity from renewable sources.





The photovoltaic covered highway and street furniture of Phosphore 4 in the Grenoble metropolitan area © EIFFAGE / Grenoble-Alpes Métropole / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary



Click back to the summary

The potential development of digital technologies, in the field of transport organisation, is extremely promising because it relates to all fields and dimensions of urban life: time, space, individuals and the community. It is multiplied by the real-time geo-localisation of mobile objects and by the citizens themselves who, through all their movements, will become both receivers and providers of information, useful individually and usable collectively. It opens the door to partial substitution solutions to mobility through e-commerce or by combining video-conferencing with exchanges of other data, for example.

In Phosphore, the mobility terminals placed in the multimodal hub exchange room, prepare, verify and validate the user's route based on individual and collective criteria. Widely deployed in the multimodal hub, to make the information an abundant commodity immediately available, even when busy, the mobility terminals are connected to smartphones. They offer the user access to real-time interactive information thanks to a tactile interface: modes of transport available for the journey, arbitration between suggested routes, purchase of a mobility ticket valid for all transport operators, reservation of various services during the journey or upon arrival.

Outside, the touch screen terminals are part of the street furniture modules dedicated to urban mobility. They are installed like public transport stations, or simply as a landmark for pedestrians in areas poorly served. Beyond the calculation of travel time to assist travellers in the last stage of their journey, these facilities are developed specifically for disabled passengers, the visually impaired people, or those experiencing difficulties understanding French.

Where possible, the information provided on the fixed mobility terminals is available even inside the public transport vehicles. Transflective screens integrated within the glass partitions of the Modul'Air® cabins show the transport offer and the route chosen in augmented reality, at the user's request.

The augmented reality in the Phosphore 4 Modul'Air®
and the mobility terminal of Phosphore 2 at Marseilles
© EIFFAGE / Grenoble-Alpes Métropole / POMA /
Pierre Gautier architecture et associée / DASSAULT SYSTEMES
© EIFFAGE Sustainable Development Department /
3e-oeil.com studio / Pierre Gautier architecture

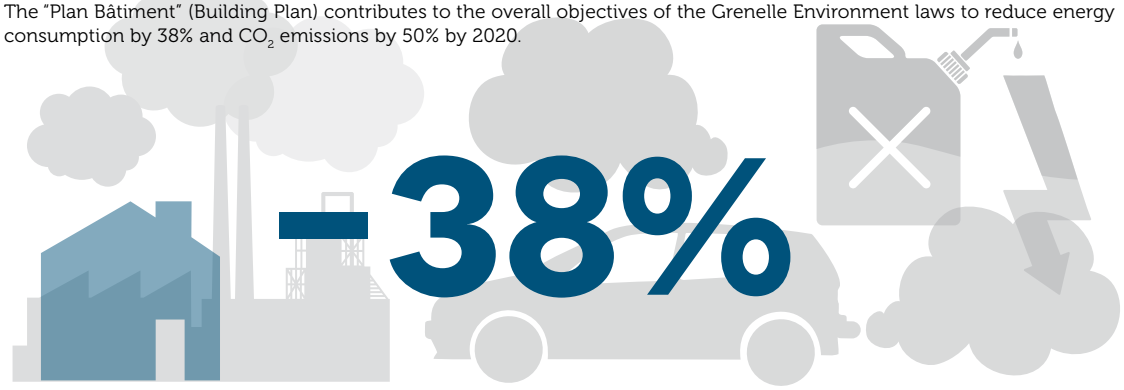
Click back to the summary

THE CARBON FOOTPRINT OF AN URBAN HOUSEHOLD

The carbon footprint of an urban household is the lowest in medium-sized towns of 100,000 to 200,000 people at 6,698 kg of CO_2 per person. This compares with 7,718 in towns of less than 20,000 and 7,087 for cities of more than 200,000 people. (Ipsos, 2010)

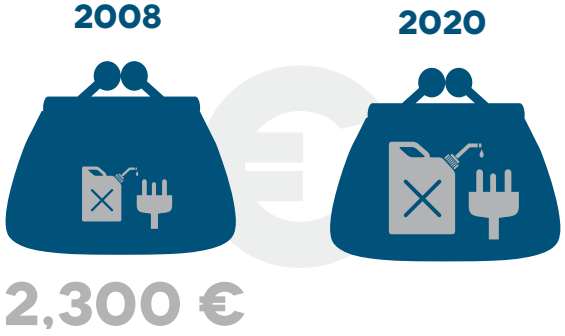
REDUCING ENERGY CONSUMPTION AT THE SOURCE

The "Plan Bâtiment" (Building Plan) contributes to the overall objectives of the Grenelle Environment laws to reduce energy consumption by 38% and CO_2 emissions by 50% by 2020.



THE GROWING IMPORTANCE OF ENERGY IN THE HOUSEHOLD BUDGET

In 2008, households spent EUR 2,300 per year for their energy consumption. This share is expected to increase in 2020 given the upward trend in energy prices. (INSEE, 2008 – Senate, 2012 – US EIA, 2010)



+67.13% FROM 2011 TO 2020

+49.46% FROM 2011 TO 2020

Click back to the summary

ENERGY SOLIDARITY®

Towards the post-carbon city

Powering a whole city in compliance with a carbon footprint as close to zero as possible begins by controlling the energy demand at its source.

For this purpose, several objectives are cumulative: massive reduction in power requirements, emphasis on sobriety for all uses – pooling of transport, reducing the needs and improving heating systems, optimising lighting and information technology networks –, use of particularly efficient systems and recovery of inherent energy.

The second step is the prohibition of the use of fossil fuels to the benefit of local renewable energy, almost exclusively. It's not a mystery that these resources are solar, wind, hydro, geothermal, biomass and waste recovery.

An energy mix viable by 2030 lies in the combined and sensible use of these resources depending on the geographical and climatic characteristics of the area. As a result, the Phosphore laboratory is committed to a double exercise: firstly, to adapt the energy mix to the local specificities of Marseilles, Strasbourg and the Grenoble metropolitan area and, secondly, to ensure that new and renovated buildings support the production of renewable energy.

"Energy solidarity in the heart of the city"

© DR

Alain Maugard is President of EUROPAN-France, a federation of organizations representing twenty European countries. Composed of architects, urban planners, researchers, experts, elected officials and project coordinators, it is a unique place of foresight and experiment for all city players.

In an increasingly urbanized and energy intensive world, the energy issue becomes increasingly acute for the city. There we must also find the answers. The positive-energy buildings show the way. It remains to extend the question from buildings to neighbourhood and from neighbourhood to the city.

Why is the energy issue at the heart of the problem of cities today?

We are facing unprecedented change. The world in which we live has become an urban world as more than half the world's population throng to the cities. It will be 70% soon! 80 to 90% of Europeans are urban dwellers. With the city consuming much more energy than rural areas, we are witnessing an explosion of the global energy demand, exacerbated by the trend of emerging countries to reproduce our energy-intensive lifestyles.
The current state of our energies, fossil, renewable and nuclear is not enough to satisfy this insatiable demand. We must therefore, imperatively REDUCE the demand. The négaWatt scenario involving sobriety, transition and technical innovation is a solution, as well as the energy mix with priority given to low-carbon energy and a significant increase in the share of renewable energy in all urban development projects.
This situation has a particularly strong impact on the building sector because we are in the heart of the city, and the city is at the heart of this problem. If we continue this trend, the planet will be consumed six times every year. It's a dead end!

Click back to the summary

Wasn't the construction of energy-positive buildings controlled long ago?

Of course! The building industry started a few years ago with the RT 2012 standard in energy-positive construction. The energy-positive buildings will become the standard for all new constructions in 2020. The solution to the issue of energy demand has been outlined and the building sector which embodied this very problem of consumption has instead become a solution – a place to produce energy.

Will energy-positive buildings solve all of the city's energy problems?

No, the buildings may become energy-positive, but that does not mean the problems are solved. There are others caused by transportation in particular, to get from one building to another, and more globally, the organization of the city. However, if we are exemplary on the subject of building construction, we can accelerate the awareness on other subjects. Not all buildings, in the immediate future, will be energy-positive, it is obvious! We will have to share the performance and investment between the buildings in the same block, in the same neighbourhood. The area will be transformed into a space of abundant energy, whether for power consumption through smart grids, or for calories which will be shared in heat networks. The principle of solidarity intervenes as an operating mode to optimize electricity production and share its uses. Solidarity between buildings, the new ones and the existing ones. Solidarity between the functions of office, housing and services. Solidarity among people will become a lifestyle.

"The sustainable city is based on a strong movement towards greater autonomy and freedom of choice for everyone."

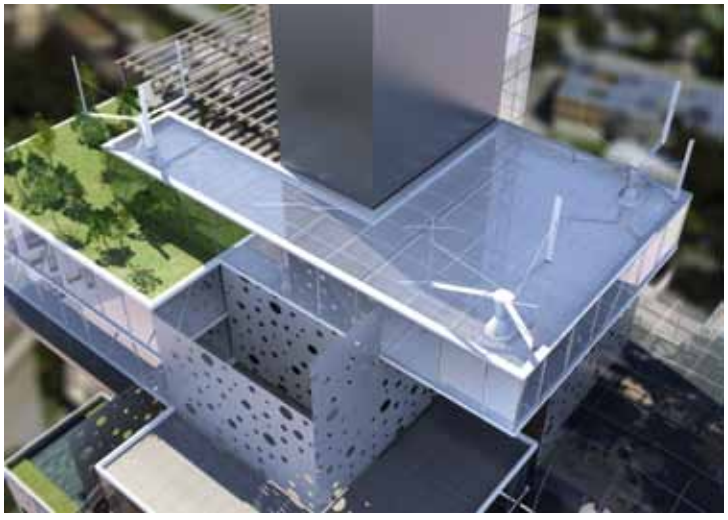
Is the neighbourhood the ideal scale to tackle the energy issue?

All scales are relevant, including that of the building, of course. However, the neighbourhood concentrates the search for all solutions. The intelligent neighbourhood network, either for energy production or for use, is also a consistent framework of reasoning applicable to water management and the circular use of certain substances and materials, including food production. I have not forgotten transport because the neighbourhood, the densified urban block, becomes a place of services, interconnection and of multimodality in order to reduce the use of private vehicles. I am adamant that positive energy should be the starting point of this revolution in the city with each and every person able to become their own energy producer.

Are we not here in some form of utopia?

Well, it may be seen as partly utopian. But the sustainable city or the sustainable lifestyles exposed here is based on a strong movement towards greater autonomy, freedom of choice for everyone. City dwellers have become energy producers and they control their use. We will evolve in a society with short cycles of production and consumption and will rediscover new service channels, relevant or not, in the market sphere. Buildings will have been at the heart of this urban revolution, as we can already see in the Bonne eco-neighbourhood, in Grenoble.
We are rolling out a city project, a different organization of society. Each one rediscovers the community, living together through the exchange of goods and services. It is no longer a world where we have no control, it is a space of freedom created and amplified collectively. This is an opportunity for change, let’s seize it!

Click back to the summary



Large wind turbines and micro wind turbines in Phosphore 1 and 2 at Marseilles © Buffi Associés – Eiffage – 3eOeil © EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary

ENERGY SOLIDARITY / THE ENERGY MIX IN PRACTICE: TWO EXAMPLES

In Marseilles, the energy mix benefits from the dominant elements of the site: the wind, the sun and the sea. The mistral is handled by urban micro wind turbines, while large turbines are installed on the seafront. Thermal and photovoltaic solar panels capture the solar energy while reversible heat pumps exploit the pumped deep sea water's thermal inertia. The production of biogas by fermentation of organic waste and biomass boilers complete the mix to power the eco-neighbourhood with heat, cold and electricity.

The principle of wind energy is based on the conversion of energy from wind into mechanical energy or electricity. The energy potential and the unlimited nature of the mistral – a free energy – are the strong points of this resource, particularly valuable in Marseilles.
The use of urban micro wind turbines positioned high on the roofs of buildings allows for a limitation of line losses through highly decentralized energy generation, at the most pertinent voltage level. The use of large wind turbines makes it possible to generate large quantities of energy. However, their positioning is conditioned by the exposure of the site to wind and the space available.

Exploitation of the sun is based on the conversion of solar radiation into thermal energy or electricity. Like wind power, the potential and the absence of cost of this energy source are the main advantages. The use of this energy requires both large areas and a sufficient degree of exposure and it is a fact that Marseilles presents very favourable conditions, considering the rate of annual sunshine, approximately 3,060 hours or 127 days of sunshine in 2011.

The principle of free-cooling by pumping seawater consists of using seawater as a direct source of heat or cooling depending on the season and the needs of the site. This technology is used to temper a global network of thermal energy distribution through access, via exchangers, to deep water at a temperature almost constant throughout the year (13°C in Marseilles). It helps, of course, to avoid using traditional air conditioning systems which generate greenhouse gas emissions.

Finally, the use of biomass occurs via the energy released by wood combustion in an appropriate boiler and can be used to produce heat, cold and electricity. The abundance and the homogeneous geographical distribution of the forest on the French territory, as well as its neutral greenhouse gas emission footprint, largely argue for this renewable resource. However, the conditions of wood management and transportation should systematically require a reasonable scheme for each case.
The combination of all these resources represents a low-emission "energy bus" that produces 130 GWh per year, needed to power the eco-neighbourhood. By emitting less than 3,400 tons of CO_2 equivalent per year in the atmosphere, the energy mix reduces the carbon footprint of buildings by almost 94% compared to a conventional energy scenario.

Click back to the summary

IT'S NOW
HEATING AND AIR CONDITIONING WITH SEAWATER

In response to the needs of heating and cooling of buildings near the coast, Crystal, an integrated subsidiary of Eiffage, has developed a powerful technology that exploits the thermal inertia qualities of the seawater. Warmer than the ambient air in winter and cooler in summer, seawater makes it possible to achieve performance which is three times higher than air for heating and air conditioning.

Already in 1998, Crystal tested this ecological solution by achieving the first thermodynamic exchange network with seawater for the Monaco Grimaldi Forum. The equipment draws seawater 15 metres deep with a flow rate of 1,250 m^3/h and ensures the thermal regulation of the 70,000 m^2 congress and cultural centre.

The Monaco example convinced the municipality of La Seyne-sur-Mer, in 2007, to develop a similar system on a neighbourhood scale. The urban network of 1,100 linear metres is designed to meet the heating and cooling needs in commercial buildings as well as in individual residences built on the site of the former shipyards, more than 54,000 m^2 of public and private buildings. When put into service, the potential energy savings reached 5,456,000 kWh per year with 1,210 tons of greenhouse gas emissions avoided.

In compliance with the systematic analysis of potential impacts, the seawater pumping activity produces no chemical, organic or metal pollution:

©photothèque Crystal

the stainless steel materials of La Seyne-sur-Mer network were selected to meet both technical constraints and the total eco-compatible requirements for the marine environment. Unlike electric air conditioners which are often unattractive, the pipelines and technical facilities are buried underground.

Thus, the initial investment represents a net benefit for both the users, with an energy bill reduced by up to 50%, and the environment.

Click back to the summary

The terrain around the Grenoble metropolitan area may make sun exposure and turbulent winds less conducive to the production of energy. However the water and forest resources from the surrounding mountains are very attractive. The energy mix proposed is therefore based on the complementarity between hydroelectric and photovoltaic production, biomass supplied by local wood and the production of biomethane.

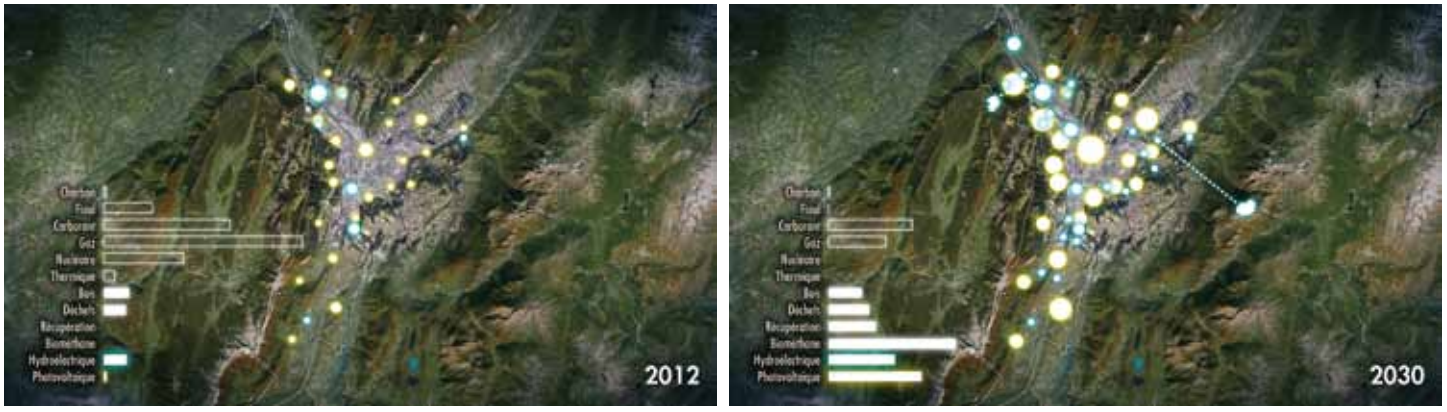
Increasing the density of river equipment helps to optimise electricity production from hydropower. In addition to the modernisation of old plants, new micro power stations are built on the drinking water reservoirs located at height. The hydroelectric input is completed with the back-up production from photovoltaic panels integrated into buildings and in the infrastructures, with partial coverage of highways.

The mountain forests in the region are also supplying power to the metropolitan area. The sustainable management of forests ensures renewability. Wood energy is derived from non-recoverable by-products or co-products, and supplies the heating network via thermal power plants converted to biomass. This solution, preferable to individual heating which is too polluting for the confined atmosphere of Grenoble, allows streamlining transportation of wood chips, optimisation of the combustion performance and guarantee of efficient treatment of fumes.

If, in 2030, the prospects for energy improvement in buildings and equipment promise a significant reduction in needs, these assumptions do not, however, apply to industrial processes, for which investments are on a different scale. In order to meet inevitable gas needs, organic waste, from agriculture and wastewater treatment is recycled in biogas plants. In addition, the residual heat from industrial activities, primarily from cooling, is returned to the heating network.

Also, the production of energy from renewable sources, which is discontinuous and random, does not always coincide with immediate needs, especially at night and in winter, when the sun fades and the demand increases. The intermittent production and the need for a balance of consumption peaks require daily and inter-seasonal storage solutions. Among options explored – mobilization of the batteries of parked electric vehicles, long term hot water storage and accumulation of potential or kinetic energy – the last one stands out in the case of the Grenoble metropolitan area. Several mountain lakes reinforce the system and offer an alternative, thanks to pumped storage stations, to store and restore electricity.

By 2030, the 40% reduction in needs together with the energy mix consisting of 75% of renewable energies will reduce emissions of greenhouse gas emissions by 70% in the city.



The energy mix of the Grenoble metropolitan area in 2012 and in 2030 in Phosphore 4 © EIFFAGE / POMA / Pierre Gautier architecture et associée / © DASSAULT SYSTEMES

Click back to the summary

The "Maison du Bâtiment" and the "Ruche" in Phosphore 3 at Strasbourg
© EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary

ENERGY SOLIDARITY / BUILDINGS, THE RIGHT PRODUCTION SUPPORT FOR ENERGY SOLIDARITY?

Building construction and operation offer considerable solutions for energy savings and reductions in CO_2 emissions. The same applies to their occupants. Phosphore thus placed sobriety at the heart of their reflections: priority is invariably given to the reduction in needs through bioclimatic architecture and the rigorous treatment of the shell. Then, the building is designed to become a decentralised production support for renewable energy, to meet its own needs and even the needs of buildings whose renovation potential has been exhausted.

With a real estate turnover rate of less than 1% per year, new construction will not in itself lead to a downtrend in energy consumption and greenhouse gas emissions in private housing and commercial buildings. The energy renovation of the existing housing stock therefore calls for both an emergency plan and an extended action plan, especially in the context of inadequate housing supply in France.

Firstly, the virtual renovation exercise engaged by Phosphore found a testing ground of experimentation in Strasbourg at the "Maison du Bâtiment", a 48 metre-high building representative of the architecture and construction techniques of the 60s. The "high-tech" differentiated treatment on the façades is an integral part of the climate regulation of the building, and their new energy potential is one of the criteria in the programme. Thus, the south and west façades benefit from good exposure, host a range of commercial activities, sports, public services and restaurants, as well as housing. In the south, dynamic shade structures generate energy with photovoltaic and thermal sensors, whilst protecting their occupants from intense exposure. To the west façade, a tempered screen is used to refresh and capture solar energy through the circulation of water from the groundwater at spandrels. A luxury hotel occupies the north-east side.

All the energy needs specific to the running of the "Maison du Bâtiment" are restricted to the maximum and are self-generated. Power requirements are reduced through the direct supply of low voltage devices and LED lighting, while inside, interactive intelligent interior (p. 91) automatically stops unnecessary consumption to the scale of each individual room. The system takes into account the influence of the occupants' behavioural habits on the global consumption; however it does intend to replace their actions completely. It gives them the possibility to act, and provides guidance through alerts and customized advice towards an efficient use of the building resources.

Each building, depending on its destination, its specifications and its layout, has a different energy profile, which limits its potential for renovation. The majority of the existing building structures and even some new buildings – poorly located or subject to strong architectural or programmatic constraints – will always be net energy consumers. Phosphore has therefore opted for an Energy Solidarity® systemic approach and worked out different applications. The new high performing buildings "deserve" the right to be constructed, that is to say, to use urban land and resources, playing the central role of local renewable energy power stations, not only for themselves, but also for the benefit of less fortunate neighbouring buildings. Thus, the "Maison du Bâtiment" exchanges electricity and heat with the new building called "Ruche" in order to optimize consumption and instantaneous energy production on Haguenau square.

Click back to the summary

The second approach, called "low-tech", has opted for a virtual testing ground in the "Restos du Cœur" building, in the Gare Basse neighbourhood, Strasbourg. It is a compact construction representative of industrial architecture of the early 20th century, which adapts perfectly to a more sober technology and is adapted to its social vocation. Whilst preserving the historic façades of this heritage building, Phosphore has repeated the energy rehabilitation exercise, with the integration of different programmatic and architectural constraints.

With these examples of Energy Solidarity® between a building showing optimal renovation and its new energy producing extension, the Phosphore laboratory intends to show that it is possible to extend the life of buildings hastily classified as "heat strainers" rather than destroy them. As part of the life cycle analysis of a building, this ambitious choice enables to pay for the grey energy corresponding to energy costs and greenhouse gas emissions during the construction phase.

To the initial purpose of social solidarity, housing features were added as well as public and commercial services. The new extension housing these services supports thermal and photovoltaic solar panels on south sloping roofs and photovoltaic glass slides are placed to the south and west. In this way, the extension meets the residual needs of the remaining part of the building.

Minimizing the grey energy of a building also requires utilising materials with a low carbon footprint and reducing the quantities used, which necessitates technical and environmental arbitration in the choice of construction processes. In the case of the "Restos du Cœur" building, a mixed concrete/wood structure was preferred for strengthening the existing structure and its extension, while the façades were made of wood.

The "Restos du Cœur" building in Phosphore 3 at Strasbourg
©EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary

POSITIVE ENERGY AT BLOCK LEVEL

Future 2020 thermal regulations include the application of a positive energy concept on all new buildings. However, there is no consensual definition as yet, the rule whereby a "building that produces more energy than it consumes" is not sufficient to answer all questions.

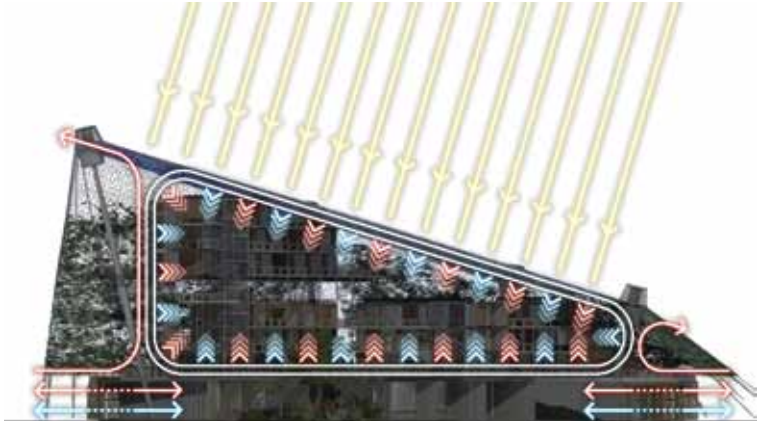
Indeed, should we take into account the construction of the building and the movements of its occupants to reach it, which can represent up to half of its energy consumption? Can we really talk about auto-production on the scale of a building, especially when a renewable energy source such as wood is used on the site, but produced elsewhere? Where does this leave the variable behaviour and activities of its occupants?

The scope of calculation chosen by the Phosphore laboratory is ambitious: in addition to the five rules used in thermal regulation – heating, air conditioning, hot water, lighting, ventilation and auxiliaries – it encompasses energy consumption related to specific use of the building. Whether used in office-related automation and audio-visual equipment or for a more specific programme such as a restaurant or a hotel laundry, it can be responsible for 25% of total consumption. The grey energy, transport and carbon footprint of the building are in turn evaluated in a qualitative way.

These items of consumption are reduced by the choice of siting, architectural design, constructive processes, materials and equipment to aiming primarily at sobriety in a life cycle approach. They are then covered – not only offset – by exploiting the potential of building renewable energy where possible on site consumption, or locally through the provision of biomass, thermal shared networks, etc.

Under the principle of Energy solidarity®, the role of a new building at Phosphore is not only to cover the residual needs of buildings when the renovation potential is exhausted, but also to compensate for the possible impact it has on the energy capacity of neighbouring buildings. In fact, in dense urban surroundings, the concept of energy-positive buildings introduces a positive kind of competition for access to resources – notably solar. Faced with this situation, the Phosphore laboratory found it necessary to extend the notion of positive energy to a block scale. The passive block of Phosphore 4 is one application within the Grenoble metropolitan area.

Click back to the summary



The interior and the thermal operating principle of the passive block of Phosphore 4 in the Greater Grenoble metropolitan area – © EIFFAGE / POMA / Pierre Gautier and architecture et associée / DASSAULT SYSTEMES

Click back to the summary

The Phosphore laboratory has experimented with the optimisation and balancing of consumption and on energy production of a so called passive block, designed according to bioclimatic principles, virtually located in Domène, in the Grenoble metropolitan area.

The inclination of the photovoltaic fabric giving the passive block its compact shape, allows for maximum solar gain. Its semi-transparent fabric provides natural light and heat while minimising the risk of glare and overheating in summer. Its vegetated outer shell further enhances it and acts as a vegetal screen protecting dwellings and outside corridors against cold prevailing winds in winter while greatly improving the external look of the block as well as offering a generous view to its inhabitants.

Inside, the atmosphere is temperate: the façades at ground floor level built in pisé[1] form breathable spaces, while upper floors, clad with an insulated and waterproof outer layer operate in passive mode. Planted at its heart in open ground the dense vegetation, conducive to evapotranspiration, acts as a temperature buffer.
From a programme point of view, the coexistence of commercial and artisanal activities on the ground floor with offices and housing on the upper floors helps to balance and complement energy needs.

Grey energy was taken into account in the choice of construction processes and materials. Thus, the recycled steel structure supports the floors, a base of concrete aggregates.
Upper floors are made of prefabricated modules, isolated and protected by timber derived from local species such as the Concept Lignum® (p. 96).

1 Pisé is a traditional construction method using compacted earth to erect walls.

Click back to the summary

IT'S NOW
FROM COLLEGE TO LABORATORY: INNOVATION AT ALL LEVELS

In July 2012, Eiffage won the first public-private partnership as part of the Plan Campus agreement. The Construction and Energy branches have worked together to develop GreEn-ER, a flagship facility situated on the Presqu'île scientific campus in Grenoble. Its 21,828 m² will house an engineering school, an annex of the Joseph Fourier University, the electrical engineering laboratory G2ELab as well as Predis, a training and innovation platform.

The purpose of the institution is to create an international innovation hub on renewable energy and resources, and thus, to promote the emergence of a national network of excellence. The building itself had to be a model in terms of energy performance. The solutions propose a very tight envelope and little heat loss, the connection of the heating and cooling devices to the future low temperature circuit pooled for the entire centre and to the recycling of calories emitted by computer equipment, the chillers and wastewater.

Thanks to these features, the building reaches the BBC[1] target based on a primary energy consumption of 75 kWh per square metre per year as, or 35% below the requirements of the 2012 thermal regulations. Students and researchers will also monitor the consumption of the building in real-time. GreEn-ER is designed as an experimental area where a zone demonstrator allows the modification and comparison of control parameters and production equipment of heat or cold, adding sensors, automation, etc.

Along the same lines, in April 2012, Eiffage signed public-private partnership contracts with the County Council of Seine-Saint-Denis to finance the construction, operation and maintenance of eight colleges within the department. Based on the High Quality of Life® concept in its design, 80% of the energy needs for six colleges will be supplied by geothermal probe field via heat pumps. Thermal solar collectors will also be used to supply hot water.

The two other buildings go even further aiming at "zero energy". In addition to geothermal power, they will be equipped with solar panels and a cogeneration power station covering the heat and electricity requirements.

1 BBC: label low energy consumption building of EFFINERGIE ®

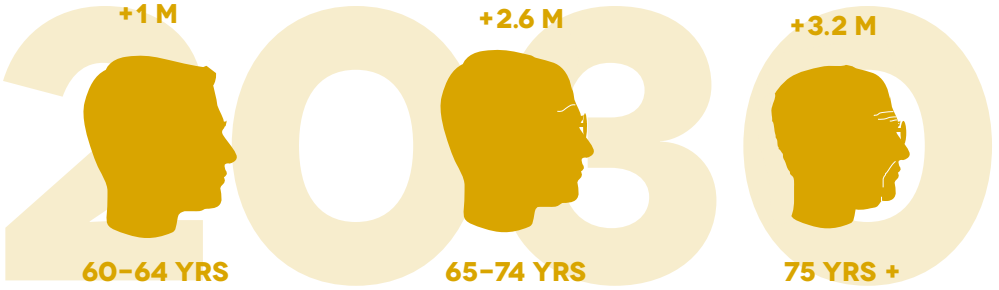
Click back to the summary

Louise-Michel College in Clichy-sous-Bois © architecte : ARCHI5PROD,
College of Aubervilliers © Lelli, "le nouveau collège international" in Noisy-le-Grand © architecte : SCAU

Click back to the summary

THE SENIOR BOOM

INSEE expects 20 million people to be over 60 years in 2030 ie. 29.4% of the population.



LIVING OLDER BUT HOW?

Unlike life expectancy, which increases, the life expectancy without disability tends to stagnate in Europe. (Eurostat, 2011)

	2004	2007	2010
W	61.5 YRS	62.8 YRS	61.8 YRS
M	64.3 YRS	64.4 YRS	63.5 YRS

THE FRENCH AND THE END OF LIFE

The French regret the high proportion of seniors dying in hospitals: 58% of them consider that the place is not suitable for end of life care. They would largely prefer be at home at the end of their life (81%). (IFOP, 2010)

ADAPTATION OF HOUSING: THE FRENCH LAG BEHIND

The proportion of over 80s who benefit from special arrangements in their homes is 45% in the Netherlands, more than 20% in Germany, Denmark and Sweden and only 18% in France. (SYNERPA, 2011)

Click back to the summary

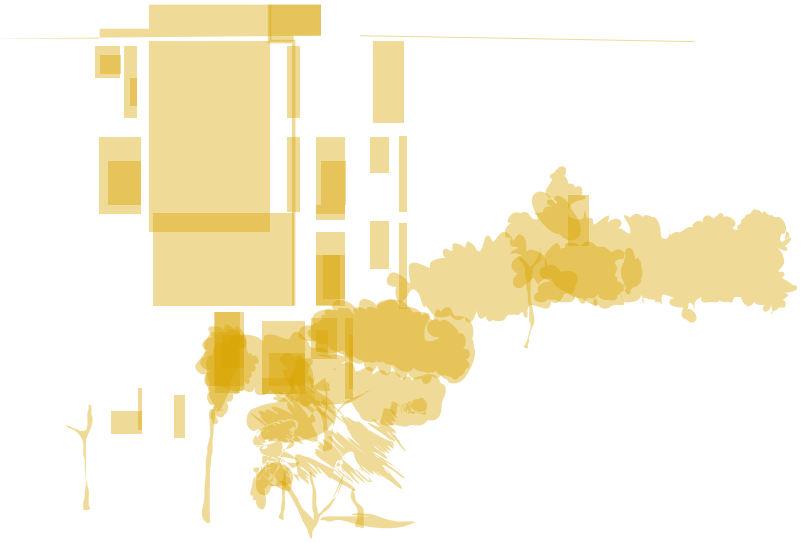
NEW LIFESTYLES
NEW WAYS OF BUILDING

Urban attractiveness, and the resulting demand for housing and services has never been stronger, it seems. It does not just come from couples who work in the city and raise their families. It is now driven by multi-dwellings patterns often linked with professional requirements, or cohabitation, supported by divorce rates and non-linear personal backgrounds.

These profound sociological changes, such as blended families, the aging population and related issues – home support, old-age dependency treatment – or adapting to new standards of employment, show that the housing issue cannot be reduced to a shortage of supply. Indeed it raises, for the years to come, challenges related to the evolution of uses at different scales – housing, building, block – the answers to which will be essential to the attractiveness of the sustainable city for all.

The rise of new ways of life coincides with profound changes in the modes of construction.

The need for ubiquitous energy management, the shortage of urban land, the conservation of non-artificial natural areas or even the announced scarcity of materials: all these pressures will affect the entire chain of the construction process, and each new building will "earn" the right to be built. Performance should not only be about energy. The environmental balance in life cycle analysis, the quality of services provided to users in terms of upgradability, adequacy to natural risks as well as the potential reversibility of the building, will also become significant criteria that will ensure its better integration into the urban ecosystem.



Click back to the summary

"Mobility is our new culture"

© J. Viard

Jean Viard, a sociologist, is Research Director for CNRS at CEVIPOF, Centre of Political Research at Sciences-Po. Former president of the groups of prospective tourism at the Commissariat au Plan and DATAR, he has just published *Nouveau portrait de la France, la société des modes de vie* (New portrait of France, Society and Ways of Life) by éditions de l'Aube 2012.

Increased life expectancy, new divisions between work and leisure, mobility, etc. The reflection on the use of space also questions the new uses of time, says the sociologist Jean Viard.

How do lifestyles shape the city today?

Understanding the city now requires more analysis on time rather than space. We have gained 40% more life in the 20th century, opening the way to the civilization of complete lives – according to Jean Fourastié. We are now working 10 to 12% of this life, about 63,000 out of 700,000 hours of life. In the early 20th century, people worked 200,000 hours to a life of 500,000 hours. That is the biggest change in modern societies. The life expectancy projections lead us to expect another gain of 100,000 h (11 years) per generation. And the longer life is, the more we live short sequences – in terms of housing, recreation, privacy – because we can always "give it another try"... plus we're more mobile. This means one simple thing: the city and the society which were organised around work, its values and hierarchies, until the 20th century... are now today co-produced by work and free time.

How do we spend this free time?

Free time refers to physical and social mobility, leisure, holiday, knowledge, privacy and love. The nature of the social bond changes dramatically. Previously connected to production, it gave rise to hierarchy at work, which induced hierarchy in family, politics and spaces: people used to live near their workplaces and the neighbourhoods or villages were homogeneous. The big change is this major paradigm shift on use of time. Applied to urban development, it is the quality of the staging of the territory exposure – Metz with the Pompidou Centre, Lens with the Louvre – that makes it attractive for people and businesses. We must now look at the city in terms of quality of life and then wonder how it can produce wealth. The soft attracts the hard!

Click back to the summary

How does the quality of life apply in the urban model?

Free time is not a time when we do nothing: we build social ties and professional skills. Each person regenerates creativity, and stores knowledge. The modernity of the city has long been the Haussmann model, which articulates work with learning, education, breathing in parks and gardens as well as cultural life. We then built the city dominated by the automobile. Characterized by urban sprawl, large car parks and supermarkets, it consumes space and is profoundly anti-ecological. This model now has little future except with reduced mobility. Today, we live in a fusion of the Haussmann model and Club Med! The ideal city functions as in the Haussmann's days – taking the children to school, going to the office, using public transport – and, simultaneously having a Club Med life! Swimming, cycling, resting along a canal or on a terrace, consuming my leisure time.

"Today, we live in a fusion of the Haussmann model and Club Med!"

What is the impact of increased life expectancy on the city?

On average, we are grandparents at 53 years old and lose our parents when we are 63. This "four generation" society gives rise to an overloaded period between these two periods in life where we take care of both our grandchildren and our parents at the end of life. We have not yet reflected on the new needs of spatiality for that type of family, their need for local solidarity. And we live at a time when pensioners also become mobile. 48% of them dream to move. They associate retirement with long vacation, and dream of moving to their holiday place or their country of origin. The pensioner becomes a migrant and a source of considerable economic development for the regions: a retired couple generates almost one job. It becomes easier to house 1,000 pensioners than to create 500 manufacturing jobs.

What is the space for the pensioners at the end of life?

If the heart of the city means free time, the heart of free time is home and family. We have not redesigned this four-generation society with all of its elderly. Nor have we thought about pensioners' life project. With an average income of 1,000 euros, pensioners, especially women, do not have access to a retirement home. We have not created space for them. There are some experiments underway, in the form of community or family groups, but they remain marginal. This is a major innovation area in our society for the coming years.

You mention mobility: what forms does it take throughout life?

Let's start with highly symbolic figures: 2,3 billion people are connected to the Internet through their mobile phone. Last year, over one billion people crossed a border. We are in an era of hyper-mobility and hyper-acceleration and it is just beginning!
At our level, in Europe, we travel 45 km every day – 70 km in the United States – against 5 km in the 50s: 15 km to go to work, 15 km for recreational activities and the last third for the day-to-day movements. The more people surf on the Internet, the more mobile they are, and the more commonplace the idea of traffic becomes. The battle for mobility ahead of us is twofold. Firstly, it is to democratize the kilometre stock. Secondly, we need to reduce non-obligatory journeys via proximity policies. But we must understand that mobility is our new culture compared to yesterday's sedentary lifestyle. Mobility must be democratized and become more environmentally friendly; the modern world is based on it.

Click back to the summary

Click back to the summary

NEW MODES OF LIVING AND BUILDING / URBAN MIXITY AND UPGRADABILITY

Demographic trends and changes in lifestyles will profoundly modify the residential needs in 2030. Longer life expectancy, an improvement in itself, also has "mechanical" consequences on housing, such as frequent under-occupation of dwellings or the slower rotation of property transfer. Loss of autonomy, whether motor or cognitive, creates the need for specialised housing that only dedicated facilities can meet. Changes in lifestyle, from the flexible family cell to the desire for a dual residence, also contribute to the housing pressure while teleworking and professional nomadism bring change to the service sector. In a context of scarcity of space and housing shortage, Phosphore tries to give responses in terms of programmatic choices and upgradable typologies of buildings.

The separation of the functions of housing, services and retailing, by building and sometimes by entire neighbourhood, generates three observations: excessive consumption of energy compared with the use, under-utilisation of facilities and increasing commuting journeys. Since its second session in Marseilles, Phosphore has suggested combining these functions in hybrid buildings with intensified use and invented differentiated typologies which can be vertical, horizontal or tree-shaped depending on the context.

Inside, the rooms are also designed to be adapted for other uses, at a low cost. To transform this first conceptual approach into an applicable principle, it was necessary to reconcile the different normative frameworks in terms of accessibility and safety while addressing the constraints of architectural design on a human scale.

The first typology organises urban mixing around interior patios where the different users meet, whereas a second programmatic interpretation features an intermediate floor with restaurants, sports facilities, cultural and public services. The third typology called "tree-shaped structure", offers greater flexibility in the evolution of its form which can welcome additional "branches" if need be. Urban and landscape continuities are facilitated by the raising of the building, also conducive to the anticipation of flood risks.

The three typologies of Phosphore 2 upgradable buildings in Marseilles –

Click back to the summary

Upgradable housing in Phosphore 3 at Strasbourg ©EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Having established the principle of durable compatibility of each new construction with the changing needs of its occupants, the Phosphore concept of hybrid building has emerged, creating upgradable buildings down to their final shape.

Engineers and architects within the laboratory have devised construction methods that facilitate space planning variations in order to reduce structural and finishing work. Thus, in its virtual exercise based in Strasbourg, Phosphore 3 imagined a new building on Haguenau Square, the "Ruche", in the form of superimposed helicoids, offering the possibility to change the layout of the internal space. Due to the light renewable energy production equipment installed on the roofs, the building can be extended upwards.

The principle of upgradability also applies to a programme of individual and collective dwellings in the neighbourhood of Wacken. Anticipated at design stage, planning permissions have been granted with multiple configurations and allow the addition of one or more modules on roofs and façades. Residents can also adapt and change their homes according to their needs using an additional room or space, whether attached to their main dwelling or not.

Click back to the summary

IT'S NOW
FIRST HIGH QUALITY OF LIFE® PROJECT

In December 2011, Eiffage Immobilier Centre Est won its first construction project designed as part of Eiffage's High Quality of Life® reference system. Situated in the joint development zone of the Presqu'île in Grenoble, close to the future school for the energy of the future GreEn-ER, the project involves 140 dwellings, 344 m² of activities, 210 m² of shared facilities as well as a nursery.

Beyond their remarkable energy efficiency, rated at 30% below BBC requirements, all the proposed dwellings are based on the principles of upgradability and reversibility developed within the Phosphore laboratory in order to effectively meet the changing needs of all residents throughout their lives.

The interior layout of residential buildings is such that the size of each flat can be changed, from T2 to T3, or T3 to T4 by adding or taking out a "removable" room with no sound or thermal impact. The room can also be independent and directly accessible from the common areas. For example, an elderly person will be able to set-up a room adjacent to his/her apartment to accommodate a student or home care. This arrangement will encourage him/her to stay at home thanks to the rent payments if used within the intergenerational solidarity plan or as part of home support and care.

This principle of the self-sufficient room can meet many other needs: provide additional income to support the acquisition of the apartment, adjust the size of the dwelling based on the number of people in the household – including the installation of a separate room for a young adult or a student – set up an office to work from home or create a shared space between co-owners, at floor level or building level, for a guest room, a laundry, etc.

Other provisions, such as the use of wood for insulation, façades and building structures, or the installation of interior and exterior LED lighting systems developed by Eiffage Energie make this operation an experimental "keystone" laid by Eiffage towards the construction of a sustainable post-carbon city.

The future Cambridge block in construction by Eiffage © Christian de Portzamparc et Agence Barthémély & Grino

Click back to the summary

The mountain neighbourhood where one can find the sheltered retirement home and an adapted home of Phosphore 4 in the Grenoble metropolitan area © EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

NEW MODES OF LIVING AND BUILDING / CULTIVATING "AGEING WELL"

How to prepare for an ageing population in the urban space via the development of new infrastructures and the profound adaptation of housing? Far from being exhaustive, the range of recommended solutions – adaptation of housing, sheltered retirement homes and intergenerational habitats of the future – is to be considered in terms of individual situations, in particular, the loss of motor or cognitive autonomy and their evolution over time. Each must be considered on a case-by-case basis, successively or alternately, permanently or intermittently, and even more so in the context of neurodegenerative conditions.

Having the desire to stay at home as long as possible in most cases, elderly people express their right to experience ageing as a natural process, as well as a desire to continue their existence without rupture – without uprooting themselves by being admitted to a specialised home or withdrawing to a place distanced from their usual environment and family.
As a result of its analysis, the Phosphore laboratory retained three factors essential to the quality of life of seniors at home: access to local shops, public transport and quality public spaces.

Inside, the adapted housing is a model of humanization: easily converted volumes and portable partitions, quality of natural and artificial light and contrasting colours to easily navigate in space and time, multifunctional suspended furniture for easy cleaning of floors, no sharp edges or legs to make moving around more secure, adapted bathrooms, etc. Automation and robotic applications are also perfectly legitimate to support home autonomy for the elderly, without isolating them.

Shared housing programmes represent a second solution: they seek to articulate family solidarity but also public support around the construction of buildings accessible to all households in order not to exclude people with low incomes. Already tested in several European countries, intergenerational shared habitats are thus an original type of lodging. It consists of connecting young people, often students or non-economically independent, with elderly people in exchange for minor services – evening presence, small shopping and housework, sharing meals. In addition, some of these structures give the host the ability to collect a moderate rent.

Subsequently, the people housed in sheltered retirement homes (EHPAD) not only require care and attention, but above all quality in human relationships. To some extent, the nursing staff could spend the precious time that they would save from the medical rituals which monitor health parameters by using remote monitoring technologies. This would give a new beneficial dimension to their daily rounds.

Click back to the summary

Click back to the summary

ACCESSIBILITY, COMFORT AND SHARING

Beyond inclusion taking into account frail and elderly people, the inclusive approach of the research laboratory addresses all categories of users with particular attention to those with motor disabilities as well as sensory and cognitive impairments.

The services offered by the city are accessible to all categories of people. Transport networks, public furniture and installations are suitable for people with reduced mobility. Signage systems facilitate the movement of everyone in the urban space, regardless of their cognitive profile and any visual or hearing impairment.
Ergonomic research plays a central role in the design of the solutions proposed by Phosphore. It is put in practice inside buildings, where well-being and safety are key requirements. The technology becomes non-intrusive to contribute to the users' comfort and health without isolating them. Thus, the interactive intelligent interior (I^3) is a home automation system developed by the laboratory for connecting occupants to their environment on many scales.

Inside the home, I^3 ensures, according to thresholds adapted to the occupants' needs, the regulation of the thermo-hygro, acoustic and light ambiance, by optimising the intake of natural light through physiological lighting. I^3 checks the quality of indoor air and warns of any malfunction. In terms of security, it adds domestic accident prevention to the traditional functionalities of intrusion and fire detection.

At the scale of the building, I^3 integrates the technical and social collective information. Finally, on a broader scale, I^3 collects and processes data on the digital city, such as opportunities for sharing services with neighbours, travel conditions, real-time cultural events or more simply, weather alerts.
With Phosphore, technology gives better access to individual and collective spaces and services.

Interactive Intelligent Interior (I^3) of Phosphore 3 in Strasbourg and Phosphore 4 mobility terminal in the Grenoble metropolitan area

Click back to the summary

THE BARE STREET®

Synonym of peaceful shared space

Inspired by the concept of shared space tested in several cities across Northern Europe, Phosphore laboratory created the Bare Street®, a public road reclaimed by the public and adaptable to the diversity of human activities and users alike. Vertical road signs and flow separation are removed in favour of all types of mobility. Often merely seen as a congested place due to traffic and parking, the street becomes a pacified area with reduced speed and increased attention, made possible by the markings on the ground.

The Bare Street® is an open plan place whose furniture is removable. This public space is fully accessible to all categories of people whose movements are less accident-prone. The space can now be occupied by other urban activities, fixed or mobile: cafe terraces, kiosks, outdoor events and street performances.

However, this new genre of public space is not neutral or less accessible: the LED Luciole® process (p. 93) embedded in the ground of the Bare Street® provides a discrete light animation that increases opportunities for activities. Entirely replacing the traditional signage and safely delivering the strictly necessary intensity, it provides simple and upgradable markings, for the benefit of a lively public space.

In the Bare Street® imagined in Marseilles, the Luciole® delineate a chicane in the morning – giving enough time for a vehicle to stop –, then they give way to wide pedestrian walkways for children coming out of school and in the evening they make the pedestrian areas safer in a festive atmosphere.
In Strasbourg, in the Gare Basse neighbourhood, studied virtually, a wave of Luciole® lighting is activated before the passage of each shuttle bus on the inter-neighbourhood plan. A light signal shows in advance if the common spot for deliveries and waste collections is reserved, whereas the luminous demarcation of cafe terraces adapt in size and position for peak times.

The Bare Street® of Phosphore 2 in Marseilles © EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary

IT'S NOW
LUCIOLE® (FIREFLY)
The light source of the Bare Street®

Developed by Eiffage Travaux Public and Eiffage Energie, Luciole® is a modular light born from the association between Light Emitting Diodes (LEDs) and construction materials.
This pre-wired process consists of setting the lighting modules on a template before flowing and embedding them in asphalt, a hot mix material, resin or a special concrete. As the modules are pre-set, the flexibility of implementation is increased which means that the majority of structural risks are avoided, and thus improving resistance to constraints on urban sites.

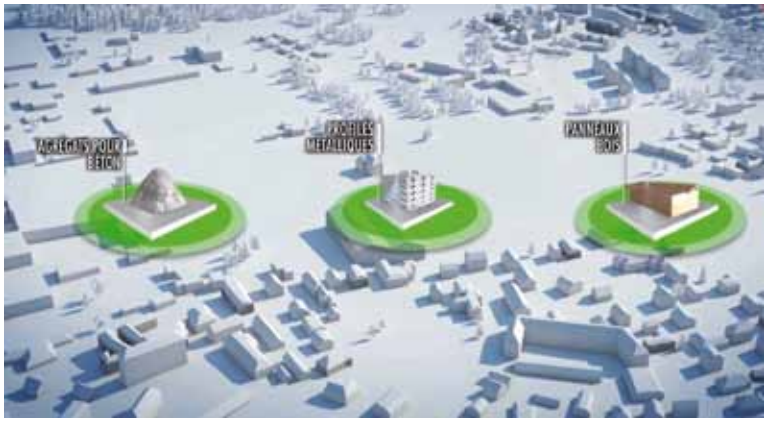
Assembled on demand, Luciole® can produce light elements in any form. Thanks to its modular system (quantity, colours, configuration and light sources animation), this process offers designers, architects and landscape architects, an innovative and economical solution suitable for various uses: construction of roads and public places, road marking or identification signals, securing a zebra crossing or enhancing the character of façades and interiors.

Sustainability, efficiency and easy integration in the site are the key advantages of this process which owes much to the qualities of LEDs, a new generation of light sources, reliable, durable and simple.
The process offers other levers of impact reduction on the environment: use of recycled building materials, bio-based and operated at a low temperature, solar or wind powered.

Several applications of the Luciole® process have already emerged.
After testing on Eiffage sites, particularly for ground markings to access the Eiffage Energie site in Verquin, in the North, the process has been put into operation to identify the two halls on the terrace of the gare Saint-Sauveur, as part of the cultural project Lille 3000.

Applications of the Luciole® process in Lille and Verquin
© Karine MIETTE / TANDEM © EIFFAGE

Click back to the summary



Recycling in place, Phosphore 4, Grenoble metropolitan area © EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

NEW MODES OF LIVING AND BUILDING / ECO-COMPATIBLE CONSTRUCTION TO SERVE THE CITY RESILIENCE

Faced with the consequences of climate change and the depletion of natural resources, Phosphore explores new construction processes which are consistent with the increasingly important environmental constraints. The environmental compatibility of materials and construction methods ensures that cities are able to adapt to natural risks and resume normal operation quickly and cheaply. Thus, like the prevention of natural or industrial disasters, the reduction of the ecological footprint in the building sector contributes to urban resilience in anticipation of the transition to a post-carbon future.

Can a city claim to be sustainable without being "reversible"?
Any portion of artificial land whose ecological and property value has been degraded by an industrial or commercial past must regain a natural or functional value after decontamination. Where it is possible to overcome the traditional techniques of land decontamination in or ex situ, the brownfield soil can be rehabilitated by phytoremediation, using the fixing capacity of certain toxic substances by plants.
To further reduce the urban renewal ecological footprint, Phosphore proposes to organise the selective deconstruction of buildings reaching the end of their life. Thus, the reduction of grey energy in structures, the limitation of greenhouse gas emissions related to transportation and strain – local or relocated – resulting from extractive activities on the natural environment, are the components of a more sober way to build. Inert waste – rubble, concrete aggregates, asphalt millings – and wood waste are sorted, processed and recycled on the site. The important deposits that represent the recycling of building and public works' materials are added to low-carbon and bio-based materials requiring moderate energy input and utilisation, such as pisé or wood.

The fourth session of the Phosphore laboratory carried out further research on resilience solutions upon the plausible occurrence, by 2030, of more violent weather hazards, as a result of climate change. To respond to the flood problem, Phosphore designs urban installations, capable of adaptating and not just resisting in case of major floods: rather than increasing protections against rising waters, building on stilts and floating platforms are therefore preferred. The use of these methods has the added benefits of gaining living space in areas that are frequently flooded and unsuitable for cultivation, and also of preserving the natural features of the ground as a biodiversity support towards the ecological integration of buildings and structures.

In addition, structural facilities, such as the universal halls, are designed to operate in "degraded mode" in case of crisis, resulting from major natural, technological and health events. Where appropriate, they are able to focus their material means and energy resources to ensure logistical and basic communication functionalities, as well as to provide the populations affected with secure emergency housing and facilities.

Click back to the summary

In response to the scarcity and higher prices of mineral and fossil resources, the use of biomass is a sustainable alternative for the supply of building materials and fuel.

In the Grenoble metropolitan area, Phosphore 4 is looking into the potential of the local wood industry, while being aware of issues related to fragmentation of forest ownership and steeply sloping woodlands.
All the links of the regional supply chain are imagined on the basis of a management strategy in line with the principles of the circular economy: forest owners' cooperatives, operating procedures facilitated by cable transportation, pooled drying platforms and local factories of first and secondary transformation. The destination of the harvested wood depends on its quality, softwood lumber and industrial applications having the priority over the wood as energy.

On the construction side, wood helps to neutralise the carbon footprint of the Phosphore buildings: whether on structure and façade as for the "Restos du Cœur" building in Strasbourg, or in insulation, Concept Lignum® wall and flooring modules for the passive block in the case of Grenoble. The industrialised prefabrication of wooden components gives control over the execution of construction projects with short term deadlines or under severe weather conditions.

On the energy side, in 2030, timber will represent an essential component of the energy mix. Easily stored, wood as energy is available throughout the year. It can meet the needs of residual heat, electricity and cold, with co-generation and tri-generation possible in biomass plants, capable of guaranteeing industrial processing of combustion fumes limiting emissions of volatile organic compounds (VOC).

Finally, petrochemical derivatives are replaced by green chemistry products. This is the case with liquid timber, an innovation created in the early 2000s, to become a common solution in 2030, biodegradable and recyclable, used in the composition of urban furniture instead of plastic materials. Similarly, Biophalt®, patented by Eiffage Travaux Publics, is a vegetable binder, a substitute for bitumen, obtained from by-products of the paper industry and used in the coating of the Urbanbridge®. Vegetable fibres, resins and natural paints are all other biobased products with which Phosphore is planning the eco-construction of the city of tomorrow.

Lignum® modules of the passive block, Phosphore 4 in the Grenoble metropolitan area © EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

IT'S NOW
CONCEPT LIGNUM®

From virtual research to an industrial patent, Eiffage Construction has designed a new range of semi-industrialised wooden products called Concept Lignum®, responding to the needs identified by Phosphore on upgradable and modular housing in buildings perfectly reversible with low carbon footprint.

Combining the advantages of engineered wood and precast concrete, Lignum® buildings support, to a maximum height of 7 floors, a series of studio modules featuring bathroom and kitchenette sub-assemblies. Concept Lignum® is aimed primarily at operating managers of student halls, service buildings or retirement homes. The arrangement of wooden modules is very adaptable in terms of combination, shape and accommodation capacity, which makes it an upgradable and modular construction scheme.

Ensuring a high carbon storage, solid wood brings lightness to the structure and guarantees rapid implementation and control of deadlines. Supporting all wooden modules, the concrete slab brings thermal comfort and durability in use. The carbon footprint of the concrete ground floor is largely offset by the levels of wooden modules. The wooden modules are demountable and can be recycled to another use when the building reaches end of life.

The thermal performance of Concept Lignum® buildings reach BBC performance in most climate zones due to the studios' airtightness and thermal insulation from the outside. Particular attention is paid to the acoustic insulation (air and noise), resistance to fire and earthquakes as well as emissions of volatile organic compounds, which makes Lignum® building works particularly virtuous, comfortable and healthy.

Concept Lignum® module concept of Eiffage Construction, external and internal view © Studiophotojm2d

Click back to the summary

Click back to the summary

WHAT ROLE FOR INDUSTRY IN THE SUSTAINABLE CITY?

On the occasion of its fourth session, which took place virtually on the territory of the Grenoble metropolitan area, the Phosphore laboratory explored the durability of industrial employment in urban areas by 2030. Taking the example of Pont de Claix – 120 hectares in the southern suburbs of Grenoble, where industrial employment is established historically – Phosphore set two major objectives for the benefit of the area, which in 2012 had 800 direct jobs and 4,000 indirect jobs.

Firstly, the aim is to anchor the industrial activity in the territory via the development of an economy of functionality between industry leaders to generate synergies and economies of scale.
This role can be played by a new profession, namely a functionality economist whose role is to conduct and centralise the industry leaders' needs in certain areas: bulk purchasing, circular management and recycling of waste, joint training, space sharing, security cooperation, etc. This profile brings together certain services offered by providers in facility management, and develops them – keeping shared costs under control – to cement the industrial community.
In 2030, the functionality economist will also create links between industry players, employees and the neighbouring community. It will monitor all exchanges such as the sharing of industrial thermal surplus to the city. It will embody the role of facilitator in charge of the day-to-day cooperation with neighbouring communities.

Then, it will be about protecting the site from potential damage resulting from industrial activities by the construction of a multifunctional interface, vegetated, which will contribute to the safety and quality of life of residents through the amenities provided.

On the industrial side, the interface will perform processing functionalities in the fields of pollution and risk prevention. The height of the interface, adjusted depending on the proximity of homes, offers effective protection against noise and visual pollution. It also constitutes a barrier that helps to control many risks: containment in case of explosion, spread of hazardous substances or flooding, coordination of rescue and intervention in crisis situations.
The inside of the structure, built of cut-and-covered or reinforced earthen bund, will house storage facilities as well as transport and communication functions. In case of emergency, the multifunctional interface will represent the core logistics system, essential for crisis management, with secure telecommunication networks, means of intervention and a decision-making command post. The interface will contribute to the implementation of a "solidarity resilience" between industrials, and between industrials and residents.

On the city side, the sloped interface, perfectly inserted in the landscape, is reclaimed by nature. The western flank welcomes pedestrians and cyclists as well as some sports facilities such as fitness trails and climbing walls. Photovoltaic shade structures are placed in the most profitable situations.

The multifunctional interface, Phosphore 4, Grenoble metropolitan area © EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

SERVICES PROVIDED BY NATURE: THE EXAMPLE OF NEW YORK CITY

Thermal control, energy conservation, carbon sequestration, fight against pollution, aesthetics and cultural heritage: the ecological services provided by the 592,000 street trees in New York are estimated at $122 million per year. (NYC)

THE URBAN GIANT FOOD-RELATED FOOTPRINT

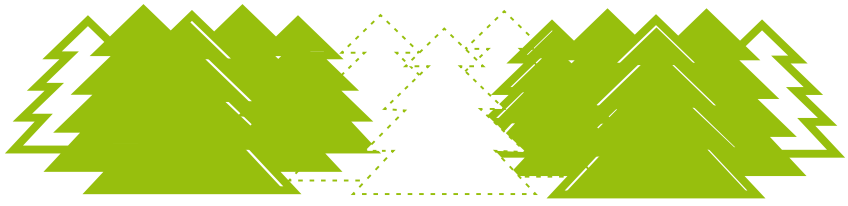
To get to Paris, a food product travels an average distance of 662 km from its place of production (790 km for fruit and vegetables). (City of Paris, 2012)

ACCELERATED LOSS OF AGRICULTURAL AND NATURAL LAND

The loss of agricultural and natural land continues today at a rate of a French département every seven years. (Jeunes Agriculteurs, 2012)

HOW MUCH REVENUE DOES NATURE PRODUCE?

The loss of ecologic services could represent up to 7% of world GDP in 2050, or 13,938 billion per year. (TEEB Interim Report, 2008)



= 13,938 BILLION €/YR

Click back to the summary

URBAN ECOSYSTEM

Restoring ecological services in the city: a necessary utopia?

If the city represents the main mode of living in the 21st century, the housing environment and the proximity to nature remain key factors to the feeling of well-being, and are therefore sought by city dwellers. Paradoxically, the density of human activities causes problems such as the poor quality of air and major noise and light pollution, responsible for affecting health and the quality of city life.

Moreover, as for urban sprawl, the urban environmental footprint is still expanding: food production as well as processing waste and wastewater are often carried out beyond urban areas, generating flows that contribute to congestion and greenhouse effect while incurring significant costs to the community through water treatment plants, the organization of the disposal of garbage or the construction of protective barriers against floods.

In the light of this, the Phosphore laboratory has tried to reconcile urban development with the natural environment to enable citizens to enjoy the ecological services it provides: the achievement of water and carbon cycles, provision of food resources, regulation and purification of pollutions, and a healthy and enjoyable living environment.

Click back to the summary

"An exclusively mineral-based system is not humanly bearable"

©Benoît Reeves

Hubert Reeves is an astrophysicist and the chairman of Humanité et Biodiversité (Humanity and Biodiversity). The public utility association, provides a platform for advocacy to highlight the challenges of biodiversity loss in society and offer solutions to address them. H & B is a partner of Eiffage.

I often reside in Paris, the largest city in France. It allows me to choose a cultural event in a museum, an art gallery, a cinema, a theatre or opera, or to take a walk to say hello to the Seine and to the trees in Jardin des Plantes or Luxembourg park... Culture and nature are for me the charm of city life.

Nature is indispensable to me even in town, even to those who do not know about it.

Urbanisation buried the earth under concrete and asphalt and some urban children rarely had, if ever, contact with plants and wildlife that goes with them. But today cities are aware that an exclusively mineral-based system is not humanly bearable.
Tomorrow is decided today! And, the good news is, professionals are reacting. This is why Eiffage created Phosphore, a forward-thinking research laboratory in sustainable development that aims to define and implement the city of tomorrow.

The city of tomorrow, as the city of today, will have its own personality. The idea is not to have a model scheme to be reproduced for each new potential city. Most often, it will be the city of today, similar and yet different.
The big difference is that, in the past, decisions were made without citizens. Now they are or will be consulted on projects about the city centre or the suburbs.

Click back to the summary

I have often been an advocate for renatured urban zones.

The association Humanity and Biodiversity offers to transform balconies, terraces as well as private and public gardens into a Nature Oasis. Flora settles in sometimes! Sometimes it needs a boost! Welcoming and enriching the flora means contributing to the development of life, by attracting representatives of wildlife, butterflies and birds... It embellishes life.
To take the initiative to put flower pots in a balcony or a terrace, more, to have the audacity to transform, whenever possible, the roof into a garden, to opt for vegetal walls, all this encourages biological corridors favourable to insects and even birds that any city should promote to be alive.

"Beyond individual initiatives, there is also room for innovative municipal decisions."

Sound barriers would gain much from being hidden by a vegetal screen, properties' dividing walls could be covered with plants and allow for the movement of hedgehogs, for example. Beyond individual initiatives, there is room for innovative municipal decisions in our cities today, where wastelands can become community gardens and the streets can host trees with vegetation growing spontaneously at their feet.

Of course, the modes of public transport will avoid the need for an individual car and one must start thinking about the conversion of factories. A new industry tends to chase another or reduce it. This means that nothing will happen easily overnight. This is why citizen consultation and their participation in debates prior to the choices made by elected officials are essential at all stages of the transformation. Recruiting ecologists in architectural and urban planning companies would show that biodiversity is taken into account.

Having just heard that a new type of concrete has been developed by researchers at the Polytechnic University of Catalonia, and being convinced that other similar innovations favourable to nature exist in France, I think that engineers, ecologists, artists and all inhabitants will be happy. The new type of concrete is suitable for the growth of moss, algae and lichens. It is no longer only the trees that will change color in the autumn! The changing seasons will be shown, even on concrete. The advantages of this specific concrete are environmental, thermal and aesthetic.

The greenery is insect and bird friendly and is beneficial to human health and to the beauty of the cities. So many benefits ahead!

Humans will enjoy a better life environment and urban planning will create urbanity.

Humanité et Biodiversité
110, bd Saint Germain 75006 Paris - France
00 33 (0)1 43 36 04 72
contact@humanite-biodiversite.fr
www.humanite-biodiversite.fr

Click back to the summary

Click back to the summary

URBAN ECOSYSTEM / CIRCULAR ECONOMY, WATER AND WASTE

Understanding the city as an ecosystem, Phosphore has chosen to tackle water and material management according to the circular economy principles. In contrast to the linear economy, where business development is inversely proportional to the depletion of natural resources, the challenge is to re-use waste from the processing of raw materials consumed. In a context of scarcity and increasing costs of fossil fuels and mineral resources and also of various threats to quality drinking water resources, it is crucial to reduce anthropogenic withdrawals from the natural environment and the pressures they generate on biodiversity.

Without going as far as evoking risks of supply or shortage, the quality and quantity of current reserves of drinking water in France are threatened by pollution and potential changes in patterns of precipitation as a result of climate change. A principle of precaution was adopted in analysing this threat. Taking into account factors such as the likely increase and frequency of violent rainstorms, the Phosphore laboratory started investigating the conditions for a reasoned management of water resources.

Upstream, it is about protecting the catchment areas that supply drinking water to cities from phytosanitary pollution. With a view to reducing consumption of this precious resource, it was proposed to prioritise its use depending on the needs. Whereas pure food and health uses and even some industrial processes require water of very good quality, rainwater is perfectly satisfactory for watering and road cleaning. To a certain extent, grey water can be used for washing operations.

Thus, the roofs of the Phosphore buildings collect meteoric water to be recycled with some grey water. Filtered and stored, it – meteoric water – is used for toilet flushing, washing machines and outside taps. Not only does this save normal consumption by a quarter, but also it reduces wastewater discharges into the sewer system. It is all the more important in the case of a combined sewer system. In fact, the dilution of pollution by rainwater in ever larger amounts – due to increased soil impermeability, the connection of new neighbourhoods and the likely rise in the frequency of intense rainfall – alters the performance of water treatment plants while contributing to a constant challenge of the volumes to be treated.

To solve the problem and better prevent the risk of flooding, the Phosphore laboratory also worked on the alternative management of stormwater to restore the natural capacity of soils to retain and purify water. In the Wacken neighbourhood of Phosphore 3 in Strasbourg, it is collected by a network of landscape ditches, and then directed to variable water tanks. The water run-off is collected along the roads, and then processed by a biological process of phytoremediation. These methods apply even to biological bathing, whose water is purified by plants in filtration and regeneration ponds. Families can then enjoy shallow water whilst swimmers take advantage of another area the size of an Olympic pool.

Biological bathing of Phosphore 3 at Strasbourg © EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary

WASTE

A workable plural potential

With the objective of creating a virtuous circle of material, from reduction at source of waste production to its final destination, the research laboratory explores all recycling avenues of this under-exploited raw material.
Based on the logic of life cycle analysis, it intends also to change perceptions on waste, now synonymous with scrap in the collective psyche.

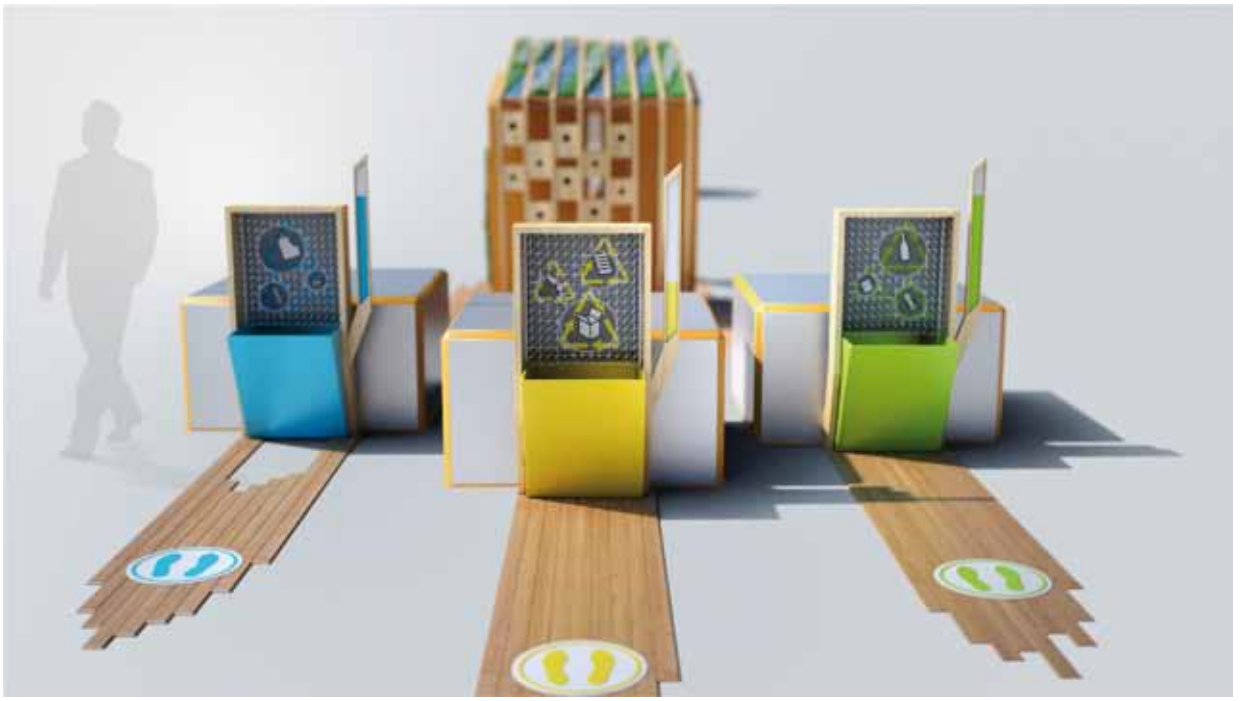
Door-to-door collection is replaced by voluntary contribution points for glass, recyclable and residual non-compostable waste. The contribution points are equipped with solar compactors to maximise the filling of containers, compatible with the modulos for a nuisance-free collection to the nearest recycling hall.
Finally, in order to improve sorting, which is known to be the weak point of the collection system, it has been made more fun and attractive by the design of interactive gauges and remote activation for the opening of the trapdoor.

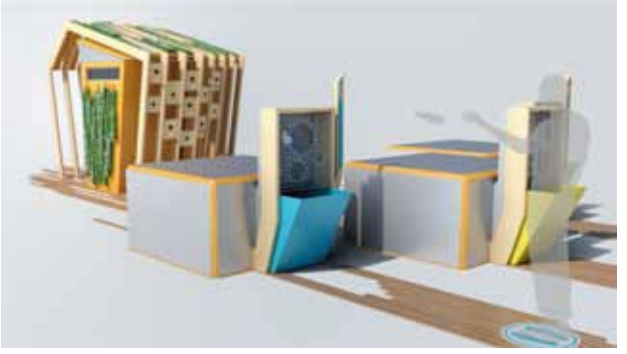
Other waste – used clothing, small household electricals and out of use electronics, etc. – is collected by the recycling hall to be recycled and have a new life. This is a universal hall, at the crossroads of a resource-recycling plant and a transport relay station, specifically dedicated to re-use or transfer waste-to-sorting centres, recycling workshops and waste-to-energy units. The priority in waste treatment, however, is given to repair and reutilisation, and then to the dismantling and reuse of components, prior to recycling. By controlling the discomforts associated with its activities in its close neighbourhood, the recycling hall is a replicable model that could be extended on the territory.

Energy recovery from waste incineration which produces only heat, comes as a last resort. The organic fraction of waste is valued more favourably with the development of composting and biogas plants, which provide a new storable raw material, used for soil amendment or fuel. With Phosphore 4 in Grenoble, compost at the bottom of the building replaces composting centres to capture and return fermentable household waste to its source. Large amounts of organic waste from agro-business activities or waste water treatment are, however, a considerable source of energy, which should be exploited by methanisation to produce biogas.

Voluntary contribution points of Phosphore 4 at Grenoble
© EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary





Click back to the summary

The urban farm and edible roofs, Phosphore 4, Grenoble metropolitan area

Click back to the summary

URBAN ECOSYSTEM / TOWARDS AN EDIBLE CITY?

The whittling away of natural spaces and agricultural land which results from urban expansion threatens natural services to cities, especially the essential service of food resources production. Faced with the globalisation of the food economy and the geographical specialisation of crops, local industries have become weaker.
Consequently, the city food footprint is degrading and increasingly distant supply increases the environmental impact of freight transport.
In view of this, how can the relocation of a part of the food production be encouraged?

In the same spirit as the experimental vegetable gardens on the building roofs in Paris, the Montreal sky farms or the "Incredible Edible" initiative in the UK[1], the Phosphore laboratory suggests ways to develop agriculture in the city. Cultivation of neglected urban land, edible roofs and even an educational urban farm: Phosphore seeks to explore all forms of agricultural integration into the urban fabric.

With Phosphore, the food crop reoccupies the urban space with a systemic approach, respectful of other ecological services like carbon cycle fulfillment and the natural purification of water.
The gaps in urban spaces and devalued land – subject to natural hazards or decontaminated after an industrial or commercial past – are exploited as flowery meadows, vegetable gardens and collective orchards. Rows of trees, parks and gardens are also used to host productive species.

In Grenoble in 2030, a farm adapted to urban constraints illustrates the integration of a circumscribed form of agriculture in the city, perfectly mastering its noise and possibly olfactory impacts. Without losing sight of the demands of sustainable farming, cultivation techniques are selected for their high added economic or social value coinciding with the cost of land: beekeeping, gardening in raised beds, aquaponics but also shared orchards and fields of flowers. The farm creates jobs and encourages people to eat "local and seasonal", promoting the development of alternative modes of consumption in the city.
Urban agriculture invades up to the roofs of buildings. Shared gardens offer residents the opportunity to reap the fruits of their organic crops.

1 Incredible Edible is a movement for food self-sufficiency through citizen participation initiated in Todmorden in the UK and known in France under the name *Incroyables Comestibles.*

Click back to the summary

THE MARKET GARDEN HALL

A local market in the heart of the city block

In Strasbourg, with this in mind, Phosphore promotes the production of local fruit and vegetables, echoing the old workers' gardens, near the Wacken neighbourhood. Now reserved exclusively for family use, one can imagine that their desirable development path, coupled with the need to reduce the food footprint of the city, has led to the partial commercialisation of their products, for example in the market garden hall.
Designed to promote short channel food supply, the universal hall revives the tradition of the market hall. It offers residents local and quality produce of a low carbon footprint. It stimulates living together and participating in the dynamism of the neighbourhood.

Connected to one another, the market garden hall forms a true network of local distribution refueled by the relay-halls positioned at the junction between the dense urban area and the rural periphery.

The market garden hall, Phosphore 3, Strasbourg
© EIFFAGE Sustainable Development Department / 3e-oeil.com studio / Pierre Gautier architecture

Click back to the summary

THE RELAY-HALL

A bridge between hyper-urban and rural populations

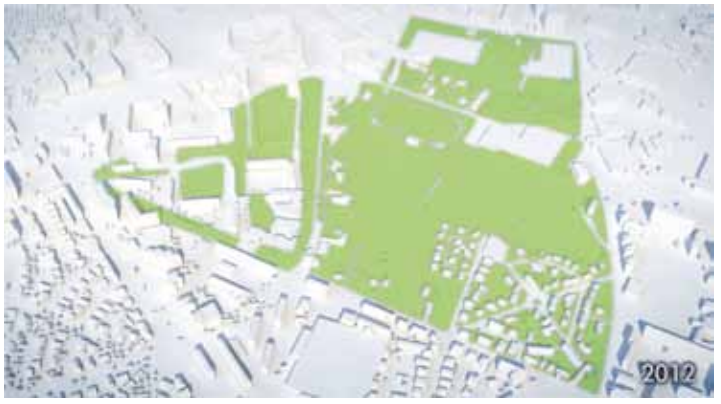
The need to control the carbon footprint when supplying cities and the growing urban appetite of urban dwellers for the local food, call for strengthened links between urban centres and the rural periphery, in a spirit of win-win-win for dwellers, farmers and the territory.
Acting as a bridge, the relay-hall connects these two worlds and their population in a spirit of reciprocity.

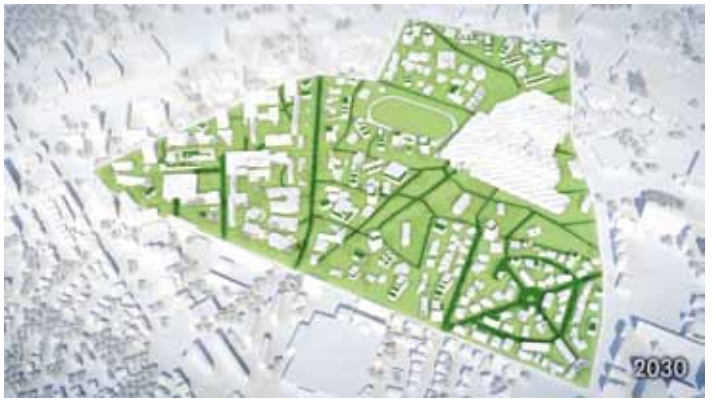
In a sense, it is an attractive place for marketing regional agricultural production – particularly from cooperatives of organic farmers and organisations such as the French network of associations for the preservation of local farming (AMAP). In addition to collecting and distributing food from the surrounding countryside to the urban centre, it can be involved in supporting the local rural economy, hosting workshops on agricultural processing and a tourist office dedicated to green tourism activities and accommodation.

In another sense, the relay-hall is also a branch of urban services, especially for the remote rural populations. It facilitates access to "central" administrative services, such as medical care, including specialised care, and to multimedia tools for people who are not connected. The relay-hall also plays a potential role in the dissemination of cultural events to a wider audience.

The operating principle of the relay-hall, Phosphore 4 in the Grenoble metropolitan area

Click back to the summary





The vegetated passive block and the principle of application of the biodiversity ratio in the Grenoble metropolitan area, Phosphore 4 © EIFFAGE / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

URBAN ECOSYSTEM / WHEN URBANISM PROMOTES BIODIVERSITY

Beyond the aesthetic and landscaping considerations of parks and gardens, the presence of nature in the city undoubtedly contributes to the maintenance of good health and quality of life in urban areas. Places of refuge relatively protected from noise and pollution, and from the "heat block" effect, the green spaces re-establish contact between urban dwellers and nature, providing much appreciated resources.

Phosphore teams have reflected on the best conditions for the development of urban biotopes to maintain the quantity and diversity of plant and animal populations in town, and revitalise the ecological services they can realistically provide. In the already dense urban fabric, it is first necessary to find solutions that will allow plants to create a vegetal fabric sufficiently conducive to host animal species adapted to an artificial environment, but with renatured "reservoirs" reconnected to each other. It is particularly important that cities emerge as shelters against pesticides spread by intensive agriculture in some outlying or rural areas, especially for critical but fragile species such as bees.

To achieve this at a time when artificial soil is one of the leading causes of biodiversity erosion in France, Phosphore has created a specific concept of biodiversity ratio, referring to the building to plot ratio. Inspired by the biotope area factor (CBS), and used experimentally in the city of Berlin, it is an ecology minimum standard to encourage developers and real estate operators to promote the integration of biotopes in all their projects.
This new urban planning rule, based on the land occupation ratio, sets the minimum percentage of horizontal and vertical surfaces allocated to the development of biodiversity on a specific plot.
It has a dual objective: to limit undeveloped soil sealing and vegetated buildings. With a view to applicability, its value reflects the urban density and the nature of the operation: unlike renovation or rehabilitation, new developments or new constructions allow, in effect, a greater margin of manœuvre for the integration of biotopes at the design stage.

However, the social acceptability of the return of all urban biodiversity components, especially species considered in the collective unconscious as pests or parasites, such as rodents or insects, raises questions, particularly in terms of health. Far from wanting to transform the city into an "urban zoo" by reintroducing animals, the goal of Phosphore is to identify surfaces conducive to the development and movement of species while minimising the inconvenience of coexistence pushed to the extreme. This approach promotes the most appropriate plant species – with weak allergenic and invasive potential, capacities to fix or clean pollutants, local plants with a good tolerance to low light and lack of fluid intake – while keeping away the people from the developed or potential animal shelters for their mutual well-being.

Click back to the summary

While the greenways and blueways will be an essential component of sustainable land management, the Phosphore laboratory does not pretend to be able to use the terms "biological reservoirs" and "ecological corridors" as such in urban areas. However, it is keen on reviving the natural fabric at the heart of the cities in order to foster the development of urban biodiversity that provides environmental services.

Phosphore therefore proposes that the interstitial spaces in the city, parking areas and outdoor urban wastelands are partially reoccupied by a local flora supporting biological life. These new surfaces complement the initial greenway in public parks and gardens, which are often the only refuge for plant and animal populations in dense urban areas. As long as the lawns are replaced by honey meadows, the hedges and shrubs are diversified in private gardens and intensively vegetalised roofs are preferred to the superficial stonecrops, the built sites may also participate in a secondary greenway both on the ground and in the air.

However, even if this is combined with animal-friendly land plots limits, it is probably utopian to think that a greenway alone can ensure the dispersal of plants and the free movement of wildlife, beyond insects, birds and small mammals. To connect these islands of heterogeneous and dispersed nature, Phosphore is trying to create real continuities if not biological, at least in terms of landscape, through the application of the biodiversity ratio on certain public roads.
The major roads which are large enough, or the secondary roads, could be gradually deconstructed and renatured at determined pace of renovation or redevelopment. The green vegetation along the bottom of walls would be followed by stages of enlargement and sealing of pavements, and then revegetation. Lower inert mineral layers could be mixed in situ with organic matter to reconstruct a living "topsoil" avoiding the removal of off-site arable land. The functionality of the ground would be restored on those greenways closed to motorised traffic – except emergency vehicles and electric modulos for waste collection – which extend the routes dedicated to soft mobility.

Added to the opening of the waterways, as is the case for the Verderet at Phosphore 4 in Grenoble, the ditches and basins designed as an alternative way of managing rainwater, form a dotted network of wetland micro-habitats, precursor of the urban blueway.

Phosphore 4 renatured road in the Grenoble metropolitan area © EIFFAGE / Grenoble-Alpes Métropole / POMA / Pierre Gautier architecture et associée / DASSAULT SYSTEMES

Click back to the summary

Click back to the summary

POSTSCRIPT

"The 21st century city: an object in the making"

© Eric Van Den Broek - Mutinerie / New Cities Foundation

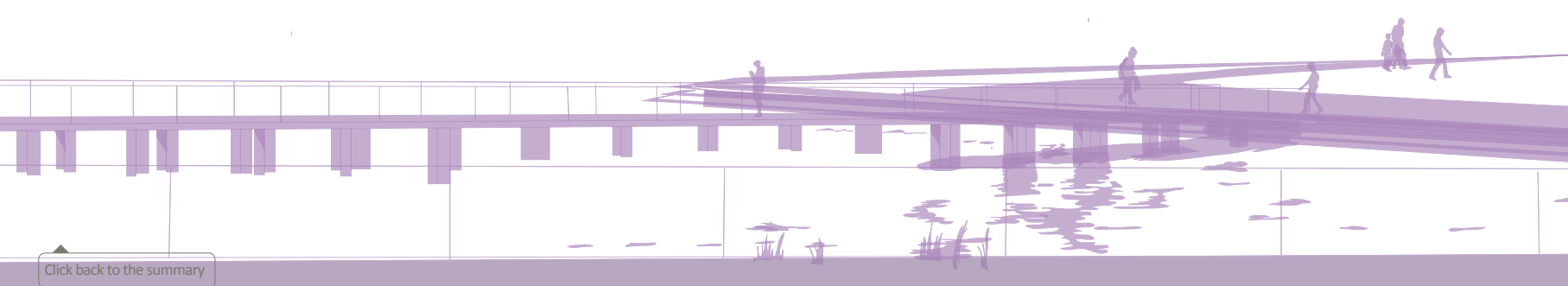
Mathieu Lefèvre is Executive Director of New Cities Foundation, with Naureen Kabir and Cristian Santibanez.

"The city has had to evolve in its materiality, authorities have been confronted, due to the growing number of urban dwellers to problems hitherto unknown. Westerners [...] underwent fundamental change which they were acutely aware of. Some of them were glad and others scared by the magnitude and consequences of a phenomenon that was transforming their way of life, before their eyes. Yet neither supporters nor opponents could deny its reality."

Le monde des villes au XIXe siècle **(World cities in the Nineteenth Century), Jean-Luc Pinol (1991)**

We are at the dawn of the century of cities. What is striking about the current urbanisation, is primarily the speed at which some regions in the world are embracing the city. Seen from Europe, the phenomenon is most surprising, but we must not let it disconcert us. Globally, the growth of the urban population will happen mainly between 2000 and 2030 and is expected to stabilise to around 6.8 billion city dwellers by 2050. It is mainly driven by two continents, Africa and Asia, but taken as a whole, it represents nearly 3 billion new urbanites in one generation – almost half the population of the planet.

In Western and European urban history, we have entered a phase of consolidation, while the rest of the world is about to suffer the brunt of rapid urbanisation. Faced with this global trend, the European experience of the city, resulting from at least two hundred years of steady growth and rapid increase in the population, is unequivocally one of our major assets. Let's not forget that Europe already experienced this profound transformation in the 19th century, from about 19 million urbanites in 1800 to 130 million in 1910.



Click back to the summary

"We must understand the city and its complexities"

This experience of the city in a world still dominated by rural life is the crucible in which our imagination and our representations of the city were forged. At the dawn of the century of cities, it is this imagery and these representations that we have to reinvent. We are heirs to a vision of the city too often equated with vice, squalor, loss of social ties and sense of community. It is time to go beyond, to take account of the immense urban wave that is sweeping the world, and to seize opportunities. Since 2008 and the symbolic crossing of the 50% of global urbanites threshold, the rhetoric around the city is increasing, alternating with an optimistic and a negative vision, doomsday scenarios and utopian scenarios. But this wave is that of a society where our symbols and representations – our culture – are undeniably dominated by the figure of new and emerging urban spaces.

What we call the city today and what we will call the city of tomorrow is not the same thing. If we are able to grasp the importance of the cities, we cannot claim to know in advance what they will be like tomorrow.
We can, however, identify the foundations and walk in the right direction. Today, it is perhaps the Organisation for Economic Co-operation and Development (OECD) that best captures the essence of this urban complexity by proposing a definition of the city that no longer relies on buildings or on the population, but on the relationship between flows and centres[1]. The metropolis of the 21st century will be this dichotomy and complementarity. To simplify it is a mistake: it is in the complexity that it must be understood. That what we call urban reality is called the systemic approach by the Phosphore laboratory.

The conclusions and the method presented in this book echo the major paradigms and idea systems around which the city of the 21st century is being built. Along these lines, we want to deliver food for thought, both a historical and prospective perspective, to better understand the complexity of these spaces around which and in which our future lies.

Click back to the summary

"Cities are both the problem and the solution"

In search of the 21st century city

Cities already produce more than 70% of global emissions of CO_2, they consume two-thirds of the world's energy and account for nearly 80% of the planet's GDP. In this sense, the global dimension of the urban phenomenon invites us to think today of the global challenges at an urban scale. To prepare for the future, we must focus primarily on cities: it is they that can both exacerbate inequality, crime and environmental degradation, crystallise an excessive consumption, or become the seedbed of more efficient environmental, social and economic solutions. In other words, cities are both the problem and the solution. The data is there: it is now a question of articulating them in an intelligible manner.

If our images and representations of the city – our urban culture – have gradually evolved, they are today more than ever confronted with a global reality that we cannot escape. Cities have always lived to the rhythm of the tensions of the century; they are witnesses to societal changes, new political demands, a re-appropriation of space, and, for a large part of the population, (re)learning societal codes – the "Arab Spring" is thus largely a phenomenon of urban protest. In this sense, the city of the 21st century should not be an exception.

By 2025, 577 cities with a population between 150,000 and 10 million people will be the source of more than half of the global growth. These are, for the most part, cities which we are just beginning to hear the names of in Europe – for example: Qingdao, Fortaleza, Surat, Luanda, or Changsha.

"By 2025, 577 cities with a population between 150,000 and 10 million people will be the source of more than half of the global growth."

The challenges and resources of these areas in the making are not the same. There is therefore a need to focus on the unit, the building, the neighbourhood, and the block – smaller scales which have the merit to highlight a shared complexity with

Click back to the summary

a dimension much easier to grasp – without putting aside, as many urban planners were able to do in the past, the general interest of the whole space. In other words, it is in the articulation between the infinitely small and the disproportionately large that one must flush out the devil and understand the city of tomorrow.

"Trying now to start a true conceptual and technical breakthrough of the city."

The systemic approach and the results of the exercises conducted in Marseilles, Strasbourg, and for the Grenoble metropolitan area, move in this direction. But beyond the French context, the assumed willingness to place at the heart of the method of thought, the complexity and characteristics of the urban spaces studied, may be useful in many other cities around the world. Take, for example, Santiago in Chile: the economic capital of the country, producing nearly 40% of the national wealth, the city wanted to put in place an ambitious public transport project a few years ago, the Transantiago. Victim of ministerial segmentation and lack of coordination between the different actors of the city, it is a classic example of a superb plan on paper, but it has collided head-on with urban reality, on a much finer scale than the assumptions of engineers and other experts who had conceived it.

Mobility problems affect us on a daily basis, they are easier to grasp. But the city also has much more complex aggregated problems: while 93% of municipal governments believe that their environmental policies will have a positive impact on the economy, there are little more than 24% of them which have developed a truly coordinated green growth strategy. In view of the environmental challenges and the scale of social changes of our time, taking action has become a matter of individual and collective responsibility, for us and for future generations.

Flourishing urban innovations

In an article published in the newspaper *Le Monde*[2] recently, we discover how the cable car, as a complementary mode of transport, has made a strong comeback, drawing on the experiences of Medellin, in Colombia, and Caracas, in Venezuela. Since we can see also

Click back to the summary

"New models are emerging"

in Rio or Hong Kong. The rapid transit bus (Bus Rapid Transit) deployed in Curitiba, Brazil, has inspired nearly 150 cities around the world and now carries more than 25 million people.

Similarly, to allow low-income urbanites access to a wage and employment, organisations such as Samasource develop new business models based on information technologies to facilitate access to work in the cities of Africa and Asia[3]. Think of La Courneuve in France and its 25% unemployment.

Likewise, to invite all citizens to participate and engage in the political future of their city, a citizen platform, *Meu Rio*, develops tools for online participation in Rio de Janeiro. Think of the loss of confidence in our institutions and our representatives so often put forward by sociologists and journalists.

Could we not learn from these cities and countries that we tend to underestimate or look at in a condescending way? These examples, among many others, illustrate how emerging cities adapt solutions to their urban context that were not necessarily conceived that way to start with.

Towards a new urban paradigm?

These solutions have a high potential for systemic impact. Still little known not so much because of a lack of willingness from those who implement them but more because of a relative lack of interest from other sectors, too often busy looking for how to restructure in a crisis. It is worth remembering these words from the last article by Elinor Ostrom, Nobel Prize winner in Economics: "Worldwide, we are seeing a heterogeneous collection of cities interacting in a way that could have far-reaching influence on how Earth's entire life-support system evolves. These cities are learning from one another, building on good ideas and jettisoning poorer ones [...]. In the coming decades, we may see a global system of interconnected sustainable cities emerging. If successful, everyone will want to join the club"[4]. In other words, new models are emerging, new forms of action are becoming a reference. Then, Europe can – and must – learn from emerging cities, and vice versa.

Rethinking the relationship between the players that shape the city is more than ever necessary. The open, dynamic, fair, creative and sustainable city – the city in which everyone can aspire legitimately – relies on urban governance that recognises, encourages, and is

Click back to the summary

enriched with new forms of collaboration among citizens, municipalities and businesses, closely involving the voluntary sector and the research community. These players will benefit from the wealth and expertise of each. In other words, these new models that we are going to build must be able to capture the essence of the 21st century cities and should enable us to build together a unifying urban future based on a renewed paradigm.

These solutions reveal that the metropolis of the 21st century is a thing in the making that we do not yet know. The paradigm foundations of urban growth over the last two hundred years have been laid by us, Europeans, and it is from them that we will build the cities of the 21st century. But we are not alone in laying bricks – we are the ones who pose the least. The cities of tomorrow cannot be reduced to spaces defined uniquely by the presence, more or less important, of humans: their complexity is both problematic and hopeful. Hopeful because, as, like numerous examples from around the world show us, it is in this same complexity that durable solutions are born.

If the population growth has been the driving force of the first century of cities, the common theme of the 21st century is composite and invites us to reconsider the idea that we have of the city. Put into perspective, the solutions mentioned above seem to draw a roadmap and the first outlines of what tomorrow's urban spaces will be: cities based on the principles of sustainable development, concerned about the natural and social environment in the context of which they form a part, never ignoring the fact of the complexity of reality and constantly seeking to reconcile the individual and the general interest.

"If the population growth has been the driving force of the first century of cities, the common theme of the 21st century is composite."

From our point of view, there are few territories where the challenges of complexity, the metropolis, and the new urban governance are more important than that of the "Grand Paris". We know from experience that planners, policy makers and businesses around the world – from Moscow to Beijing via São Paulo – are watching carefully what will become the "Grand Paris", certainly ambitious, but ill-defined, when it is essential for the economic and social vitality throughout Europe and for its exemplary environmental issues.

Click back to the summary

"Rethinking the relationships between the players who shape the city"

Beyond the mega-urban transport plan, our "Grand Paris" requires a true vision which perhaps we cannot see today. Without this dream, underpinned by metropolitan governance and systemic thinking, the Grand Paris seems very small.

The architect and former mayor of the Brazilian city of Curitiba, Jaime Lerner, said humorously that the slogan of the city of tomorrow could be: "Basta de obras, ¡queremos Promesas!", "Enough work, we want promises." This could well apply to the "Grand Paris" because it is rich in plans and sketches, but do we not have reason to fear it is short-sighted? At a time when international urban competition looks tough, what could be missing for the "Grand Paris" is this intangible identity – yet essential – that has allowed cities of yesterday to become tomorrow's big cities capable of rising from the ashes.

The unimaginable progress made in one generation, especially in information technology applied to the city together with our expertise and our commitment to creating more sustainable cities, dynamic, creative and just, means that our future is open. It is in our hands. The contradictions of the 19th century cities were found in those of the 20th century. It is up to us to make sure that it is different in the 21st century.

1 For more information concerning the method that the OECD is currently developing for identifying functional spaces, see www.oecd.org/dataoecd/41/37/45511614.pdf
2 « Les projets de téléphérique urbain fleurissent en France » ("urban cable projects flourish in France"), published in the newspaper *Le Monde* under the Planet section October 14, 2010
3 See http://samasource.org/mission/how-we-work/ for details
4 original text: "Worldwide, we are seeing a collection of cities heterogeneous interacting in a way that could have far-reaching influence on how Earth's entire life-support system evolves. These cities are learning from one another, building on good ideas and jettisoning poorer ones. (...). In the coming decades, we may see a global system of interconnected sustainable cities emerging. If successful, everyone will want to join the club" extract from *Green from the Grassroots* by Elinor Ostrom.
The full text in English is available at the following address: http://www.project-syndicate.org/commentary/green-from-the-grassroots.

Click back to the summary

Since 2007, the four sessions of the Phosphore research laboratory have imagined sustainable urban development by 2030 in three virtual playgrounds:

- **in Marseilles: Phosphore 1 (2007-2008) and Phosphore 2 (2008-2009);**
- **in Strasbourg (2010-2011);**
- **in the Grenoble metropolitan area (2011-2012).**

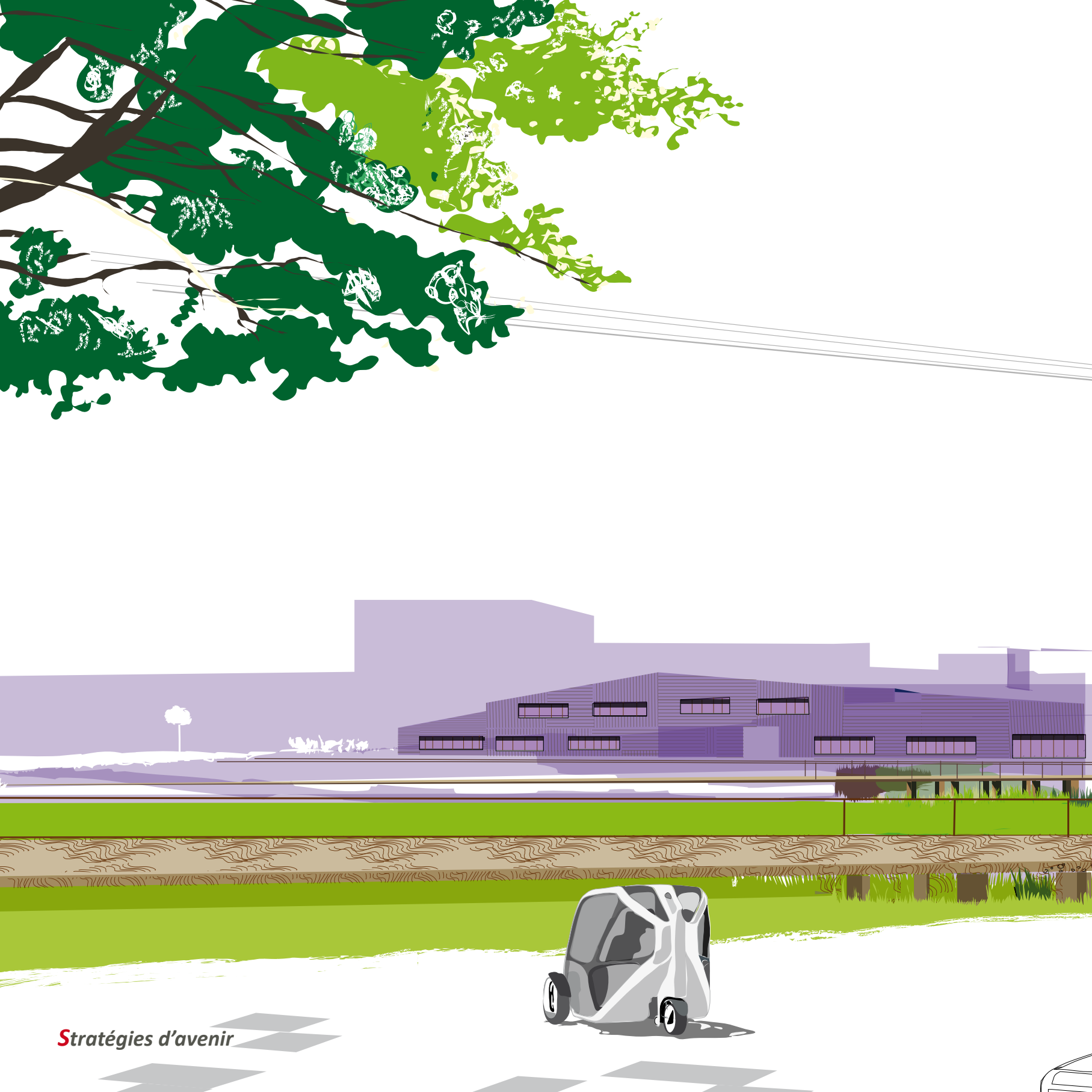
The contributors, all from different professions at Eiffage, are representative of the diversity of Phosphore: mixed genres and generations, various backgrounds – from sciences to humanities and social sciences – varied professional experiences and personal stories.

Here's the complete list:

Frédérique Alacoque (EC), Iswann Ali Benali (DDD), Bernard Aversenq (APRR), Fadila Azouaou (EC), Dominique Bellegy (EM), Marcel Bernhard (EE), Victor Blondel (EM), Valérie Boniface (EM), Jacques Bouillot (EC), Jean-Louis Boularan (EC), Isabelle Boyeau (EC), Alexandra Brunetto (DDD), Christophe Buhot (EM), Thomas Caron (EE), Jean-Jacques Charrie Thollot (ETP), Jacques Chassany (EC), Joël Chaudier (EM), Mélanie Coessin (DDD), Xavier Couraud (EE), José Cumplido (EC), Jean-Pierre Daillère (ETP), Christian Dal Santo (EC), François Dapilly (EC), Marie Dariel (DDD), Valérie David (DDD), Christophe Degand (EE), Dominique Delmas (ETP), Philippe Deveau (EM), Maxence Dewulder (EE), Stéphane Dufresne (EE), Vincent Dumas (EE), Charles Dunesme (EM), Marc Duprat (EC), Jacques Durieux (APRR), François Farges (APRR), Geneviève Ferone (DDD), Romain Ferré (EC), Daniel Frasca (EC), Vianney Fullhardt (EC), Stéphane Gaffié (ETP), Marie Gauthier (DDD), Pierre Gauthier (EC), Cyril Goiset (EM), Jean-Michel Grave (EE), Nicolas Gravit (EC), Fabrice Guichard (EM), Aurélie Guillois (EC), Jean-Jacques Jarland (EC), Ingrid Jouve (EC), Hervé Knoery (EM), Jean-François Langumier (APRR), Daniel Lauton (APRR), Sarah Lavaux (DDD), John-Mathieu Laverty (EC), Alain Le Floch Eiffage Concessions, Emilie Lefebvre (EC), Joachim Lémeri (DDD), Denis Levasseur (EE), Valérie Loubès (ETP), Jean-Pierre Mahé (EC), Christophe Mathey (APRR), Michel Measson (ETP), Isabelle Metais (EM), Philippe Montel (ETP), Marc Moretti (APRR), Nicolas Moronval (DDD), Leïla Nassiri (ETP), Bastien Nevejans (EE), Michel Noble (EC), Jean-Raphaël Ogé (EM), Fabrice Ollier (APRR), Evelyne Osmani (EC), Julien Ousteau (EM), Brigitte Outrey (EC), Nathalie Paillon (ECM), Maxime Pain (DDD), Régis Pajadon (EC), Emmanuel Passchier (EE), Frédéric Pastor (DDD), Vincent Pereira (DDD), Sylvain Ponçon (DDD), Patrick Quentin (EC), Henri Quenel (EC), Karuk Quinol (EC), Marie-Françoise Roussel (ETP), Henri Roy (EC), Dena Rozwadowski-Monribot (EE), Bernard Savary (EC), Cécile Séry (EC), Hervé-Patrick Stella (EC), Franck Templer (EM), Thierry Thibaux (ETP), Céline Tilly (DDD), Yves Urbain (APRR), Charlotte Valancogne (ETP), Sébastien Vicherd (EE), Yves Vircondelet (EE), Hervé Willaume (ETP).

EC : Eiffage Construction (construction)
EE : Eiffage Energie (energy)
EM : Eiffage Métal (metal)
ETP : Eiffage Travaux Publics (public works)
DDD : Sustainable Development Department Eiffage

Click back to the summary



Stratégies d'avenir