COP22

POSITION PAPER

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UN CLIMATE CHANGE CONFERENCE

THE CLIMATE STAKES OF CONSTRUCTION

Circular economy, biodiversity:
How can transverse solutions be developed ?

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For more information, please contact:

Alice SARRAN | Circular economy / Territory project leader
sarran@oree.org | +33 (0)1 48 24 31 33

Camille SAINT JEAN | Circular economy / Recycling project manager
saint-jean@oree.org | + 33 (0)1 48 24 31 39

Hélène LERICHE | Biodiversity and economy supervisor
leriche@oree.org | +33 (0)1 48 24 31 38

Many thanks to ORÉE team members for their commitment to the making of this paper: Nathalie BOYER, Cécile COUTEAU, Camille GRANGIER, Hélène LERICHE, Mélodie MERENDA, Camille SAINT JEAN et Alice SARRAN.

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Association ORÉE | 42 rue Faubourg Poissonnière 75 010 Paris

EDITORIAL

Patricia SAVIN, President of ORÉE

ORÉE has been working for a number of years on the topics of circular economy and biodiversity and has realized the need to analyze these subjects simultaneously in order to fight climate change more efficiently. The built environment is an excellent support for experimentation to deal with these subjects through a multi-actors approach and in a transverse and systemic manner.

The present note is based on various ORÉE's works in which our members have taken part, namely:

- in Circular economy, the cycle of the Circular economy/Territory Working group (2014/2015) on the theme of « flows and channels » resulted in 2015 in a deliverable which specifically broached these stakes where the protection of resources and the climate is concerned. Subsequent to this work, at the beginning of 2016, ORÉE launched a new cycle of « Circular economy and planning » Working Group which broaches among other subjects the topic of construction.

  ORÉE's Deconstruction Club Métiers has addressed, since the beginning of 2015, the challenges facing contractors on the subject of the deconstructing buildings and infrastructures and the Public Works waste (inert and finishing works) generated. The subjects which have already been explored are, amongst others, the best organisation practices of the deconstruction sites, traceability, the eco-design of buildings in view of anticipating their deconstruction, and the economic interest of deconstruction (specifically re-use);
- In Biodiversity, the built environment is broached in the ORÉE « Building and Biodiversity » Working group. Since June 2013, this working group has been working on assessing the impacts and dependencies of buildings regarding biodiversity. Based on the research work and feedback from members, ORÉE's Biodiversity and Economy Working group is also developing a long-term reflexion. The links and interdependences between the future of biodiversity and climate change evolutions are broached in the document published during COP21 in 2015 [(2)].

  Enjoy your reading!

  We really wish COP22 will allow the translation of the actions which need to be implemented after the COP21 and Paris Agreement.

INTRODUCTION

In France, the building sector represents 43% of total energy consumption and produces over 120 millions of tonnes of CO2 per year, i.e. almost a quarter of the country's emissions [(3)]. Buildings use energy and emit greenhouse gas emissions (GHG emissions) during their building phase (extraction and processing of materials, building sites), in their use and maintenance phase (heating, electricity, etc.), and also in their spatial distribution. Urban spread leads for instance to lengthening distances and a more intensive use of cars. It also contributes to the destruction of habitats and to the erosion of biodiversity due to the artificialisation of soils.

If the word « building » means an isolated object, the term built environment implies thinking the interactions and synergies which take place both between the buildings themselves and between the buildings and their environment. The built environment includes all the functions (habitat, tertiary, etc.). However, the term excludes linear infrastructures (roads, railways and technical networks).

Two approaches can be used to apprehend and understand the links between built environment and climate. On the one hand, circular economy provides ideas for solutions to reduce the impact of the built environment and thus participate in mitigating climate change. Indeed, in its principle, it aims at preventing and reducing the use of resources (therefore of the associated emissions), optimising and closing the loops of materials and energy flows. It seeks to reproduce the principle according to which « Nature produces no waste», and implement it into human activities. In a global approach, circular economy deals with both direct and indirect emissions (grey emissions) [(4)]. It contributes to the reduction of pressure on the territories (avoiding deforestation, etc.) and thus contributes to the transition towards a more sober and efficient system.

On the other hand, the necessary adaptation to climate change implies rethinking the management of biodiversity at construction level. This plays an essential role in the resilience of territories, including urban ones, which are subject to the acceleration of climate change [(5)]. This particularly implies the protection and restoration of natural environments, the management of agricultural and forest areas faced with increasing land pressure, and also the design of built areas which give more room to biodiversity.

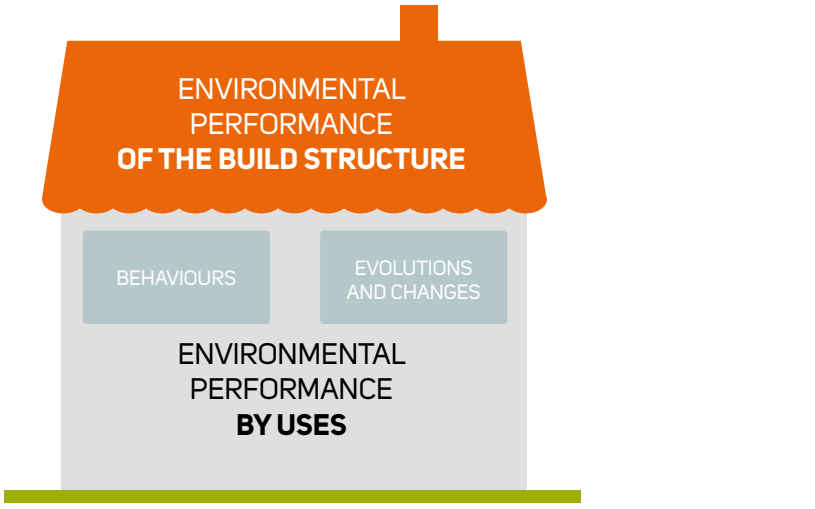
DESIGNING THE BUILT ENVIRONMENT

IN THE LIGHT OF CLIMATE CHANGE BY INTEGRATING BIODIVERSITY AND CIRCULAR ECONOMY

The most used resources in the building sector, such as sand and metals, are non-renewable resources. Extracted, transported and processed in ever-increasing quantities, at ever-higher energy costs and with consequences which are far from negligible for the environment, their use does not fit with a sustainable logic. Thinking in terms of circular economy prompts us to take another look at these linear and consuming models, at both the level of materials for building, energy, land, and that of waste management.

Building and planning projects which take biodiversity [6], into consideration anticipate the protection of the natural environments which could be destroyed for the extraction of materials (« ex situ » biodiversity). On the built land (« in situ » biodiversity), it should be privileged to choose parcels with less ecological value, while reducing the floor space of the building and developing biodiversity areas (on the ground, the walls, the roofs). In addition to this, the operating phase, also known as « use and maintenance », is thought as to upsetting the functioning of existing ecosystems (wildlife movement, collisions avoided, managed water draining, etc.) as little as possible.

The aim is therefore to act on the efficiency of the building, that is to say, to reduce its consumption and lessen its emissions, in order to control its impact on the climate. These efforts can directly bear on the environmental performance of the structure (reduced energy consumption, renewable materials, re-use as well as taking biodiversity into consideration). However, to reach a global performance, it is also necessary to take users and their practices into consideration (see diagram 1 below).



- Producing sober, efficient buildings and factoring in biodiversity
- Making it possible to accompany the user in order to limit consumption
- Creating the conditions needed for a development of the functions of the built environment over time

Designing efficient buildings by structure and use

The environmental performance of the built structure

The performance of the built structure can be anticipated according to four complementary criteria: sobriety, the optimisation of the building, modularity (which consists of changing the building to adapt it to the needs of users), and reversibility (which makes it possible to consider a recovery of material and soils). These complementarities enable a lesser consumption of resources and protection of environments in the short, medium and long term. They enable a global vision of the building's life cycle, from design to use and maintenance phases right through to deconstruction.

Sobriety as the guiding principle of construction

In any planning operation, the needs have to be accurately assessed in order to best define the available options when carrying out work on the existing building or getting started in new building constructions, in order to protect resources in the best possible way and limit the artificialisation of soils.

In biodiversity, this principle is illustrated by the ARC doctrine, « Avoid, Reduce, Compensate », which is a legal obligation established by the law for the recovery of biodiversity, nature and landscapes of July 2016. In circular economy, the « 3 R » approach (« Reduce, Re-use, Recycle ») is inviting to consider first and foremost how the production of waste can be avoided (prevention, fighting programmed obsolescence, etc.). In French law this approach has resulted in the Waste Framework Directive which recommends ranking processing methods by encouraging prevention, re-use and re-employment before even considering recycling or energy recovery.

Therefore this means first exploring the possibilities available and offered by construction in order to consider a densification, changes in functions or transfers, in order to be as virtuous as possible regarding the responsible use of space, materials and energy.

When new construction or the extension of the built environment becomes necessary, an eco-design approach must be adopted to maximise the building's efficiency. For instance, passive buildings or positive energy buildings are designed to produce renewable energy which compensates (passive), or even exceeds (positive) this consumption. Future changes must also be anticipated, keeping in mind the necessary protection of ecosystems.

The living world, which grows under spatial and energy constraints, can also serve as an example. The re-use of materials, the multi-functionality of shared spaces are just some of the inspiring aspects of biodiversity for construction. Biomimicry contains a number of innovations, including for the running of buildings, as is shown in the example of the luxury Eastgate hotel in Harare (Zimbabwe) built with neither heating nor air-conditioning, and which gets its inspiration from « Macrotermitinae » termites who are capable of maintaining constant temperature and hygrometry in their mounds in order to cultivate the fungus which takes part in their food process.

The optimisation, modularity and reversibility triad of construction

Eco-design also consists of taking a closer look at the materials used and the building processes, in order to guarantee their efficiency in terms of environmental performance (optimisation) from the energy point of view (justified environmental cost, environmental solutions adapted to requirement). Life Cycle Analysis (LCA) is a multi-criteria tool which enables the assessment of the environmental impacts of the necessary flows of materials and energy right through the lifespan of a product or service (from cradle to grave), using an assessment of the global energy cost (investment and operating cost). In the case of a building, this includes the extraction phase of building materials, its construction, use, maintenance and deconstruction phases, while taking into account the impacts of transportation at each stage. LCA also makes it possible to compare different scenarios with a view to eco-design. For example, renewable, local (to minimize emissions during transport), and bio-sourced materials. However, bio-sourced materials warrant serious consideration regarding the choice of species, local production capacities and the frequency of ressources renewal. It is not actually a question of replacing food crops by « industrial » crops dedicated to materials production. It is important to be careful in the choice of species (avoiding potentially invasive species) and to exploit in the best possible way and with respect for the capacities of the environment (vegetation renewal rate, soil protection, etc.) the potentialities offered locally for procurement.

Anticipating modularity in the eco-design of new buildings makes it possible to favour their re-employment/re-use to extend their technical lifespan. Eco-design avoids construction obsolescence so that, in the future, its transfer can be facilitated (see legal insert 1). For this, special attention can be paid to the design of materials and multi-purpose buildings (which can house several functions) rather than hyper-specialised ones. This means being capable of adapting the built environment by modifying it as little as possible: in the design phase, this implies anticipating this versatility, for example regarding technical elements such as connections (see insert « Bouygues Immobilier OWWI »).

1: legal, economic, normative blocks to the modularity of construction and reversible construction

Three essential obstacles to construction modularity can be identified. Firstly, the mutualisation of facilities generates issues of responsibility. Secondly, the transition of facilities is confronted with different tax or normative obstacles and the constraints of co-ownership regulations. Thirdly, the integration of recycled materials in operations is subject to legal constraints and leads to consequences regarding responsibility. The question of the promoter's ten-year guarantee is also raised in the case of recycled products, in as far as this tool is not adaped to recycling.

- Reversible construction is an emerging concept in the building sector, particularly for offices. It aims at anticipating the change of function from the design stage.
- Regulations are also changing according to practices (e.g.: car parks, etc.). We need to be able to test innovative practices (right to experimentation) in order to identify the obstacles or too stringent standards and allow for an adaptation of the legislation to these practices.

Bouygues Immobilier OWWI: adaptable housing

Bouygues Immobilier, with its OWWI offer, applies the principle of building modularity in a very practical manner. Thanks to an innovative system, electrical cable ducting systems at the top of load-bearing walls make it possible to develop an electrical distribution system in movable partitions, without using a raised floor or a technical ceiling. This housing unit is fully personalisable and progressive. The firm offers its clients, on the basis of four load-bearing walls, the personalisation of their future living area according to their needs using the Reliz3D 3D modelling tool. OWWI will also enable the inhabitants of the housing unit to rearrange it right through its lifespan. It will therefore be possible, with a minimum of work and at a reduced cost, to make a studio flat independent from the rest of the flat in order to anticipate the progressive decohabitation of a teenager, or simply create a new room or even enlarge the living room when a child has left home. OWWI is a flexible solution which follows the inhabitants' uses and at the service of the housing unit's sustainability.

Lastly, from the design stage, the reversibility of facilities must be taken into consideration. This specifically means enabling the recovery of building materials at a lesser environmental cost: the eco-design of the built environment must necessarily take into account the prospect of deconstruction. To this end, the use of certain complex materials, such as alloys, or certain processes, such as glues, must be limited as they make it difficult to deconstruct, re-use and recycle material. Tools to do so are available to the actors of spatial planning, such as the BAZED web site which aims at accompanying approaches of «zero waste, reusable and upgradable buildings which can be dismantled» [(7)].

It should also be possible to make land available to new users, including the restoration of the dynamics of natural ecosystems (on pollution-free soils for instance). To enable this resilience, particular care must be taken from the design stage to the protection of ecosystems, in the building phase (protection of the trees on the site, harvesting of soil before building begins for the subsequent restoration of green spaces), which is often disturbing for wildlife, and during the building lifetime. A number of technical solutions are available to the actors of the built environment to enable ecosystems to continue developing (building on piles for example) and be restored after the building has been deconstructed (depollution of soils by flora...) [(8)].

Thinking about the users to improve environmental performance

Tools for acting on the performance of the built structure leave out essential aspects: The Life Cycle Analysis, for instance, does not include certain parameters, such as the performances related to the inhabitants of a building, which do actually have a very important role to play. The relationships between users and performance of the built environment can be broached first by the users themselves. For example, how can they be encouraged to become the actors of consumption reduction, to take part in the building's performance and seize over the technical or technological systems to use them in the best possible way? On the other hand, modularity, mentioned above, consists of adapting the built environment to new uses.

The protection of biodiversity is also poorly taken into consideration in LCA: if certain calculation criteria are indirectly linked to biodiversity (global warming, soil eutrophication, etc.), only the « land use » indicator assesses approximately the biodiversity losses by converting them into surface areas (the floor space of a building for instance). It is for this reason that this indicator is considered as being « not robust ». Yet a building cannot be considered as really efficient from the environmental point of view if, while producing very little GHG, it contributes to the impoverishment of the ecosystems which contribute to the regulation of the climate. A better consideration of biodiversity can also be encouraged by a change in uses (mentalities and practices), particularly by raising awareness on these issues to target creating new links between human activities and the biosphere in buildings (see insert « Vertdéco »).

The reciprocal challenges of biodiversity and circular economy: Vertdéco

Vertdéco is a company which designs, develops and maintains landscaped areas, factoring in biodiversity. However, it is faced with the issue of the acceptability of the projects: landscaped areas have a particular aspect at certain times of year because they produce dead leaves and fallen fruit, etc. The company's approach is therefore that of raising its clients' awareness: all these « wastes » are actually materials which can be recovered, as compost on the spot, and reintegrated into the natural cycles of landscaped areas. There is a clear link between the issues of biodiversity and circular economy which gets its inspiration from this. Indeed, one of the major stakes in circular economy is to change the way users and inhabitants see what is currently considered as a disturbance but which is actually a resource. Managers can for instance contribute to closing the loops of flows on the scale of the buildings, setting up educational initiatives, raising awareness on circular economy, biodiversity and the natural cycles of plants (by means of shared gardens, for example) contributing at the same time to quality of life.

The behaviour lever: facilitating and motivating energy saving

Several levers can be used to support users in the management of their use of resources (water, materials, energy), and thus improve the performances of the building. These solutions invite users and inhabitants to regain control of the stakes and solutions that they can also initiate, and modify their behaviour to limit their consumption.

Nudges

The nudge or how to gently motivate people to change their behaviour without them realizing, through, for instance, gamification/game aspect, in order to promote a good behaviour. Here, the game of hopscotch motivates users to sort their waste (personal motivation to win or altruistic motivation).

In « Smart Cities », the intelligent management systems (energy, water) enable consumers to have fast and easy access to the monitoring of their consumption. In companies, these systems are combined with a legal obligation to report environmental data (energy audits, Greenhouse Gases Emissions Balance), which encourages them to measure their impacts and helps them in this way to formalize the necessary action plans to reduce them. Some willing companies are currently committing to this type of approach which targets environmental exemplarity (see insert « Gecina's climate road-book »). In a « low tech » approach which can be combined with the previous one, behavioural science enables the detection of the psychosocial motivations, brakes and levers of users. Works about « binding communication» highlight the importance of convincing the inhabitant of the soundness of their gesture, by delivering a clear, relevant and visible message (see « Nudges »).

It is important to keep in mind that these approaches, bearing on the behaviour of users and inhabitants, must be combined with actions on the building itself in order to renovate the ones which are too energy-intensive and to reduce fuel poverty.

Getting equipped with tools to control one's impact: Gecina's « climate » road book

Gecina is a French real estate investment trust which owns, manages and develops assets of around 12 billion euros, mainly made up of offices in the Ile-de-France region. It has integrated sustainable construction and the reduction of its impact on the climate into its processes and management. The company is thus committed to reducing the GHG emissions of its assets under exploitation by 60% before 2030 (in relation to 2008) and avoiding and compensating the remainder from 2017 onward. Simultaneously, Gecina is targeting the neutrality of all its construction and restructuring programmes and is seeking to commit its partners and clients. A number of measures are thus planned on the assets: to connect up with heat networks wherever possible, prefer materials with a low carbon weight (use of LCAs) for restructuring or construction operations, developing renewable energy, and encouraging biodiversity on its assets. Co-built with the representatives of its different stakeholders, and steered internally by a multi-professional working group, this road book is part of a long-term approach to encourage the deployment of innovative actions and a profound change in management practice.

Adapting the building to changes in use

Optimizing the built environment means making its mutualisation easier: through the more intensive use of the existing premises (in time for example) and through the creation of synergies between functions, in order to avoid the extension of the built environment as far as possible. It is therefore a question of either pooling the requirements of several users in a single facility, with a sole function, or allocating different functions to one building alone, by distributing them over time. Chronotopy is thus an approach to urban development inviting to think the built environment in the course of time to find complementarities in uses. A car park used by day for offices can shelter the cars of the inhabitants of housing in the vicinity; a schoolyard used during the week could be open at weekends to become a leisure area...

Lastly, facing the impossibility to optimize the building without modifying its structure, the mutability mentioned on page 5 makes it possible to make a building change. This can be done without intervening on the function: for example, by adapting housing to courses of life (living apart, i.e. when the couple's children leave home; housing a pensioner; the need for a complementary income). But the function of the building itself can also change. For instance, the increase in teleworking could lead to a decrease, in the medium and long term, in the need for offices. In order to adapt the urban fabric to these transfers, it is possible to make these offices into housing. Likewise, a decrease in the use of cars, which is anticipated by numerous actors, can encourage the creation of the technical conditions to make it possible to change car parks into offices or shops, as was developed by EPA Euroméditerranée (Marseille) or SEM Ville Renouvelée (Lille).

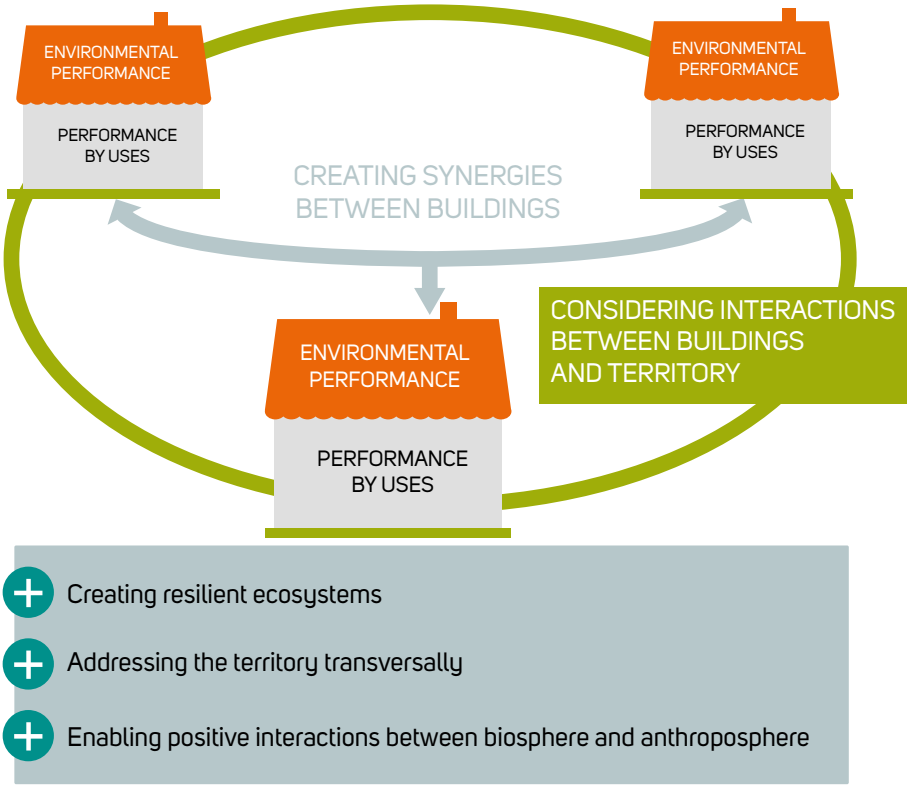
The issues of uses are to be correlated with major stakes of current urbanisation: on the one hand, a strong need for new buildings, and on the other, issues of vacancies [9] or the under-use of the existing built environment. A reflexion on spatial distribution should thus be led.

Circular economy approaches therefore already present some solutions on the scale of the built environment. As to biodiversity, it can serve as an inspiration (biomimicry). In addition to this, it must be taken into account at the design stage in order to provide an overall reflexion on the performance of the built environment and limiting the artificialisation of soils. Giving thought to energy and material loops, flows and the links with ecosystems nevertheless implies replacing the built environment on a larger scale.

CHANGING SCALE
TO GO FURTHER

Cities are perceived as ressources consumers, GHG emitters and predators of natural areas, and would therefore be harmful for the environment. It is however possible to imagine a virtuous model where the built environment would have a positive impact on its close environment, both regarding the management of materials and energy and at the level of biodiversity. The first stage consists of considering synergies between buildings, particularly in dense areas: exchange of materials, water, energy, and even of « the living ». Moreover, it is necessary to replace the built environment in its context: these synergies must be territorially grounded, and factor in local particularities, especially when biodiversity is concerned.

This implies giving thought to the inscription of the built environment in the green and blue belts, and even in the natural cycles of the renewal of resources. It is a matter of rethinking the value of buildings, not only from the economic point of view, but also according to what they bring to their environment in terms of biodiversity and quality of life [10]. To do so, the synergies need to be considered first between buildings, and then between the buildings and the territory (see diagram bellow).



Reconsidering the value and positive effects produced by buildings

Encouraging synergies between buildings

To optimise the use of buildings, synergies can be encouraged through mixed uses. On the scale of a block or a neighbourhood, a city or a territory, it is a matter of generating complementarities between functions to facilitate the flow of people, materials and energy in local loops, and mutualisations (goods, services, facilities). This means applying the principles of industrial and territorial ecology [11] to the city, enabling the mimimization of movement, limiting urban spread and the extension of networks, and even encouraging the exchange of resources by valorising in situ waste or energy. Changes in urban development planning follow the lines of this mixed use: the new zonings of the Local Urbanisation Plans (PLU), by making it possible to mix housing and offices on very fine scales, can indirectly facilitate the mutualisation of facilities (car parks) or the supply of energy (day/night: see below).

Flow exchanges

Synergies between buildings, which aim at using local and renewable resources wherever possible, can take several forms, such as exchanges of water, energy and even materials.

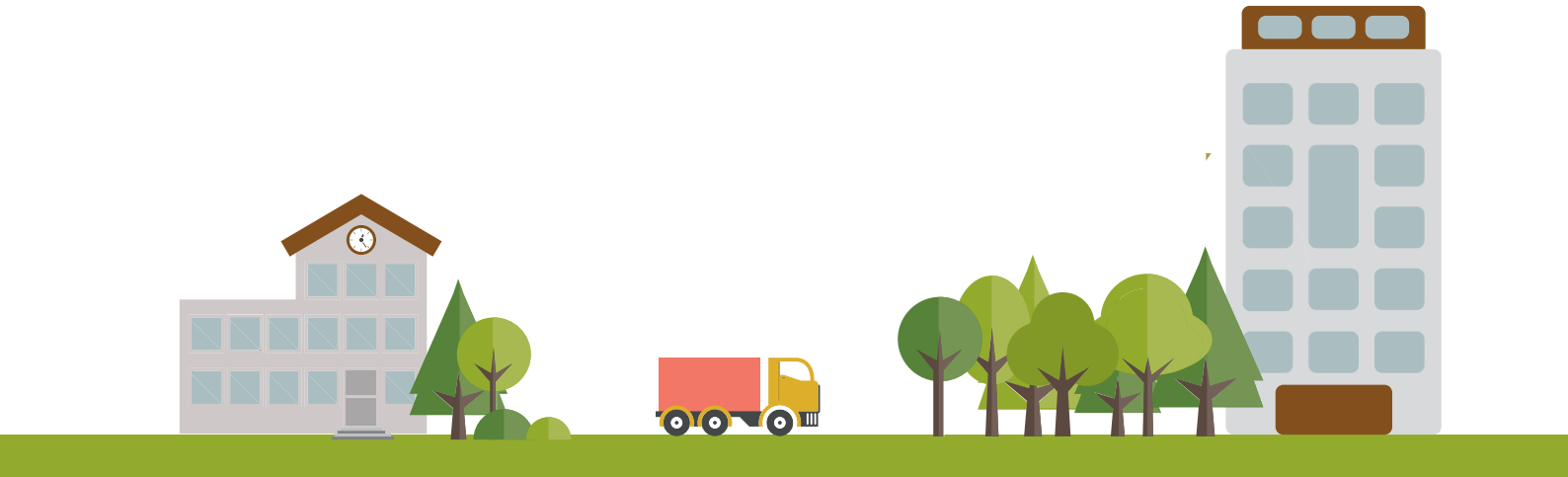
An operational example of these synergies is that of heat or energy networks. Some buildings such as industrial facilities or data centers produce unavoidable heat, i.e. the energy produced during a process which does not specifically target its production. This energy is wasted if it is not recovered, but it can be reused to supply other buildings through heat networks. In another logic, energy solidarity between buildings set up in the framework of Smart Grids can be based on a supply of energy mutualized between several buildings with different functions. In the same way as the car parks mentioned above, here it would mean mutualising energy requirements between offices (occupied during daytime) and housing (occupied in the evenings and during weekends) in order to spread costs.

Anticipating these exchanges from the design phase of a built perimeter (block, neighbourhood), therefore consists of encouraging mixed neighbourhoods, due to the fact that the proximity of the buildings bearing different functions makes it possible to facilitate mutualisation and the circulation of flows. Moreover, other synergies, such as the recovery of stormwater, the recovery of greywater, the use of water in cascades, and even loops of material linked to the recovery of waste (substitution synergies), can be implemented, in the logic of industrial and territorial ecology.

The built environment as a stock of secondary raw materials

To consider the built environment no longer just as a consumer and emitter of GHG, but also as a resource, implies focusing on building materials. The built environment can be considered as a stock of secondary raw materials, immobilized for a relatively long period of time, representing resources for the territory and allowing to limit the import of new materials (and the related emissions) in the future. Some tools enable the quantification and qualification of these resources, and specifically to identify when the material will be available to supply new constructions. The new technologies in the building trade, such as computer modelling (BIM: Building Information Modelling [12]), make this process easier. It is through this re-use of material that synergies both in space and time are created between old buildings and future constructions (see legal insert 2).

The re-use of materials on a territory necessarily implies thinking the logistic conditions of its implementation, in order to avoid importing resources and exporting waste as much as possible. Circular economy and re-use within territories must be anticipated, and land should be reserved in this goal (see insert « the Noé platform »). This type of space faces an issue of acceptability: these are often storage areas which are perceived as not being highly aesthetic and a source of disturbance. However, these areas, which are somewhere between wasteland and reserve, have great potential, on the condition that they are well designed. In a circular economy logic, they can be a support for a variety of uses related to the sorting and re-employment of materials, contributing to the creation of wealth and employment on the territory (as is the case of the approach led by Plaine Commune in the Ile-de-France region and Bellastock on re-employment). In addition to this, they also have potential as hosting areas for biodiversity in the territories. By ensuring cohabitation between ecosystems and human activities in these areas, their value can be maximised.



2 - Circular economy in French law

Act No 2015-992 of 17th August 2015 relative to energy transition for green growth (LTECV) advocates the transition to a circular economy which aims at exceeding the current economic model by promoting a sober and responsible consumption of natural resources and primary raw materials. Circular economy implies the prevention of waste production by following the ranking of methods for processing waste, with special care to use methods which range from re-use to a valorisation of waste.

Decree No 2016-288 of 10th March 2016 specified the measures relative to distributors of building materials, products and equipment for professionals taking back waste from the same types of materials, products and equipment they sell.

Companies must be included in this process in order to reach the goals set by LTECV, of 70% valorisation of building materials between today and 2020. Taking back of waste from the same types of building materials, products and equipment must be organised by all the distributors of these materials whose production unit exceeds a surface area of 400m² and a turnover of a million euros. There are already examples of companies combining into interest groups in order to mutualise processing and valorisation areas on dedicated platforms.

Dedicating land to circular economy: the innovative concept of plateforme Noé

The building site platform Noé was set up in the framework of the Bordeaux-Euratlantique spatial planning operation by Eiffage and four partners: Suez, Keolis, EFFIA and Engie. This dedicated area in an urban area enables the mutualisation of logistic services which are essential to the different firms working on the building sites or public works sites in the city. They can find everything they need there, with a high level of security and traceability: car parks, living areas, a training area and a supply store, as well as a location for stocking backfill and excavated material and the sorting of polluted soils, designed to reduce the disturbances for residents and improve the city flow, even in periods of major works. This platform targets a better social acceptability of urban building sites by decision-makers, shopkeepers and inhabitants. Lastly, in order to recover materials from building sites, part of this land is dedicated to storage, processing and valorisation, in particular through re-employment. Platforms of this kind on the territories, associated with approaches which anticipate the deconstruction of buildings, are to become the main solution for managing secondary raw materials locally and for improving re-use / recycling in order to avoid the input of new materials.

Buildings and biodiversity, synergies to be established

The built environment can have a strong value regarding biodiversity, especially in urban environments. In the same way as ecosystems are the foundation of our human societies, buildings can be supports for the development of biodiversity, whose flows and circulation (Blue and green belts, cycle of water, etc.) must not be hindered but encouraged. In this way, Natureparif suggests to think about cities and buildings themselves as ecosystems but also to use the circular economy model [13]. Moreover ecological diagnosis are essential tools on the scale of neighbourhoods and parcels to design environmental-friendly projects, and specifically greening-over the built environment (greened walls and roofs, green areas) coherent with the context (re-use of building site earth, endemic plants, vegetable gardens).

In turn, the development of biodiversity in cities enables adaptation to climate change. For example, experimentations conducted by Veolia [14] regarding the reduction of urban heat islands have shown the efficiency, at a low cost, of the greening of rocky areas [15]. Greening-over also allows a better management of storm water and even a biological treatment of waste and grey waters (see insert «the eco waste water treatment plant - Beynes »). It also means maintenance of green spaces at a lesser cost!

With the aim of including buildings in their ecosystems and taking inspiration from the living world, bioclimatic construction implies not to give standardized structures and systems for buildings which consume resources (grey energy) but rather to factor in the particularities of the building's location (close vicinity), for example by considering the circulation of air and light on the parcel through the seasons, to lessen heating or air-conditioning needs.

Encouraging the interactions between the built environment and the territory

Buildings belong to a global territorial issue, which can be tackled by the notion of territorial metabolism [16], i.e. the way in which the territories mobilise, consume and process the resources of the biosphere (dependence on resources), and their waste (see insert « Bruxelles-Capitale approach»). From this perspective, it means thinking the built environment is not thought as isolated but in relation to the different tangible or intangible components of the territory [17]. In this way, a change can be made on a territorial scale. Nicolas Buclet (Professor at Grenoble II University and qualified member of ORÉE) states: « With a territorialisation of human activities, taken as the geographic grounding of synergies between human activities in a particular context, taking into consideration the special features of each situation, the networks of actors, know-how and the natural environment, the interactions between humans and their environment generate a multitude of possible balances [18]».

The eco-design of the Beynes Eco-waste water treatment plant (Yvelines), by AR ARCHITECTES

AR ARCHITECTES designed the eco-waste water treatment plant in Beynes using the HEQ (High Environmental Quality) approach. This new installation, which has been operational since 2013, combines renewable materials, energy control, respect for biodiversity and the sustainable management of stormwater. Its design integrated both the building's function (filtering of water and depollution ensured by a 4000m² reedbed, a greenhouse helping to filter bad odours from the air), and the context in which it is located (inhabitants in the vicinity for instance). The building is bioclimatic and its operation is considered through the seasons. Among the exemplary systems, also are heavy-duty roads designed with hollow-core slabs made from recycled tyres (infinitely recyclable) which the water can seep into, and a former retention pool (pool used to store water leaving the plant) redesigned as a natural area. The project enabled savings for the municipality, as the plant needs very little maintenance; the cost of the treated water has also decreased for the taxpayer (from €1.70/m3 to €1.60/m3).

Understanding the built environment in relationship to its territorial characteristics

These questions imply first and foremost to challenge once again the notions of local and proximity loops. If circular economy aims at closing the loops of materials and energy flows, it does not target producing closed-in ultra-local systems any more than « soil-less systems » - an idea borrowed from biodiversity preservation approaches which means solutions which would be developed according to standardized stakes, instead of considered in association with their territorial context. By using urban planning and development documents, the territorial context can be considered at all scales, in order to protect and even increase the natural and agricultural areas in coherence with the built environment: by greening built structures, setting up blue and green belts to link green spaces in order to create ecological continuities (see legal insert 3).

A number of authors also propose to broach sustainable urban planning and development with the tools of the industrial and territorial ecology, by considering the setting up of symbioses. This is the significance, for example, of experimentation conducted on a national scale on « reciprocity agreements » which aim at contractualising exchanges and links between major cities and rural territories, in a perspective of territorial ecology [19]. To include cities in their territories, and imagine complementarities between areas, there is no single model or an ideal scale. Well-thought exchanges, with clean transport and optimised by inverse logistics, can prove to be very efficient from an environmental point of view.

Therefore, it is not a question of building new facilities without assessing precisely if they meet a requirement (from waste processing to sports infrastructures), and for what perimeter they would be optimised. For example, if methanisation appears as an opportunity to produce renewable energy and valorise materials, it is not advisable to oversize the installations beyond the capacities of territories to supply them.

Metabolism analysis: Bruxelles-Capitale approach

The administration in charge of the environment (Bruxelles Environnement) initiated a territorial metabolism analysis for the Government of the Bruxelles-Capitale Region, carried out by EcoRes, ICEDD, and the BATir research group (Université Libre de Bruxelles). Using an analysis of input and output flows of materials, this study which was published in 2015 gave a complete metabolic analysis of the Region, per type of flow, before concentrating more precisely on the potentialities of twelve flows (including several construction-related flows) and identifying potential synergies on the territory. Following the publication of this study, the Bruxelles-Capitale Region adopted its Programme Régional d'Economie Circulaire (PREC) in March 2016. This PREC, which provides over a hundred practical measures in favour of circular economy, has several objectives: to contribute to closing the loops of materials and energy flows, to change environmental challenges into economic opportunities for companies and local employment, and position the territory as an innovative region. Among the measures, actions in favour of a better governance, the identification of technical and legal levers and even reponsible public procurement.

3 - Urban planning documents, biodiversity and circular economy

Urban planning documents reflect the integration of biodiversity into territorial planning. Consequently, the Territorial Coherence Scheme, which is an intercommunal implementation design and implementation tool makes it possible to intervene on the Blue and Green belts (BGB) and biodiversity in two ways. It enables the control of urban development and guarantees territorial balance by preventing the threats which weigh on biodiversity and by acting on the use of spaces, the trivialization of environments and landscapes and environmental fragmentation. It also influences the conservation of natural areas by taking part in the protection or the rehabilitation of ecological continuities.

The BGB is a network made up of terrestrial and aquatic ecological continuities identified by the regional schemes of ecological coherence, which factor in the challenges and objectives of TCS, as well as through documents by the government, territorial authorities and their groups.

Territorial authorities must also provide action plans to meet the principle of Agenda 21, a set of practical recommendations for 21st century which stem from the concept of sustainable development and are based on 3 founding pillars: economic action, social development and the careful management of natural resources. Its success implies a collective construction which combines public and private actors as well as the population.

The implementing of circular economy in urban projects, widely recommended in the French Energy Transition for Green Growth Law, led the French Environment and Energy Management Agency (ADEME) to launch a call for expressions of interest in August 2015. The objective of this call for expressions of interest was to apply circular economy to urban planning through territorial planning, encouraging and multiplying the collective dynamics which enable a sustainable economic and environmental transition of the territories. Five projects were selected in January 2016.

Dynamics and interdependencies of territorial scales

Natural ecosystems, and circular economy which is inspired by them, work dynamically, i.e. they experience permanent developments, exchanges and interactions. The richer these interactions, the more resilient the system. Thus, to grasp the relationships between the built environment and its territory does not mean simply making a frozen diagnosis of this territory, but actually thinking of how they work. On the one hand, the different scales (district, city, employment area, region, etc.) are interdependent, and on the other hand, the different territories both near and far are linked by flows (resource extraction location, place where resources are used, etc.). For instance, designing an eco-neighbourhood without thinking it in coherence with other scales, leads to the building of high environmental performance islands, exemplary from the point of view of biodiversity and the local management of resources (water, energy, etc.), but often disconnected from the close territory (breach in urban continuity). Even though they are highly efficient, these eco-neighbourhoods can result in negative externalities on neighbouring territories, such as the transfer of waste for example.

Considering the inclusion of neighbourhoods in a city and the links between the different neighbourhoods (living area/working area for example) in a dynamic logic (movement and logistics, synergies on a larger scale, etc.), may help optimizing the metabolism of the territory.

CONCLUSION

Various levers have been presented in this document to improve the environmental efficiency of buildings regarding climate change, thanks to circular economy approaches and the factoring in of biodiversity. Both in the building/deconstruction phase (sobriety, management of resources and environment, lifespans, etc.) and in the operation (reduction of consumption, behaviour, etc.) attention has been drawn to the need for a change of scale and the setting up of synergies and exchanges. Therefore, considering the building or the built environment in its territory, by taking the interactions into account at a global level, makes it possible to contribute to a sustainable perspective.

In addition to being multi-scale, these approaches, to be efficient, must also be multi-actor ones: economic actors accompanied by willing communities and a civil society which is increasingly committed can strengthen the resilience of the socio-ecosystems on which they depend.

The human dimension is therefore essential, from taking users into account to governance issues, as well as the social stakes of territories. Being globally concerned with quality of life and well-being leads to moving the focus from building questions to the functional issue of « living in it » (lifestyle, needs, expectations, etc.). This issue requires new actors to be integrated for new solutions to arise [20].

SOURCES

(1) Source: ORÉE, 2015, Circular economy. Serving the preservation of resources and the climate. A flows and channels approach to a territorial ecosystem.

(2) Source: ORÉE, 2015, Climate and biodiversity. Stakes and solutions. Actors of today and the future at the interface of climate and biodiversity stakes.

(3) Source: www.developpement-durable.gouv.fr

(4) The term « grey emissions » means the emissions produced during the whole life cycle: extraction of materials, transport, transformation, product-maintenance, end-of-life (waste processing, etc.)

(5) See reference (2)

(6) Source: Stéphanie Lux, Gilles Lecuir, Nadia Loury (dir.), 2012, « Bâtir en favorisant la biodiversité. Un guide collectif à l'usage des professionnels publics et privés de la filière du bâtiment », Agence régionale pour la biodiversité en Île-de-France (Natureparif). Victoires Éditions.

(7) Source: www.bazed.fr

(8) Association HQE, Association ORÉE, 2014, Biodiversité et bâtiment, des enjeux à chaque étape au bénéfice des utilisateurs et de la planète. Memento pour les acteurs de la construction et de l'immobilier.

(9) According to INSEE, in 2015, there were 2 880 000 vacant housing units in France (estimated figure). Source: http://www.insee.fr/fr/themes/tableau.asp?reg_id=0&id=69.

(10) Source: Grégoire Bignier, 2015, Architecture & écologie. Comment partager le monde habité ? (2nd edition) Eyrolles

(11) www.oree.org/3priorites/economie-circulaire/ressources.html

(12) Source: « Maquette numérique. La construction durable passera par le BIM » (2016, July-August), Environnement magazine, No 1749.

(13) Source: Natureparif, « Bâtiment et biodiversité. Et si l'on pensait les villes et les bâtiments comme des écosystèmes ». Online video on Dailymotion.

(14) See reference (2)

(15) Source: « Îlots de chaleur : premières pistes pour réinventer la ville » (2016, July), Environnement et techniques, No 360.

(16) Source: Pascal Repellin, Benoît Duret, Sabine Barles, 2014, « Comptabilité des flux de matières dans les régions et les départements. Guide méthodologique », La Défense : Ministère de l'Écologie, du Développement durable et de energy – CGDD (coll. « Repères »).

(17) Source: Pascal Gontier, 2013, « Vers des écosystèmes métropolitains », Cités Territoires Gouvernance.

(18) Quote from Nicolas Buclet. ORÉE, 2015, Climate and biodiversity. Stakes and solutions. Actors of today and the future at the interface of climate and biodiversity stakes.

(19) Source: Sabine Barles, 2014, « L'écologie territoriale et les enjeux de la dématérialisation des sociétés : l'apport de l'analyse des flux de matières », Développement durable et territoires, Vol. 5, nº 1.

(20) Source: Jean-Christophe Lipovac and Antoine Boutonné, « Villes durables : leviers de nouveaux modèles économiques et de développement? », Développement durable et territoires, Vol. 5, Nº1.

ORÉE'S RESSOURCES

Publications

Association ORÉE, 2015, « **Climate and biodiversity. Stakes and solutions.** Actors of today and the future at the interface of climate and biodiversity stakes.»

Association ORÉE, 2015, « **Circular economy. Serving the preservation of resources and the climate.** A flows and channels approach to a territorial ecosystem.»

Association HQE, Association ORÉE, 2014, « **Biodiversité et bâtiment, des enjeux à chaque étape au bénéfice des utilisateurs et de la planète.** Memento pour les acteurs de la construction et de l'immobilier.»

Working groups / Clubs métiers

ORÉE circular economy and territory Working Groups: « circular economy and spatial planning » cycle (2016-2017) : deals with questions related to the method of integrating circular economy approaches in territorial and sustainable development planning strategies and their impacts on planning and urban development. The contents of this cycle was co-built with the members of the association. The topics broached in 2016 are land, the built environment and energy. In connection with this cycle, OREE is committed, with Inddigo, in carrying out a « circular economy and spatial planning » Project Management Assistance supported by the ADEME. This cycle will lead to a deliverable to be published in June 2017.

ORÉE/HQE Biodiversity and economy Working Group (2013/current): set up by ORÉE and Association HQE to assess the impacts and dependencies of a building in relation to biodiversity in the framework of the new HQE Performance standard. It resulted in the publication of a Memento.

« Deconstruction » Club Métiers (2015/current): deals with the methodologies available to clients, the channels and connexions between actors, the interaction with the territories and the economic aspects.

ORÉE Local grounding of companies Working Group (2012/current): deals with the topic of « Local Grounding and global performance ». In the framework of this Working Groups, the members of OREE are currently participating in the building of an indicator of interdependency between companies and their territory(ies). A deliverable is to be published in December 2016.