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INTRODUCTION

Family breakdown, changing lifestyles, an ageing population, the incorporation of housing into the sharing economy, an overall increased interest in sharing, the promotion of localness and nearness, the meteoric rise of digital technologies and connected devices, and sustainable development concerns are just a few of the factors that are changing the form and function of housing and disrupting how residents use the places where they live.

No aspect of housing has been spared from these changes. Housing layout and distribution, the role and uses of a home, its connection with the neighbourhood, and the structure of the residential building are all being reinvented in accordance with three overarching principles: housing that is agile and custom-built, housing that is shared and open to the rest of the city, and housing that is sustainable and resilient.

Bouygues Construction decided to merge its thought process with the vision of experts and housing stakeholders to suss out what housing will look like in the future:

■ How can housing be adapted to accommodate a wide range of family situations, changing lifestyles, and the specific needs of each individual?

■ What balance should be struck between the need for privacy and the growing trend towards sharing and opening up the home?

■ How can housing be made more service-oriented and connected with the neighbourhood?

■ How can housing be made healthier and more pleasant for the user and less harmful to the environment?

■ How can digital technology be harnessed to respond to all of these challenges?

The goal of this report is to present the main trends that are shaping the housing market and offer effective ways to anticipate them. It will set out best practices and inspiring examples, give voice to housing experts and stakeholders, and list recent Bouygues Construction projects to illustrate how these trends are playing out in homes all over the world.

Happy reading!
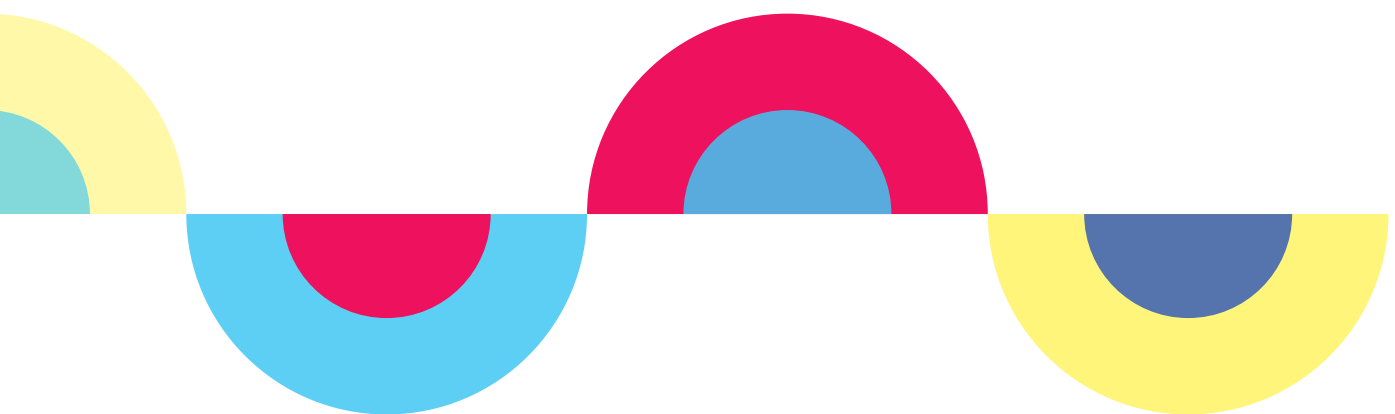
CREATING AN AGILE, CUSTOM-BUILT HOME

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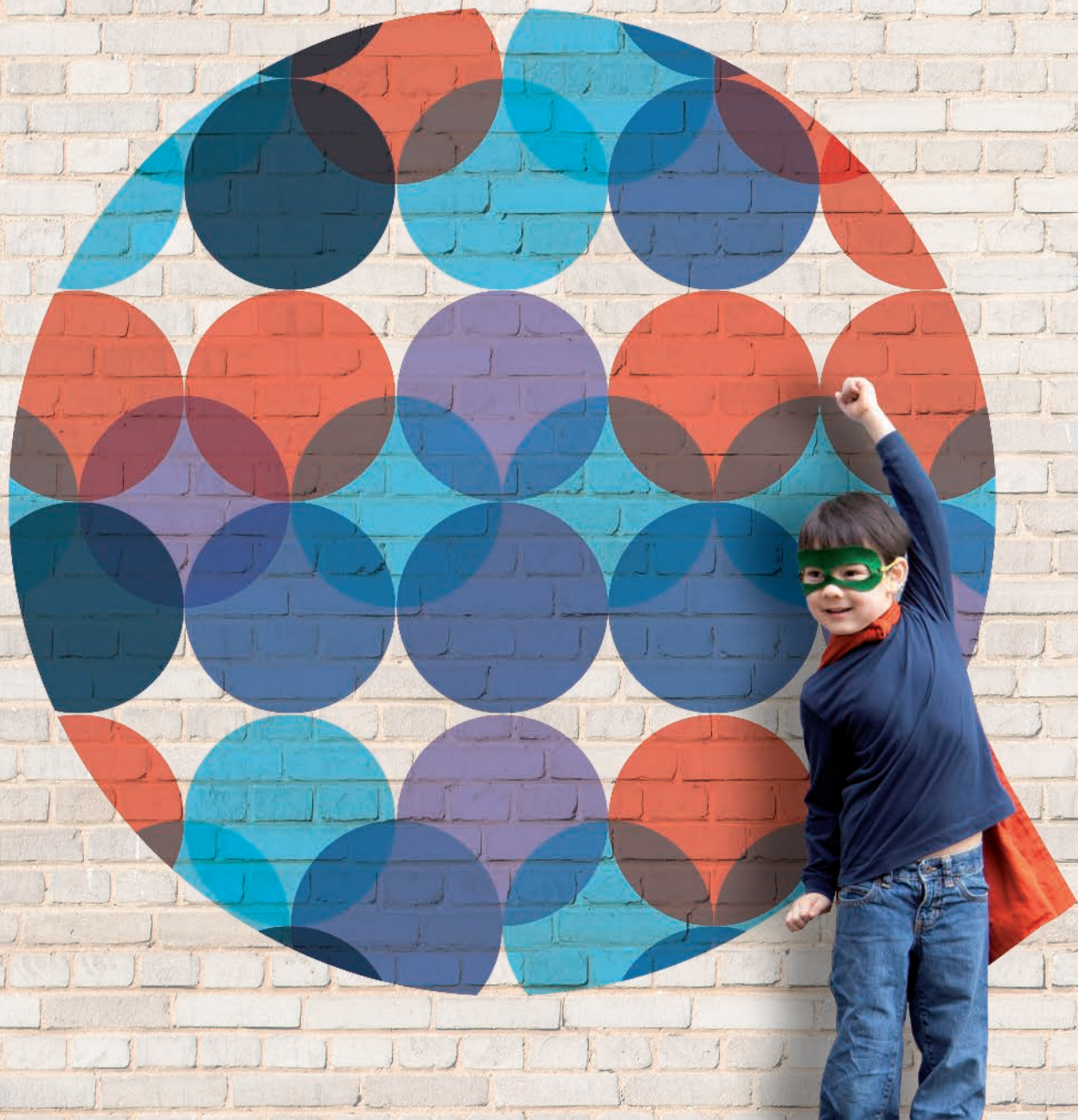
In response to family breakdown, new lifestyles, and the specific needs of certain segments of the population, including seniors, children, people living with disabilities, etc., housing must become more adaptable than ever to accommodate a wide range of disparate situations. Housing units with adaptable shapes as well as designs that allow for more modular and customisable configurations are being developed to offer residents personalised solutions. ∎

A DOMESTIC
REVOLUTION

3.4M

children live
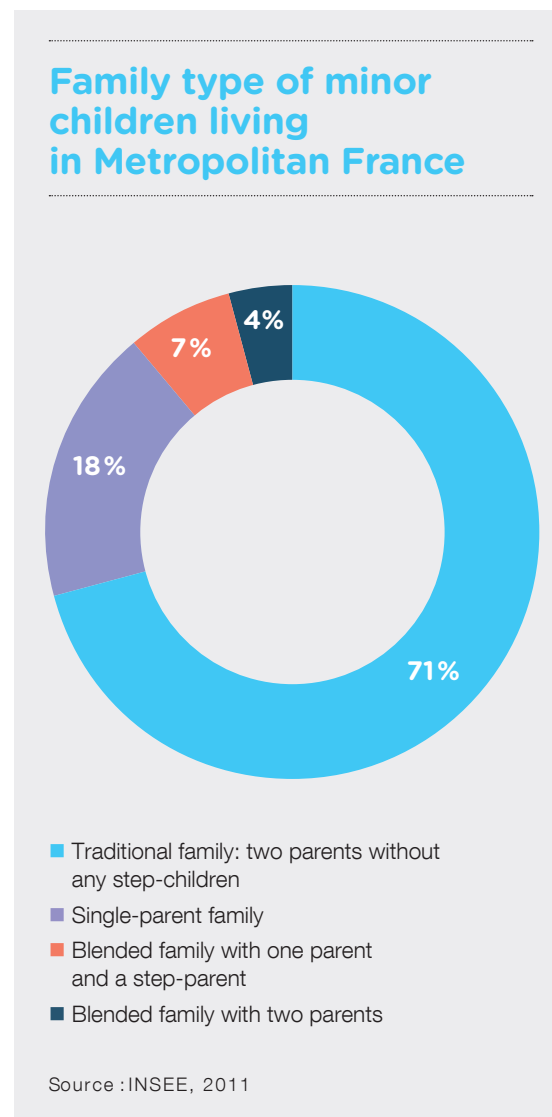with one parent [1]

The breakdown of the traditional family unit

In France, the traditional family unit consisting of a couple with or without children is being replaced by a wide range of domestic groups, including individuals, single-parent families, and blended families.

The number of single-parent families with one or several children nearly doubled between 1990 and 2011. During this same period, nearly one out of every 10 children lived in a blended family [1]. At the same time, the proportion of single-person households increased as people tended to live together less frequently, separations became more common, and the isolated phenomenon of couples cho separately emerged. After the age of 30, one out of every 10 civil partnerships lives in two separate households.

[1] INSEE

Family type of minor children living in Metropolitan France

4%

7%

18%

71%

- Traditional family: two parents without any step-children
- Single-parent family
- Blended family with one parent and a step-parent
- Blended family with two parents

Source : INSEE, 2011
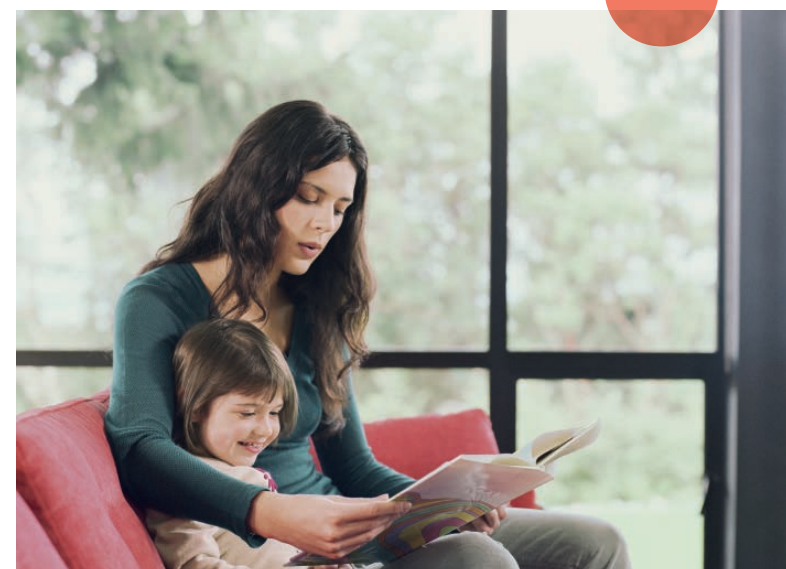
Variable family sizes

These changes have in turn altered people's living habits and homes, which now host families that grow and shrink within a shorter and shorter time frame:

A quarter of children living with one parent regularly travel back and forth between the homes of their two parents. In 2011, 900,000 children in France were living in this type of family situation [2].

Moreover, as explained by the sociologist Jean-Michel Léger, "blending a family would be nothing more than a game of musical chairs within the [housing] market if it wasn't a source of economic inequality for the former couple" [3]. Because it's rare for a couple to separate and form two new couples all at the same time, the single parents will have to pay increased housing costs (since it's cheaper to pay rent with two sources of income instead of just one) while also housing their children part of the time in sufficiently comfortable conditions. "In these conditions, juggling the composition of the household, the amount of revenue, and home size is a difficult challenge".

The economic context and challenging job market also help create a more volatile family unit. Young people's patterns of leaving the parental home have become more precarious as a result of these conditions as well.

900,000

children split their time between the households of their two parents [2]

The path young adults follow towards independence, from being able to access housing to paying for it entirely on their own, is not often linear, but instead marked by returns to the parental home and a reliance on housing solutions such as flat-shares and student dorms. While this transitional phase towards adulthood is not new, it is becoming longer and more uncertain. Between 2002 and 2013, the number of young people over the age of 25 who returned to the parental home after leaving it, i.e. children who had already flown the family nest, increased by 20% [4]. This creates a delicate situation at an age in which the need for independence and privacy is strong.

[2] INSEE Première no. 1647, *Living with several family configurations,* May 2017

[3] Jean-Michel Léger, "Different ways of living: architectural design resources", in *Habiter. Imaginons l'évidence !,* 2013

[4] Fondation Abbé Pierre, The hidden side of the "Tanguys": young adults forced to live with their parents, December 2015

A daunting challenge!

These sociological changes have contributed to the drop in average family size over the past few decades. According to projections released by INSEE, this trend is set to continue and even accelerate. The average number of people per household, which was 2.88 in 1975 and 2.31 in 2005, should hover around 2.04 and 2.08 by 2030.

These figures, when combined with the average floor space of housing units, which has remained relatively stable since the early 2000s, mean the number of square metres per person is increasing. However, the lack of change in average floor space does not reflect the significant variations present if location and type of housing are taken into account. While the average floor space of individual homes has continued to increase, apartments are becoming smaller.

And yet, the desire for a larger home represents the number-one reason why people decide to move (excluding professional and family-related reasons), especially for those living in apartments [5]. The motivations for this decision are anthropological and include the need to store and keep souvenirs, the French cultural trend of hosting family and friends at home, the need to have a home that serves a wide range of uses, and the shift from thinking of the home as a place for sleeping to a place for living.

This issue cannot be fully understood by using a mathematical approach that just focuses on the overly restrictive metric of total floor space. Floor area can be perceived to be larger or smaller depending on how it is presented and the range of uses it allows.

[5] INSEE, 2013 Housing Survey

In France, the average floor area of an apartment dropped from 65.6 m^2 in 2006 to 63 m^2 in 2013 [5]

Nemausus, Jean Nouvel's "large housing solution" in Nimes

In 1986, Jean Nouvel designed the Nemausus complex in Nimes. These two parallel rows of buildings with 114 social housing units were designed with the understanding that "a beautiful home is a large home; a beautiful room is a large room".

Determined to offer residents more space, air, and light, the architect decided to create double-exposed buildings that were up to 40% larger than average without costing more than a traditional construction project at the time. He reached his goal by using raw materials taken from the industrial sector and optimising the overall interior volume of the building by placing the stairwells and corridors on the outside. The result was a non-traditional building resembling a cruise ship, with industrial sheet metal and metallic passageways covering the facades, and loft-style apartments featuring very high ceilings and an open floorplan.

The project, which was considered daring at the time for its novel design, was the subject of countless articles after its construction because it exceeded its original budget, fell victim to design faults, was poorly maintained, and charged 30% more than the average social housing unit. The rules for calculating social housing rent are based on the number of square meters, and these same rules apply to Nemausus.

Nevertheless, the building did manage to recruit residents who were won over by the increased space and light. In 2008, it was listed as a "20th century heritage site".

Ageing well at home

In December 2015, in France, there were more people over the age of 60 than under the age of 20.

This shift confirms that we are living in a longevity boom. It's no longer uncommon to hear of people living to age 100 and beyond; in fact, we've never lived longer! Pensioners are remaining active and independent for many years, and dependency and the loss of independence is happening later in life at around age 85. We now use the terms "third age" and "fourth age" to talk about these two periods in the life of seniors.

"Housing planning and adaptation remain some of the most important ways to favour a high-quality ageing process", explains the sociologist Serge Guérin. The goal is to respond to a desire shared by nearly the entire population: to live as long as possible at home instead of going to a specialised facility. This aspiration is even more strong given that the longer people live in their homes, the greater their attachment, the stronger the force of habit, and the greater their fear of change will be. These needs call on our collective ability to imagine new layouts, appliances, services, and support to create housing solutions that meet the needs and expectations of ageing populations as well as their friends and family.

bien **vieillir chez soi**

ANTICIPER LE LOGEMENT POUR DEMAIN

What are the needs and expectations of the baby boomer generation, now arriving at retirement age? How can we address frailties when they are both multiple and specific? How can housing promote prevention and anticipate disruptions to people's life paths?

Bouygues Construction tried to answer these questions in 2016 by conducting a research project that used a working group sponsored by Serge Guérin, a sociologist specialised in the economic impact of seniors, and composed of backers, sociologists, occupational therapists, and personal service representatives.

The summary of this project is the subject of the "Ageing well at home: Creating housing for the future" trend report, which is featured in issue no. 4 of our collection.

All of these factors challenge the way we think about housing. How can we help seniors live at home for as long as possible? What solutions can we offer young adults who have returned to the parental home and yet yearn for independence and privacy? How can we offer flexibility to families whose composition changes every week? How can we best organise a home to offer a high quality of life in a smaller space?

Designing a more adaptable home

Even though new residential projects are offering increasingly refined facades and sophisticated technical systems, the inside of these homes is still very standardised. Modular, flexible, and scalable—there's no shortage of terms to describe the wide range of new strategies that are redefining what a home looks like.

Adding an "extra room" is the most commonly cited solution for addressing needs caused by changes in family size (the arrival of a new child, the return of a young adult to the family home, etc.), economic-related uses (working from home), a desire for greater comfort (library, game room, etc.), one-off situations (hosting friends and family), and the simple goal of wanting more options without having any set plans for the extra space. However, this often proves to be infeasible due to financial reasons; the household budget is just too small to purchase or rent the extra square meters of space. Initiatives and experiments are being developed to create new, affordable models.

Splitting the cost of an extra room

Sharing an extra room between several households within the same apartment building is a way to keep costs down. This pragmatic solution also becomes an outlet for community building when used by several people at the same time, such as a common room set aside for events among residents, for example. The extra space can also be designed to be used by an individual, such as a shared guest room. Residents pay when they use the space, and the cost of the service is typically added to either rent or utilities.

An extra "plug-in" room when you need it

In 2004, German architect Stefan Eberstadt presented his Rucksak House in Leipzig. This lightweight, 9 m² room is designed to plug into the side of a building using steel cables attached to the roof and positioned in front of the apartment's window, which then becomes the entryway for the new room. The concept, which takes advantage of the thickness of a building's facade, can be attached at any time. Instead of adding it during the design stage, residents can gain an extra room when they need it and can afford it.

Reducing costs by renting an extra room

The concept of a "home within a home" refers to a main apartment attached to an extra living space equipped with a toilet, bathroom, and an exterior entrance, making it completely independent. This space can be used in a variety of ways, including as a room for a teenager who wants more independence and privacy, a guest room, a remote-work office, or as a rental space to help pay for the main apartment.
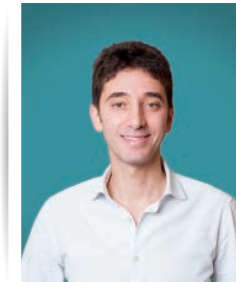
A ROOM ON DEMAND

Michele Dominici

Who was nominated to the professorship that designed and piloted the Room on Demand (now a member of the E-Lab in the Innovation Department within the Bouygues Group):

Scalable housing makes it possible to change the surface area by adding or removing modules, combining two housing units, or splitting one home into two separate ones. Nowadays, this process has been widely tested, and it meets the needs of families that change in size, whether due to children leaving the family nest, a separation, or the arrival of a new baby. Still, it requires a technical intervention and a period of time to make the new housing configuration usable.

Aware of the need for scalable housing but determined to get rid of the constraints caused by construction, the "Smart housing and innovation" research chair of the Rennes 1 Foundation designed a simple and flexible concept that allows residents to instantly change the configuration of their homes. Located between two or more housing units, the extra room can be easily incorporated into any one of these apartments. Whether as a private room for apartment A, a private room for apartment B, or a shared room used by both apartments A and B, the residents can choose the configuration that suits them best at any time thanks to a 3-button switch system in which each button represents a different configuration.
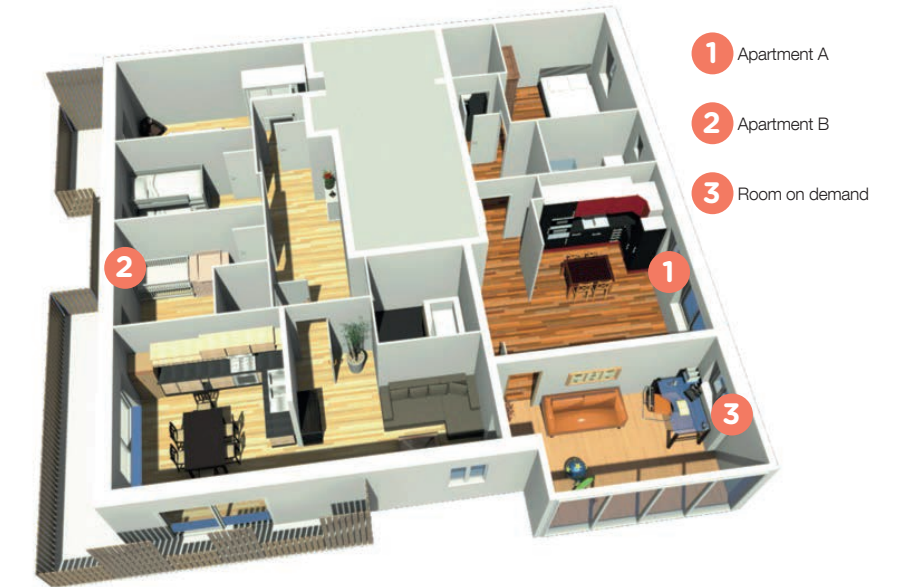
The system uses built-in technology that includes a lock, an electricity and water monitor for the room on demand, and a memory that stores the furniture and decoration preferences of each user.

- When the room is attached to apartment A, the entry way from apartment B is automatically locked.

- The water and electricity used by the resident of apartment A are automatically credited to his or her rent.

- When the user of apartment A reserves the room on demand for private use, his or her favourite photos or images are automatically uploaded to the room's digital frames. The lighting and electricity settings are automatically adjusted as well.

In Rennes, the housing company Neotoa decided to join forces with the research project and has been testing the system since May 2017 in one of its residences. The Room on Demand has helped improve relationships between families. It can also be used to host the grandchildren of an elderly person over a weekend or holiday or organise parties between renters. The housing company has decided to expand this successful experiment to its other buildings.

Other experiments are taking this principle even further by designing housing that can adapt and change along with a family. The 358 housing units planned for Ilot 3H of the Ivry Confluence joint development zone, located just outside of Paris, are being designed with the uses and needs of future residents in mind.

1 Apartment A
2 Apartment B
3 Room on demand

Photo credits: The "Room on Demand", NEOTOA

66

The Room on Demand is a joint effort involving academic, institutional, and economic partners. It offers a creative response to our society's need for flexibility and scalability. It is also in line with efforts to render cities more sustainable and advance the sharing economy.

99

THE "SCALABLE" THREE-BEDROOM HOME

Scalable three-bedroom home after the children move out: the apartment is ready to be divided up

| Master bedroom | Living room | Kitchen | Kid's bedroom 1 | Kid's bedroom 2 |
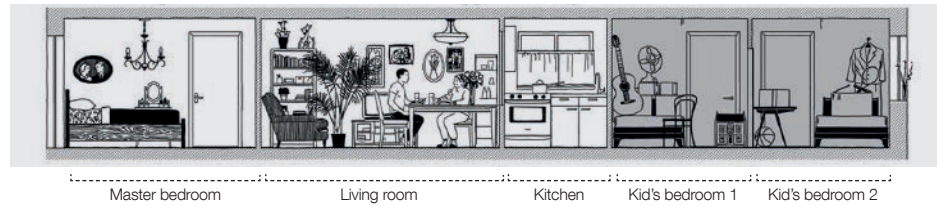
Scalable three-bedroom home after division = one-bedroom + studio

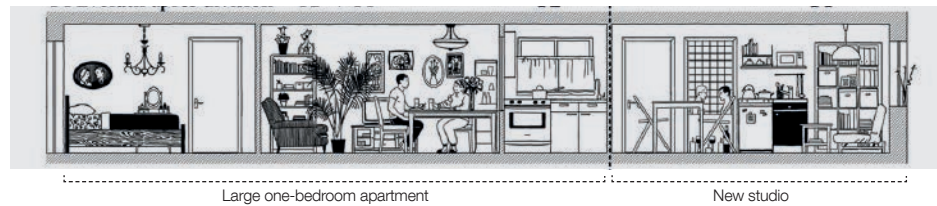| Large one-bedroom apartment | New studio |

Photo credits: Scalable three-bedroom apartment, STAR Strategies + Architecture

TESTIMONIAL

SCALABLE, ADAPTABLE, AND GROUPED HOUSING FROM THE ILOT 3H PROJECT AT IVRY CONFLUENCE: PUTTING USES AND LIFESTYLES BACK IN THE HEART OF THE DESIGN PROCESS

Reinventing the apartment block and designing a housing solution that's adapted to current and future lifestyles is only possible through out-of-the-box thinking.

One such unusual approach involves reversing the housing production chain. The planner Sadev 94 first selected an architect (STAR strategies + architecture), who established the specifications, before working together to choose a property developer. The consultation was organised like a design workshop.
Over an 8-month period, four competing teams of property developers worked with the planner, its architectural project leadership team, and all stakeholders, including Ivry, housing companies, residents, and town planners, to create and expand upon the Ilot programme. Sogeprom, Bouygues Bâtiment, and Foncia Groupe won the consultation process.

This project is anything but traditional. It features housing units with adjustable shapes and uses intermediary space to accommodate the needs of a wide range of families and modern lifestyles. The two-bedroom models include alcoves that can convert into a home office or provide an alternative to the couch for a divorced parent when his or her children come to visit over the weekend. One-room and two-room flats can be added to a three-room unit to create a five-room flat. Every three-room flat features a more independent room and a second bathroom for hosting. This layout makes it easier to house a young adult who has come back to the parental home, a grandparent, a home care worker, or a student. Once the children in a family more out, four- and five-bedroom flats can be easily divided to create a studio that can be sold or rented out. Finally, the project includes "co-residence" apartments designed for house sharing in which some spaces are open to all roommates.

> " This project lets us offer our customers housing that is more flexible and capable of adapting to the changes that occur in every person's life. "
>
> **Chantal Magnier**
> Opérations Director for Sogeprom

The project's secret for success? A significant amount of spatial, technical, and normative work that makes dividing or combining spaces possible. Soundproofing and door placement as well as the electrical circuitry and heating network were all planned out early on in the building process, and the building rules, which were written in partnership with the future property development company, take into account the scalable nature of the housing units. Most importantly, the architect created the project from the inside out and analysed all possible uses to understand how the future residents would live in their homes. Such an approach is crucial for putting uses at the heart of the building process.

By allowing families to stay in the same building indefinitely, these kinds of experiments will likely give rise to various types of residential real estate pathways. Such a design ensures residents can live in the apartment that best suits their needs at any time in their lives without having to move. Put differently, as the sociologist Monique Eleb has explained, it means people can "move at home".

Modularity, adaptability, flexibility, and scalability

■ Modular housing allows residents to change the interior layout and distribution of their home by expanding certain rooms and shrinking others, such as by using a system of removable dividing walls, for example.

■ Adapted or adaptable housing refers to homes that cater to the specific needs of certain populations that are more vulnerable, such as people with physical disabilities. The spaces, appliances, and services of the home, building, and outside areas are adapted with the uses of these populations in mind.

■ Flexible housing can accommodate a wide range of possible uses for a home. For example, it uses furniture solutions like multi-use pieces or furniture that can be hidden in the floor or ceiling.

■ Scalable housing allows residents to change the overall size of their home by easily adding a room, creating an independent living space within their home, or by dividing or adding another housing unit on demand. This solution is more complicated than the others and requires planning during the construction phrase to correctly place load-bearing walls, networks, and ductwork.

GRANTING USERS
COMPLETE CONTROL OF THEIR HOMES

Taking ownership of your home through customisation

Current trends, including *Do It Yourself,* personal branding (creating a personal brand on social networks), and empowerment (giving power to individuals to help them design solutions to the social, economic, and ecological challenges facing them) all point to the growing importance of individualism within society. People now aspire to affirm their independence, showcase their own personalities by setting themselves apart from others, and have more control over their lives.

These new goals are even more present in the home due to its key role in shaping familial and personal identity. The age-old adage of "tell me where you live, and I'll tell you who you are" sums up this phenomenon handily. A person's "home sweet home" is an intimate, emotionally-charged space that he or she chooses to open up to others. As such, it's important residents make their living spaces their own.

There's a wide array of solutions individuals can use to shape their homes how they like. They vary depending on the status of the resident, owner, or renter and the timeframe at which the decision is being made, such as before the design stage, during the housing search, when the person is moving in, on a day-to-day basis, or when the occupant's needs or situation changes.

Designing a building or housing units in collaboration with future residents

An emerging trend consists of incorporating the future purchaser of a new home into the design process as early as possible by using a wide variety of digital tools. More and more stakeholders are providing 3D configurators that allow future buyers to decide how to arrange the available floor space and pick the colour of wall paint, type of floor covering, and bathroom fixtures they want. They are generally coupled with virtual reality systems that allow residents to visualise the future space with the selections they've made.

While some stakeholders are using this tool solely for apartment design, others are taking it a step further by applying it to the architecture of the building and taking into account the desires of a group of users via digital platforms or secured messaging apps. Issues such as deciding how to arrange shared areas, whether or not to add bike parking and where to place it, and deciding if the building should have a rear entry point are typically addressed by a group of users interested in fostering a warm sense of community.

Thanks to the development of digital tools like digital platforms and digital models, co-design offers a third option between traditional promotion and self-promotion (in which project management is overseen by a group of future residents).

HABX, the digital platform that's putting future residents in charge of designing their apartments

This digital platform reverses the typical property development process by taking into account the specific needs and wants of future residents before building a new property in order to establish the agenda, floor space, and layout of the housing units.

In addition to allowing for a high level of customisation, this system reduces marketing costs because the buyers have already been identified up front. Users select which project they want from a variety of options on the platform and pre-book their apartment by providing proof of funds and indicating their preferences in terms of floor space, sun exposure, and interior layout. Once a plan reflecting the buyer's requests has been drawn up, users receive a booking contract containing the apartment's blueprints, which are created in accordance with regulations and their wishes, and can change it by discussing the project with the architect.

Co-designing a property with the Boulle Group

This approach lets the future building residents help design their apartments using digital tools. After paying an entry fee, the future buyer can visualise the project in 3D using a digital model. The buyer is given access to a configurator that lets him or her provide the project manager with feedback regarding the building's architecture and the design of the apartment. The buyer can also speak with other co-designers to complete tasks, such as to draft a community living charter, for example. The respective parties can communicate via a secured messaging app. This type of collective discussion is useful for determining usage guidelines for the future building.

Day-to-day flexibility

Making housing more flexible means giving residents the ability to adapt and transform their homes as often as they want, whether over the long term or on a day-to-day basis.

The goal is to allow residents to open up or enclose their space, make certain rooms bigger, and vary their level of privacy. Sliding dividing walls have long been used in Japan, where they are referred to as *shoji*. These sliding walls made of paper and mounted on wooden frames are used to divide rooms as needed or to enclose spaces. Removable dividers use this same concept to reconfigure a home's layout. Recent progress in this field has removed technical barriers and paved the way for a variety of new dividing wall systems. Bouygues Immobilier's Owwi concept features partitions that can be easily installed and snapped together without any technical floor or ceiling fixtures as well as a system that allows residents to re-connect all their equipment when changing the apartment's configuration without having to redo the electrical wiring.

Each new concept is more innovative than the last, offering residents a maximum level of flexibility. Solutions include giant Lego blocks that can be used to build dividing walls, furniture that's joined to the walls so residents can change the layout of their apartments by changing the position of the furniture, and modular structures on rail systems that let users push walls where they want them. The challenge for all these solutions is to combine flexibility with good sound proofing, which is sometimes lacking.

All I Own House: the modular apartment

The Spanish firm PKMN Architectures has designed large modular wooden structures inspired by library shelves and mounted on rails. These structures look like a hybrid between shelving and walls and extend from the floor to the ceiling. They can be easily moved via the rail system, which lets residents push their walls where they want them. The structures are built with OSB panels, which are made from slats of pressed wood—a material that is both inexpensive and sustainable.
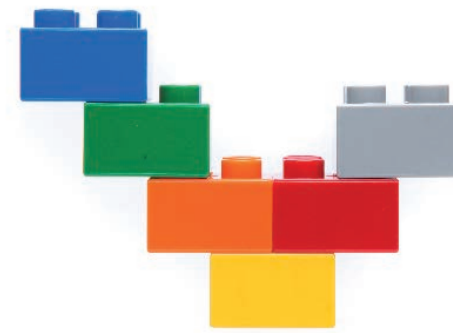
Building walls and furniture with life-sized Legos

Everblock builds giant plastic blocks that can be used to create furniture or an interior wall. The bricks are equipped with holes, allowing metal bars with a diameter of 1.2 cm to be slid through the centre of each unit to strengthen the wall. Tablet and platform accessories can be used to make any type of furniture, including tables, shelving, and more. A 3D simulator is also used to calculate the number of bricks needed for each project.

Personalised decor

In France, two out of three people prefer spending time at home [6] — hence the current interior decorating craze. Residents enjoy taking care of their homes.

Seventy-seven percent of French people report being interested in interior decorating. Out of this group, 40% even say they are "extremely" or "very" interested in the subject. This penchant for decorating is centred on the living room, which is the favourite room of the French and where they prefer to host friends and family. Residents pay careful attention to the image their homes give off; most believe it's important to show others they have good taste when it comes to interior decorating.

There is a wide variety of coaching services available, a growing number of magazines and TV series are tackling the topic, and the home staging trend has never been more popular. While it's often likened to simple interior decorating or home improvement work, home staging actually consists of preparing the home for selling by presenting it in the best possible conditions. It aims to make the home appear bigger, harmonise the space, and remove any personal features so future buyers can imagine themselves in the home more easily and start to make it their own.

6 "The shift from a 'cosy' home to a 'living room' home: the French people's passion for decorating", 2014 IPSOS study for But.
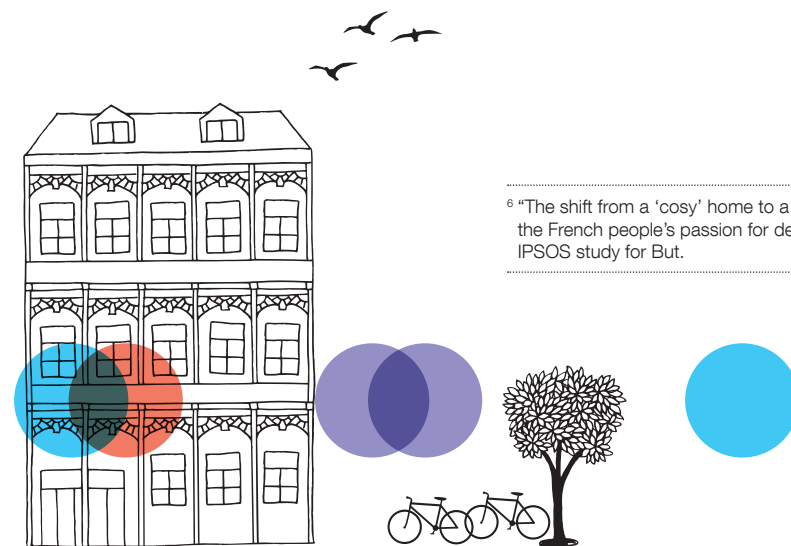
Designing interactive housing

Current trends call for more and more interaction between residents and their homes as well as for increasingly close-knit ties between a building and its occupants.

For example, a home equipment company has developed an interactive wallpaper depicting a dozen characters that the user can scan using a dedicated application to learn about their adventures. Similarly, the development of the smart home has allowed users to control and customise an increasing number of features. With this technology, objects, services, and equipment that are a part of the home's interior or exterior can be connected and managed by the user all in one place, typically via an app. Let's look at lighting as an example. Users can now create customised lighting effects (white light, dim light, accent colours, and more) in each room and program their use.

Furlenco: a subscription service that allows users to change their furniture every year

The Indian company Furlenco lets subscribers rent designer furniture. In exchange for a monthly fee, residents can select furniture from a catalogue of pieces designed by the company and manufactured from durable, recyclable materials. After a year, users can select new models and styles from the catalogue and change out all of their furniture without paying delivery fees. To help maintain the furniture over the long term, the company offers its subscribers a yearly cleaning service free of charge. Each piece of furniture that's returned is collected and renovated by the company.

DESIGNING CLEVER HOUSING

Making the most out of small spaces

Due to limited space and significant economic constraints, major city centres offer a range of small apartments.

As urban populations grow, cities work to increase the density of their central districts, and real estate prices continue to go up, optimising small spaces has become a key issue. The Keret House, which was designed by the Polish architect Jakub Szczesny, is a prime example. The building, which is nestled between two buildings in Warsaw, measures between 92 and 152 centimetres and includes a sleeping and working area, a kitchen, and a shower. Without going to such extreme lengths, many architects have come up with a plethora of ideas for designing small, cosy, and functional homes that are pleasant to live in.

Modular furniture that's built into the structure of the home

Optimising small spaces typically depends on three principles: taking full advantage of all available space, increasing storage space, and making furniture more efficient.

This last aspect is doubtless the most important. In a home where each square meter counts, it's hard to have several pieces of furniture without creating an overcrowded space. Modular and multi-functional furniture, trapdoor systems set into the floor or ceiling that store smaller pieces, and wall concepts equipped with built-in furniture that slides, tips, or pulls out like a drawer are crucial assets. When designed well, they make it possible to optimise a home's space while also using the most efficient furniture options. For example, a low platform can serve as a frame for a pull-out bed and help divide the space.

These same principles can be used to create storage space, which should be maximised as much as possible.

In a small apartment, it's best to avoid clutter when every square meter counts. Reinforcements in the wall can be used for this purpose. Similarly, corridors, which are often treated like passageways and made no bigger than necessary, can be slightly widened to accommodate narrow furniture or folding tablet systems that can serve as temporary office space.

## ORI Systems: Swiss-army-knife furniture

Designed by researchers from MIT Media Lab in partnership with the Swiss designer Yves Béhar (Fuseproject), ORI Systems is a multi-functional piece of furniture that can meet its user's every need, whether in terms of sleeping, eating, entertainment, work, or more. Designed to look like a large wardrobe, this smart piece of furniture includes an office, library, couch, TV stand, bed, lights, and electrical plug-ins. The entire unit is controlled by a centralised system that uses a simple series of switches, which in turn can be operated via a smartphone app or vocal commands given to Alexa, the artificial intelligence device from Amazon.

The wall that does everything

Commissioned to renovate and optimise a 20 m² studio, New York architect Michael Chen came up with a "wall that does everything". The unit includes pull-out furniture and is divided into three parts: a sleeping and dressing room section, a storage section with sliding elements, and a kitchen. Because the wall was designed without any apparent handholds, some of the flip-down furniture is motorised. The wall also holds a Murphy bed and a sliding table that can seat four people.

Focusing on a home's quality and liveability

As part of a competition launched by New York City to address rising real estate costs, the nARCHITECTS firm designed Camel Place, a building featuring micro-apartments ranging in size from 23 m² to 35 m². Pride of place is given to quality and liveability. Each apartment has a balcony and 2.7-3 m ceilings, which increases the amount of light, promotes better air circulation, and creates space for lofted storage areas, which frees up space on the floor. The idea is to optimise the use of space within the apartment with the understanding that a smaller room is acceptable as long as it has large openings and a high ceiling.
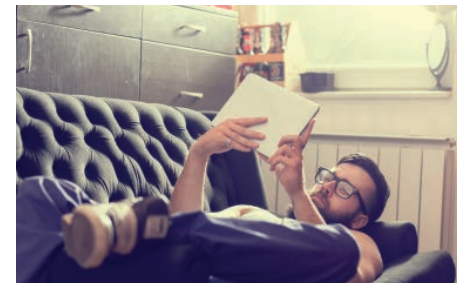
BoKompakt: 10 m² micro-houses for students

The architecture firm Tengborn and student housing specialist AF Bostäder set out to prove it's possible to live comfortably in a small space and address the student housing shortage in the university town of Lund, Sweden. Their 10 m² micro-homes contain all the essentials, including a lofted sleeping area, kitchen, bathroom, small office, and even a relaxation area complete with a hammock— all thanks to an ingenious layout and a beautiful design featuring wood, pastel colours, and rounded shapes.

A rotating house that maximises every last metre

Presented at the Ideal Home Show in London in March 2017, this home is built within a large cylinder and uses a system of motors to pivot in place by a quarter turn in a few seconds with the simple press of a button. The walls then become the floor and ceiling, creating a new room. The kitchen table, which is attached to the floor in the first configuration, is now affixed to the wall and becomes a screen. All the elements are built into the wall or secured via magnets. The toilet and bathroom remain fixed, however. This rotating home provides 40 m² of useful space despite having a mere 10 m² footprint, thereby saving space and reducing costs.

The concepts presented in this chapter are a far cry from a standardised solution that's suitable for everyone and ready to use tomorrow. However, they do offer alternatives and provide users with more agency over the place where they spend the most time on a day-to-day basis, i.e. their homes, therefore giving them the means to make it their own.

A WINDOW INTO CHANGING HOUSING LAYOUTS IN FRANCE
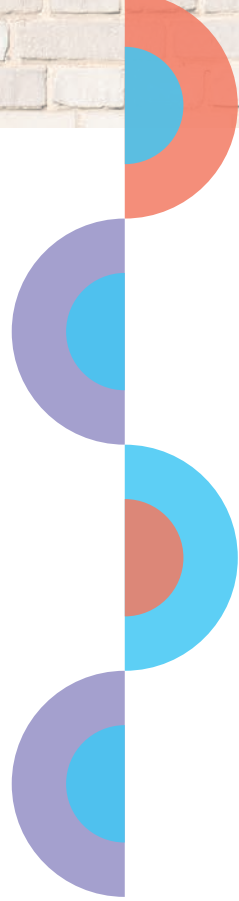
Monique Eleb,

As a sociologist specialised in housing and a professor at the Ecole Nationale Supérieure d'Architecture Paris-Malaquais, Monique Eleb's research focuses on how lifestyles and ways of collective living have changed in the Paris region from the post-war period to now.

Open kitchens aren't universally popular

The kitchen and bathroom are the two rooms that have changed the most in the Paris region since the 1950s. Only 10% of homes used to have bathrooms, compared to almost all homes nowadays. The kitchen has moved from the back of the apartment near the facade to next to the living room. In some cases, it's even merged with this part of the home. While the majority of housing professionals now opt for this design, not all users like it. In fact, many residents close off open kitchens as soon as they move in.

The end of a day-night division within the home

Starting in the 1950s, engineers designed homes to be divided between day- and night-time uses. The "night" side included the bathroom and bedrooms, while the "day" side was made up of the kitchen and living room. This design continues to be used despite its well-known disadvantages, including the close proximity of bedrooms, which takes away from the privacy of the couple, children, or teenagers in the family. A large number of architects have addressed this problem by placing a bathroom in between two bedrooms or splitting the bedrooms by building one near the entryway.

> " By creating more flexible spaces, social housing can become personal and individualised. Open, adaptable, and neutral floor plans; shared living spaces; additional rooms; and walls with built-in furniture all create new possibilities. "

The entryway and storage space: two essential features of French households

As the size of apartments has shrunk, certain spaces such as the storage area, utility room, and entryway have disappeared. The mismatch between supply and demand is undeniable given that the French retain a strong cultural affinity to having a public entryway and recreate this feature in their homes using furniture or divider screens. The exact opposite is true of inhabitants of northern Europe, where guests and residents enter through the private part of the apartment, i.e. the bedroom. Similarly, storage and cabinet space are in high demand and yet are often lacking.

Designing flexible housing that can adapt to a wide range of households and lifestyles

Housing must be able to accommodate a wide variety of domestic groups. Similarly, given that members of the same household tend to have increasingly different uses within the home as well as different schedules, modern homes must include solutions that help people live simultaneously together and separately. The time for cookie-cutter layouts is passed. Homes must offer individualised solutions on a collective basis by becoming more flexible. Open plans, adaptable layouts, neutral plans, shared spaces, extra rooms, and walls equipped with furniture redefine what is possible. There's no shortage of inspiration. Rotterdam's Didden Village, which was designed by the MVRDV agency, is one such example. On top of the flat roof of a building, the agency created a miniature village square equipped with benches, trees, and public space, all surrounded by three small houses designed to offer a maximum level of privacy to each family member.

DESIGNING A SHARED LIVING SPACE THAT'S OPEN TO THE REST OF THE CITY

2

While still a place of refuge and privacy, the home is increasingly becoming a shared space as well. This is evident by the growing interest in a wide variety of shared living arrangements (flat sharing, participatory living, intergenerational living, and co-living), the availability of housing as part of the shared economy, and the role of the living room within a home. As the household's most popular room, the living room is becoming the epicentre for an ever-increasing list of activities, including working out, improving wellness, working from home, and more. To accommodate these new uses, housing is becoming service-oriented and strengthening its ties with the city by turning into a neighbourhood mainstay. ∎

REVERSIBLE BUILDINGS CREATE A MORE **FLEXIBLE URBAN ENVIRONMENT**

In rapidly changing urban environments, a building's flexibility has become a key asset for accommodating constantly changing needs.

A building should be designed to serve a variety of functions and be able to transform from an office into an apartment block or school over the course of its life cycle. This transformation should be anticipated as early as the design phase so builders can tailor their approach to minimise the extent and cost of the renovation work whenever a section or the entire building is converted to suit another use.

The ability of a building to transform from an office into an apartment has become a special point of study now that the office space market has become more uncertain, the rapid change in working methods is requiring more flexibility, and certain regions are struggling with housing shortages. When designing a reversible building plan, the depth and height of the floors and the pattern of the facade must be able to accommodate a wide variety of functions. During the renovation, the facade remains the same. Only the floor, networks, and fluids are replaced to prepare the building for its new use.

In this way, reversible apartment buildings help create a city that is both flexible and fluid.

The Haussmannian buildings in Paris are a perfect example of reversible buildings.

Originally designed as apartment buildings, many have been converted into office space relatively easily. The high ceiling make it possible to install a dropped ceiling to cover the ductwork and cables necessary for an office space, and the many windows along the facade mean rooms can be easily combined or separated. Nowadays, in response to the housing shortage in the French capital, some are working to reverse this process.

Office Switch Home

This office building concept from Bouygues Bâtiment is designed from day one to potentially transform into housing (an apartment building, student dorm, or hotel) more cheaply and quickly than traditional buildings. The design owes its flexibility to a unique technical platform.

STRENGTHENING THE TIES BETWEEN **HOUSING AND MOBILITY**

"The home is based on possession, belonging, and appropriation. However, while living somewhere is characterised by settling down and being anchored, the philosophical understanding of 'living' in a place suggests an acceptance that goes beyond the mere notion of housing. The individual who lives in a specific area […] also moves within their physical and virtual networks and alters their social and economic relationships […]. Accordingly, it follows that mobility is a key part of living somewhere".

The introduction of the "Living and mobility: trends and scenarios for new urban landscapes" report by the Chronos Group are clear: housing and mobility are two paradoxical and yet inseparable sides of the same coin. This reality becomes visible when the time comes to select a home.

Real estate is cheaper away from the city centre, but commuting costs are greater, meaning families need to take all factors into account. Similarly, eco-neighbourhood projects take great care to account for residents' transportation methods and the district's connections to networks and transportation grids. As a result, it's logically to think of mobility as an extension of housing. Some projects are pursuing this approach by incorporating genuine mobility solutions into their buildings, including fleets of self-serve vehicles, car-pooling solutions, real-time updates about public transportation timetables, and more. In other residences, such as at Bike City in Austria, residents' mobility needs and choices even dictate the project's planning and architecture.

Bike City: A real-estate programme that encourages soft mobility

Inaugurated in 2008 in Vienna, Austria, Bike City was designed in keeping with policies aimed at reducing carbon emissions and promoting soft mobility. Everything about the project is geared towards promoting the use of bicycles. Bike City is connected to urban bike paths, includes bike parking, features elevators and corridors that are large enough to accommodate bikes, and has its own repair shop. The number of parking places for cars is 50% less than mandated by current regulations in Vienna. The resulting savings were reinvested in communal facilities, including a sauna, relaxation areas, and shared green spaces.

Buildings without parking places

In December 2015, a Parisian apartment building was built without parking places; this was the first such building since 1977. By obtaining an exception to the Paris City Hall's rule that every 100 m² of housing should have a parking place, the project saved around 8% in construction costs. This approach is especially useful in Paris, since nearly 60% of households in the capital don't own a personal vehicle. In the wake of this development, changes to the 2016 Local Urban Planning Scheme removed the requirement to build parking places for housing programmes.

Clem': a residence-specific car-sharing service

Clem' has developed a car-sharing solution designed specifically for housing complexes. It offers apartment residents the option of using an electric car for a few hours at a reasonable cost and optimising their transportation budget by not having to own a personal vehicle. The solution includes a car-sharing platform, a built-in carpool platform, electric vehicles, charging infrastructure for the vehicles, and installation and monitoring services.
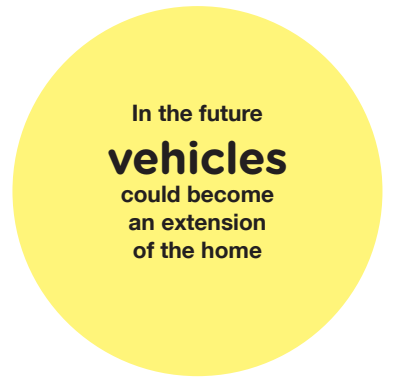
Residential choices given new types of mobility

Current and future changes to mobility are affecting housing. The promise of new types of ultra-fast transportation, such as the Hyperloop, as well as new forms of non-mobility made possible by digital technology are changing our relationship with space and time.

With the possibility of a future in which fast transportation is possible or even increasingly unnecessary, housing choices and regional configurations could be profoundly altered. This is exactly what is starting to happen with freelancers and remote workers who decide to move to rural areas or the city suburbs for a better, greener life. These neo-rural residents, or rather these "extra-urbanites", as the sociologist Jean Viard calls them because their lifestyles resemble those of city dwellers, but in a rural setting, move to rural areas that are connected, attractive and equipped with digital infrastructure in addition to professional sites and human networks. This trend is still in its infancy but could grow if, as many analysts have predicted, the number of independent workers increases significantly.

Other freelancers who aren't tied to a specific location by their jobs have decided to work while travelling. Dubbed "digital nomads", these individuals travel from city to city (and even from one country to another), and regularly change homes. In response to this phenomenon, some stakeholders have started to develop services geared towards these types of workers. Roam is one such example. The company offers its clients access to a global network of co-living options. In exchange for a monthly subscription, the service guarantees access to a room with linens, a bathroom, and a kitchen; living and working spaces in the city of your choice (Miami, Bali, Tokyo, London, and San Francisco for the moment); and the possibility of "moving" to another city at any time. Services like Roam are laying the groundwork for a subscription-based housing system.
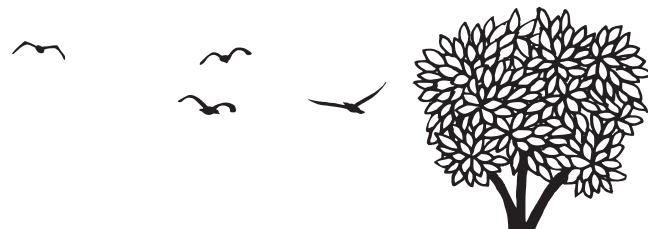
Vill@ge Factory, co-working in the countryside

In March 2016, Vill@ge Factory opened its first co-working space in the former village school of Asnières-sur-Vègre in Sarthe. The goal was to create dynamic communities and offer a shared office space to workers in rural areas. Several rural areas now feature this type of service to increase their appeal and attract company executives and freelance workers.

Housing and self-driving cars

Not a day goes by that the imminent arrival of the self-driving car isn't in the news. According to the latest statements from car manufacturers, the technology should come to the market by 2020. While these vehicles are sure to hit the streets in the near future, their impact on our mobility habits and the organisation of cities is harder to predict.

Currently, cars are parked on average 95% of the time, which takes up a large amount of parking space. One possibility could be to have fleets of small shared vehicles that drive around continuously and pick up passengers as needed. Self-driving technology might not change the current paradigm; an underused personal vehicle could actually be sent out to drive around so the owner doesn't have to pay for parking.

Does this technology pave the way for collective vehicles or personal cars? One option frees up space once used for parking and ensures the generalisation of housing complexes that don't need parking lots. The other could reinforce the idea among certain drivers that their vehicle is a "second home"[7]. Since self-driving technology could allow drivers to take their hands off the wheel and focus on other activities, cars could be perceived as an extension of the home.

[7] Nicolas Dubois, "The vehicle: a place that's treated like another home", University of Nanterre, 2004.

Nowadays, a car is parked **95%** of the time

In the future **vehicles** could become an extension of the home

INCREASINGLY INTENSE AND DIVERSE USES:
THE SHIFT TOWARDS HYBRID LODGING

The concept of the "intense" city has gained traction in the 2010s as an offshoot of the dense urban model. While dense cities are primarily associated with saving space and fighting urban sprawl, intense cities add a more qualitative dimension. This type of city is characterised by multiple flows and interactions. It is a place that creates urban environments that are ideal for exchange and sharing.

Intense cities are also more compact and provide access to a wide variety of amenities, businesses, and services by harnessing the sheer scale of daily life and the close proximity of people and major facilities.

From this perspective, optimising the use of well-equipped, connected, and available urban space is logical. However, a large number of housing units that meet these criteria remain empty a large portion of the day while their occupants do activities (work, recreation, etc.) outside. This period of under-occupation can be used by taking advantage of a site's schedule. Each time period can be matched with a specific use. This would mean opening up one's home to "secondary", outside users. By capitalising on this trend, sharing economy and on-demand economy platforms are already helping diversify the way we use housing. At any one time, a home can be transformed into a hotel, a concert hall, an office, a restaurant, and more.

With proper management, such a system benefits all parties.

It provides a source of extra income for the main occupant of the home, provides users with flexible access to a wide range of local and well-connected sites, and increases the density and intensity of cities and regions. Increasing the efficiency of each square metre precludes the need for new land, while boosting the occupancy level of residential buildings helps make cities more animated.

Hoffice, co-working for free at home

This Swedish concept lets individuals open up under-used rooms in their homes to workers who are looking for co-working space. The original reason for the idea was to allow freelancers and isolated workers the ability to work with "colleagues" and benefit from a friendly, interesting environment instead of working alone at home. The system is free, but money can be collected to pay for expenses like coffee or food. Hoffice takes it a step further by also offering to organise users' times by 45-minute increments. At the end of each block, co-workers can take a 10-15 minute break to walk, meditate, play exciting games, stretch, and more.

Housing acquires new uses

In addition to its primary use, housing is serving an increasingly diverse set of functions. Nowadays, living somewhere also means being able to work, take care of oneself, work out, consume, do odd jobs, create objects, garden, recycle, produce energy, and study at home—all at your leisure. Housing is now becoming associated with activities and functions that were once associated with other places.

The incorporation of new uses into housing has been largely fuelled by the advent of digital technologies, which provide access to a growing number of functions and services from any place that has Internet access. For example, a work-out coach app and a few pieces of equipment can replace a class at the gym. Platforms based on the sharing economy are also helping to redefine how housing is used. Each solution is more creative than the last, allowing users to transform all or part of their homes into a hotel (Airbnb), office (Office Riders), restaurant (VizEat) or concert hall (Sofa Concerts).

What role does housing play in patient treatment?

Medicine, which is traditionally associated with the hospital or doctor's office, is starting to enter the home thanks to the meteoric rise of telemedicine, or the use of information and communication technologies to practise medicine. This shift also helps divert traffic away from traditional healthcare establishments, some of which are becoming overburdened. In France, 4 out of every 10 surgeries are performed on an outpatient basis, in which the patient is treated without hospitalisation and allowed to return home after the procedure. For some surgeries[8], this rate can go as high as 8 out of 10.

[8] « Prise en charge, chirurgie ambulatoire », hopital.fr

Home is one of the place of the remote work

Teleworking, or working outside of an employer's office, is one use of housing that is on the rise. Remote working can be done while travelling, in co-working spaces (which have become increasingly popular), and at home. In 2016, an estimated 16.7% of French people worked remotely for more than one day per week. Most (64%) did so from their homes[9]. This practice is often rooted in the desire to make employees more comfortable (less time in public transportation, more sleep), which has a direct effect on their work (fewer sick days, more time spent working, and increased productivity).

In 2016,
16.7%
of French people teleworked more than one day per week.[9]
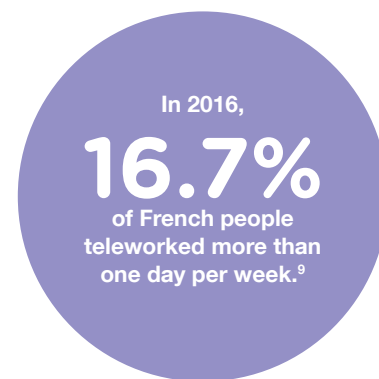
[9] RH Kronos, « Les chiffres du télétravail en 2016 »

Housing is becoming a "hub for life"

The increase and diversification of uses within the home has also affected its layout. The goal is to find solutions that accommodate a growing number of uses that are in turn associated with their own set of problems, such as finding a way to rent all or a part of one's home while still protecting the privacy of the main occupant and making space for a remote worker's private and professional life at home.

The answers lie with flexible, scalable, and modular design strategies. Some places must be able to switch from one function to another to make housing a "hub for life" capable of hosting a wide range of day-to-day activities, including sleeping, working, exercising, purchasing, and more.

In light of these varied practices, it's hardly surprising that the popularity of the living room has increased. According to studies and opinion surveys, it's the favourite room of the French. One of the reasons why the living room is popular is its versatility. The survey the trend forecasting firm Nelly Rodi conducted for the Paris Trade Show in April 2017 confirms this: "Within the home, the living room is becoming a true space for living—one that adapts and changes depending on the needs and wants of its occupants. For 84% of respondents, the living room is no longer a fixed, statutory place. In fact, the opposite is true; it's become a place that's much more prone to shift and change". In doing so, the living room has become a "platform within the home".

Designing service-oriented housing

The growing number of ways the home is being used and the shift towards housing that operates as a "hub for life" clears a path towards service-oriented housing.

Instead of being a function of the floor space, number of rooms, or layout, a home's quality of use is increasingly becoming a reflection of the amenities and services associated with it as well as its range of possible uses. Quality of use depends on three factors: the home, the apartment, and the neighbourhood. Some residences are equipped with mobility services such as a fleet of shared vehicles. Concierge services, which have become genuine hubs for local services, have now become a key feature of neighbourhood development projects. Similarly, neighbourhood social networks that let residents connect with each other have become increasingly popular. Residence evaluation platforms designed by some stakeholders are incorporating this new aspect of services and neighbourhood life. The challenge is to shift from selling or renting square metres of liveable surface to the possibility of finding a home, i.e. housing as well as services, neighbours, and a neighbourhood, that best suits each moment of life by putting the user back in the centre of the process.

Apimka: a review platform for apartments, buildings, and neighbourhoods

This website lets future home owners and renters see reviews from current occupants regarding four aspects: the characteristics of the home, the apartment's score, the building/neighbour score, and the neighbourhood score.

The value of proximity and a connection to a local community

The push for a closer connection to one's neighbours and neighbourhood is part of a trend that calls for community and proximity, which in turn meets social, societal, and environmental needs.
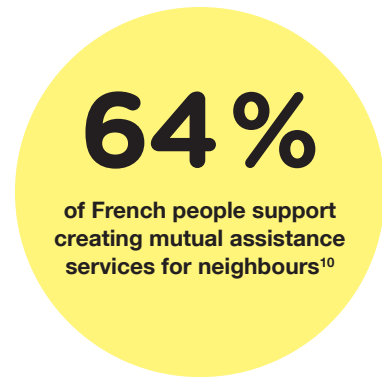
A majority of French people wish to meet their neighbours, use carbon-free transportation by walking or riding their bikes, and rediscover their home's biodiversity by encouraging short circuits. 66% would like to have closer ties with their neighbours, and 64% support creating mutual assistance services for neighbours[10].

[10] Ipsos poll for Altarea Cogedim, "French people and neighbourhoods in the future", June 2015.

Bordeaux and the 15-minute city

Bordeaux has decided to take a time-based approach to urban planning by partnering with La Poste to create a 15-minute city. The goal is to ensure each resident has quick access to day-to-day services by tailoring the city's offer and maintaining a sense of community within neighbourhoods.

66 %

of French people would like to have closer ties with their neighbours[10]

64 %

of French people support creating mutual assistance services for neighbours[10]

Barcelona's superblocks

Famous for its chequerboard layout made up of square blocks, Barcelona is now switching to a "superblock" system. Within these 3x3 grids of blocks, streets are closed to car traffic (except for residents' vehicles, municipal services, and emergency services). Superblocks promote pedestrian and bicycle traffic and foster the development of businesses, recreational activities, and special events on a local scale.

The communal concierge service

As building concierge services tend to disappear but the demand for day-to-day services increases, several concierge services are cropping up in neighbourhoods, third places, business parks, etc. The Communal Concierge Service stands out for its focus on co-development. The concierges are in the process of rejoining the labour market, and the structure works closely with stakeholders in the social and solidarity economy. This type of facility provides users with a wide range of services, including dry cleaning, ironing, borrowing or renting home improvement tools, collection points for throwing away items in an environmentally friendly manner, a digital and paper copy of the neighbourhood directory, printers, and even a mail service since the Communal Concierge Service is a certified post office.

Smiile

This neighbourhood social network helps neighbours help, share, and collaborate with each other and helps foster a more vibrant community. The members of the network can submit posts (carpooling, loaning or swapping items, requests for services), conduct polls, share good deals, communicate about events, and more. The network app is also open to services offered by other start-ups, such as Koolicar for carpooling, La Ruche Qui Dit Oui for food, and more. Finally, network security is one of its strongest features. The identity of every new user is verified via documents that prove their address or through their neighbours' approval.

PROMOTING SOCIAL COHESION WITHIN NEIGHBOURHOODS

The concentration of social housing in certain areas and of underprivileged people in the least valuable section of this type of housing creates clusters of struggling populations in certain urban areas.

To prevent the development of urban ghettos, public policy has been focusing on fostering social diversity for many years. From an operational perspective, this goal is implemented through a series of actions aimed at re-balancing the distribution of social housing units across districts and that of underprivileged people within the social housing offer.
This goal was reaffirmed through the Equality and Citizenship Law of January 2017, which further demonstrated the crucial role of housing policy in facilitating social diversity.

Nevertheless, some find this approach to social diversity to be too focused on location, arguing that spatial proximity and a diverse range of housing occupation statuses is not a guarantee of social cohesion.
Other methods suggest using complementary approaches focused on housing, similar to the sociological method co-created by Losinger Marazzi, a Swiss subsidiary of Bouygues Construction, and the University of Engineering and Architecture of Fribourg.

FOLLOWING THE SUSTAINABLE DEVELOPMENT METHOD AND TOOLS (SDMT)
## APPROACH TO HELP NEIGHBOURHOOD RESIDENTS LIVE TOGETHER HARMONIOUSLY

Louise de la Guéronnière,
real estate developer with Losinger Marazzi
(Swiss subsidiary of Bouygues Construction)

The SDMT programme arose from a research project led by the Transform Institute at the School of Engineering and Architecture of Fribourg (HEIA), Switzerland. What was the purpose of the research project and what was the advantage of a partnership between a university and a company?

The goal of the research project was to implement a decision-making and design tool to help stakeholders roll out sustainable development in operational terms at a neighbourhood scale.

For the School of Engineering and Architecture of Fribourg, the purpose of the partnership with Losinger Marazzi was to test out the results of this research on a practical level on real eco-neighbourhood projects. The university-business partnership was encouraged and facilitated by the Commission for Technology and Innovation (CTI), the agency responsible for promoting innovation in the Swiss Confederation, which encourages applied R&D.
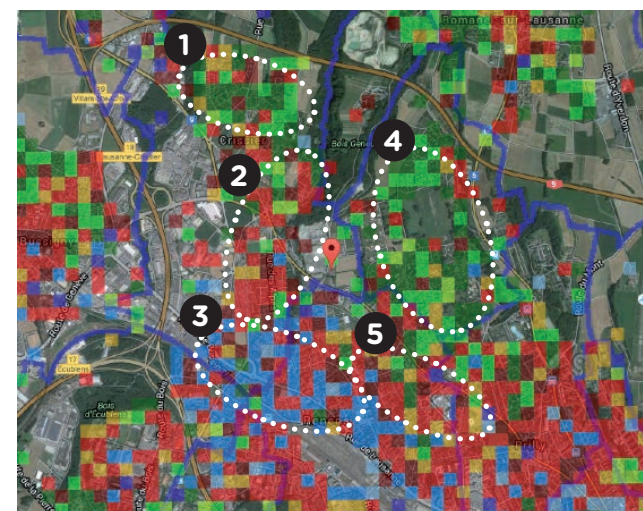
The company's role was to provide sociological methods and tools for a better understanding of the social dimension in the design of eco-neighbourhoods, something that is often considered less than the environmental and economic aspects. Developing an urban planning approach suitable for different demographics that makes it easier for them to live alongside each other is all the more important in eco-neighbourhood projects because they have greater objectives in terms of population density. So, how can you create optimum conditions for an increase in population density, while maintaining a good quality of life for everyone?

The response envisaged in this applied research project was based on a detailed analysis of the sociological characteristics of each demographic to get a better understanding of their lifestyles, usage habits, and needs. How was this analysis performed?

HEIA used the housing demand segmentation calculated by the consultancy Fahrländer Partner in partnership with Sotomo and drew from the work of a researcher at the Urban Sociology Laboratory (LASUR) at the Swiss Federal Institute of Technology in Lausanne. By cross-referencing these studies, HEIA was able to create a typology of residents' sociological profiles and identify their preferences regarding the way they live in a home, residence, and neighbourhood.

A wide-scale survey was conducted amongst residents in several existing neighbourhoods to pinpoint how the neighbourhoods function, the relationships between residents, how residents feel, and their lifestyles in the neighbourhood.

Qualitative data such as the level of urbanity acceptable to residents, quality of life in terms of community, and preferences in terms of transport were collected to create the different population profile types.

For example, "established alternative types" have a lifestyle geared towards personal development. They are very ecologically and socially aware, with a keen interest in culture. Whether they live within city limits or the suburbs, they place greater importance on the cultural and creative aspects of their area than property ownership. They will in particular look for densely-populated neighbourhoods offering an active cultural life and housing with a strong element of sharing, such as flat sharing, intergenerational housing, and shared communal spaces.

Each profile was described in an observation notebook in order to better pinpoint the expectations of the demographics concerned.

Moving from theory to practice, how were these tools used in designing new neighbourhoods?

HEIA worked with Losinger Marazzi in 5 neighbourhood projects in Vaud canton in French-speaking Switzerland to apply this method to real neighbourhood planning projects.

The first step involved determining in advance of the project which demographic profiles were most likely to move to the future neighbourhood. This was determined by taking into account the character of the area, demographic profiles in neighbouring areas, current population trends, and the local political will to intervene in developing these trends.

This expected social composition of the neighbourhood was then compared with the sociological profiles from the research phase to anticipate future residents' needs, usage habits, interactions, and any potential tension between the different demographic profiles. This information is an invaluable planning tool for more effectively addressing: How to lay out and organise a neighbourhood to keep all future residents happy? Where to locate public spaces? How to distribute different demographic profiles in a neighbourhood so they can live peacefully side by side?

It's a real tool in favour of quality of use in future neighbourhoods which offers key information for creating a true vision of urban design.

Example of population segmentation in the town of Crissier and the surrounding region (Lausanne metropolitan area, Switzerland)

- Rural and traditional
- Modern workers
- Unfixed alternative residents
- Classic middle class
- Open middle class
- Established alternative residents
- Upper middle class
- Upper class with a focus on education
- Urban trailblazer

1 Predominance of the upper middle class

2 Predominance of the open and classic middle class

3 Predominance of modern workers

4 Predominance of the upper middle class and upper class with a focus on education

5 Predominance of the open middle class and established alternative residents

Source: Fahrländer Partner & Sotomo

SHARED HOUSING
BECOMES MULTIFORM

In France, shared housing has long been associated with solely a financial decision.

While this criteria remains the main reason, there are a growing number of other motivations as well. The desire to not live alone and to share and belong to a community is changing the game; some residents are deliberately deciding to share their homes.

Even though shared housing is starting to make headway in France, it's still much less common than among residents in Switzerland and northern Europe, who are experts in the topic. Shared housing has been a tradition in this part of the world for several decades. Denmark's first such community was founded in 1972, and a major project made up of 84 apartments, Stoplyckan, was built in Sweden in the 1970s.
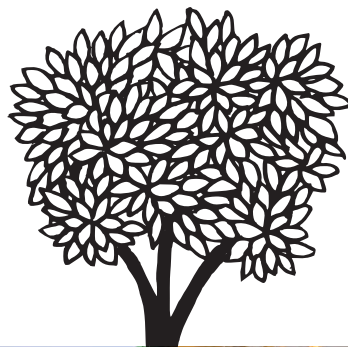
Stoplyckan: Sweden's largest shared housing community

Built in the 1970s in Linköping, Stoplyckan is still Sweden's largest shared housing community. Equipped with 184 apartments split between 13 buildings, the complex is home to 400 residents. Stoplyckan was designed according to a vertical urban planning strategy and is owned by the government, two features that are specific to shared housing in Sweden. In Denmark, on the other hand, shared housing is the product of private initiatives and is built horizontally. Because the complex is publicly owned, the residents of Stoplyckan share some of their communal areas (dining hall, sports areas, etc.) with health services according to a well-established schedule. The health services rent the space until 6:00 p.m. in the evening, after which the residents take over.

Young professionals are also sharing their flats

Flat-sharing represents the most common and well-known type of shared housing. In 2014, one out of every six French people had already lived with a roommate [11]. This type of living arrangement is more frequent among young people, but concerns both professionals (54%) and students (45%), contrary to popular belief. This relatively mature approach to housing has led to the emergence of purpose-designed offers, such as apartments with two bathrooms and at least one separate toilet for a four-bedroom unit.

Chez Nestor

Flat-sharing comes with its own set of challenges. If one roommate fails to pay their share of the rent, the rest of the occupants have to make up the difference. Couples or individuals looking for a short-term solution often struggle to find a place. To make life easier for students and young professionals, the start-up Chez Nestor offers short- or long-term flat-shares with individual leases in which couple are also accepted. In order to help new arrivals settle in or enter professional life more smoothly, all the essentials are already set up, including Internet, electricity, a wash machine, renter's insurance, furniture, and more. This "turnkey" service also offers additional services like any-day check-in/check-out, car service to the airport, etc.

[11] Guy Hoquet l'Immobilier Survey – CSA, June 2014

1 out of every 6 French people had already lived with a roommate in 2014 [11]

Participative housing: from a resident-led initiative to "institionalisation"

Participative housing refers to initiatives organised by groups of residents who want to collectively and independently design and manage a real estate programme in which each person has access to a private home and shares spaces, such as a common room, workshop, utility room, etc., with the other residents. After first appearing in the early 2000s, the practice gained traction in 2014 when the ALUR Law (Housing Access and Renovated Urban Planning Law) granted it legal recognition and created two types of participative housing:

The Resident-led cooperative allows a group of individuals to become owners on a collective basis. The apartments belong to the cooperative. Residents purchase membership shares from the cooperative and pay monthly rent. As a result, members have a dual status as part of a company and as a renter.

A member can decide to leave the co-op, at which point he or she can withdraw their initial investment, which is updated to reflect the cost of living.

The Attribution and self-promotion company most closely resembles the home ownership model. Unlike a cooperative, which raises money by borrowing collectively, all of the funds for the apartments are paid to the Attribution and self-promotion company by the associated families. Once the residence is built, the company does not necessarily continue to oversee the management of the building. The apartments are attributed to each family based on their shares in the company.

While participative housing was initially created by residents, professional stakeholders are now becoming involved with this approach as well. Local authorities are launching calls for projects that encourage groups of residents to apply to build on previously selected plots, and council estate organisations are stating operations directly. Surprisingly, the involvement of professional actors in participatory housing has been partially structured by residents. In response to the challenges associated with certain projects, residents sometimes turn to housing construction professionals for help[12]. The ALUR law made this shift official by allowing public housing providers to own up to a 30% stake in participative housing companies.

Given the challenges created by the development and diversification of actors involved in participative housing, it became increasingly important to create a framework for the process. As a result, the Coordin'action Nationale de l'Habitat Participatif, a union of national participative housing associations, was created in November 2012. In collaboration with the Colibris movement, which connects and supports citizens involved with an individual or collective fight for change, the group created the first national database on the subject. In September 2017, 471 participative housing project records had been filed in France.

[12] City Planning Thesis, Camille Devaux, "Participative housing: the emergence of a resident-led initiative and its incorporation into public programmes", November 2013

Participative housing in Europe

Norway:
cooperatives represent over 15% of all real estate (up to 40% of housing units in Oslo with 650,000 residents concerned)[13]

Germany: 5 million residents in 2.2 million housing units are part of cooperative arrangements, i.e. over 10% of the country's rental stock[13].

Switzerland: 5% of all housing units are part of cooperatives (up to 20% in Zurich)[13].

[13] Site internet : habitatparticipatif-paris.fr, contexte

[13] http://www.habitatparticipatif-paris.fr/habitat-participatif/contexte/hors-de-france/

Tübingen: a laboratory for participative housing

In Tübingen, located in the German state of Baden-Württemberg, the city has built over 200 participative housing projects since the 1990s. They are mostly concentrated in the "French district", an old military site held by the French army until the fall of the Berlin Wall. The city hall owns the land of this former military base, and the abandoned industrial field has been gradually decontaminated and rehabilitated. It sets the resale value and selects projects brought forth by groups of residents. This approach lowers the cost of housing in the university town, where demand is high. The city also sees participative housing as a way to guarantee the diversity of the buildings on offer. In total, over three-quarters of all new housing in the neighbourhood is part of a participative housing arrangement.

Sharing to splits costs, meet your neighbours, get more space, and access new services

When it comes to housing, sharing arrangements involve allowing a group of residents access to spaces, equipment, and/or services. The reasons can be varied, and each type of project presents its own set of challenges.

Participative housing is run by activist residents who want to live together and create a community. They share a single vision based on a shared project and similar day-to-day practices. In a context in which sharing provides a way to promote discussion, meet others, and live together, a common room where residents can host meals or events is especially important.

The goal can also be to share the investment and operations costs between residents to achieve economies of scale. For example, a shared utility room with washing machines prevents residents from having to purchase one on their own and lets them save a few square metres in their apartments.

Finally, sharing also provides a way to offer residents extra services that they wouldn't necessarily have been able to purchase on their own (e.g. a shared car in a social housing building) or wouldn't have been able to include in their own apartments due to a lack of space, like a shared guest room where friends and family can sleep from time to time.

Making sure shared systems last

Sharing shouldn't be entered into lightly. In fact, it can become a nightmare if enough preparation hasn't been done ahead of time. For example, in countries where a shared laundry room is commonplace, such as Switzerland, Germany, Sweden, and elsewhere, this room can sometimes be a source of tension, as documented in an article published in the Swedish daily paper "Svenska Dagbladet" and republished by "Courrier International"[14].

The article describes certain problems and indicates that in 2008, 72 claims were filed in Stockholm country for abuse and violence that took place in the shared apartment laundry rooms. Still, the laundry room can also be a place for pleasant interactions between neighbours. In order for any shared space to operate smoothly, it's important to identify potential uses ahead of time, precisely establish the financial and human modes and methods of management, and even write a charter or list of rules for communal life. Residents' ability to take action and come together also plays a role, but this factor is much more difficult to anticipate except when residents are "selected" for their motivation.

The way the system is managed determines its longevity. A variety of methods are possible, including self-management by the residents or renting the space to an association, which then operates and manages it.

Residents can enter into these arrangements through a variety of ways as well. In co-ops, one approach is to have everyone help pay the building costs for these spaces to keep the price lower. In its Lil'Seine programme in the Ile-Saint-Denis eco-neighbourhood, the Brémond Group has each homeowner purchase four extra square metres (at most) so they can have access to future communal areas for free. These facilities include a multi-purpose room, a laundry room, guest rooms, and a 380 m² roof-top terrace.

Other alternatives include a pay-per-use model, shares that are included in the co-op fees or rental fees, or membership fees paid to an association that manages the space. The use of a digital platform can also make it easier to manage the facilities. Residents can then use their accounts to reserve services. They can also see the price of the services they've used, which are added to their rent or utility bill.

Mehr als Wohnen: "More than a living space"

In Schwamendingen, in the suburbs of Zurich, the Mehr als wohnen cooperative includes 380 apartments and 1,200 residents distributed over thirteen buildings. In this residence, the aim is to encourage social interaction and to "intensify" the buildings, without sacrificing comfort. Each person has a 35 m² apartment, which is far from the Swiss average of 50 m²[15]. The reduction in private areas is compensated for by the presence of many shared spaces. The residence has ten shared rooms, the use of which is defined by the residents: meditation room, repairs workshop, a room for screening films, etc. In addition to their private area, the residents can also rent offices and extra rooms with bathrooms on a fixed-term lease. Fifteen apartments are built in a "cluster" principle, that is growing in Switzerland: private accommodation units with two rooms, a bathroom and a small kitchen connected to an area that includes a large lounge and a kitchen. A new form of cohabitation.

What can we learn from past and current sharing initiatives in housing? Is sharing compatible with social housing, and if so, under what conditions? What role should renters play in these new types of housing? What investment and support should the landlord provide?

Bouygues Construction has tried to answer these questions by holding a collaborative discussion in 2014 with sociologists, anthropologists, architects, social housing providers, and representatives of associations.

The summary of this work is included in the trend report entitled "A bold step: sharing resources in social housing. A practical guide for landlords", the second issue of our collection.

[14] "Sweden: the powder keg in the laundry room", Courrier International, December 2009

[15] "Housing of the future will be shared", Le Temps, December 2015

Co-living: living and working within a community

Some freelancers and young entrepreneurs are choosing to work in co-working spaces where they can use shared offices and interact with their peers.

Co-living, a concept that originated from the United States, takes it a step further by giving these same users the option to live within a community in a place designed to meet the needs of professionals. This approach is part flat-share, part co-working. The residents have access to a personal space that includes a bedroom, bathroom, and sometimes a kitchenette and share many communal areas within the building, including working spaces complete with equipment and Internet access. These facilities allow residents to focus on their careers and work during unusual hours, such as at night. Co-working spaces, however, are rarely open around the clock.

The Collective Old Oak co-living space

Opened in 2016 in London, The Collective Old Oak features 550 rooms, making it the largest co-living space in the world. Residents can choose between several options: "twodios" (two bedrooms, two small bathrooms, and one shared kitchenette), "studios" (one small bedroom, one bathroom, and a kitchenette), or "apartments" (one large bedroom, a large kitchen, and a large bathroom). Each bedroom is equipped with a double bed and storage space. The communal areas are decorated in a very modern style and include a restaurant, game room, co-working spaces, a library, a film room, a spa, and a rooftop deck. The building is set up like a large-scale flat share. Rent is around €1,200 a month and includes housing, linens, taxes, and Wi-Fi access. Some have criticised the model for its lack of social diversity and minimal interactions with the local population. The size of the bedrooms isn't very conducive to children, and the variety of services and amenities doesn't encourage residents to have contact with people outside of the building.

Strengthening intergenerational solidarity through housing

In an intergenerational housing arrangement, people from several generations live together in a residence or home. The most common type pairs up young people looking for housing with seniors who want a companion and a helper with day-to-day tasks.

Students receive housing for a minimal price or even for free. In exchange, they spend time with the retiree and/or help him or her out with various tasks (grocery shopping, household chores, etc.). Typically, associations serve as intermediaries and create the conditions needed for a successful experience. Since 2004, the Cohabitation Solidaire Intergénérationnelle (CoSI—Solidarity Through Intergenerational Living) network has overseen this type of structure.

When the system works well, everyone wins and there are many advantages. This arrangement helps prevent seniors from becoming isolated and lets them live at home longer. In addition to providing a cheap housing option, the experience lets students gradually transition to independence after leaving the family nest for the first time.

Vivir y Convivir: strengthening intergenerational solidarity through housing

Created in 1997 through social funding from the Caixa Catalunya bank in collaboration with cities and universities, this programme targets issues such as preventing loneliness among seniors, helping students find housing, and strengthening intergenerational solidarity. A student living far away from their family and an able-bodied senior agree to a set of conditions established ahead of time with help from a psychologist, specifically that the student receive free lodging, the student accompanies the senior to the doctor's office as needed, meals are shared, the student takes care of grocery shopping, and the student adheres to a 10:30 p.m. curfew during the week, is free on the weekends, and returns on Sunday night. The senior receives a monthly stipend for housing the student, and students are reimbursed for their transportation costs.

Färdknäppen: housing for retirees and working-age adults without dependent children

This programme, which includes 43 apartments and is managed by a public housing organisation in Stockholm, brings together retirees and working-age adults without dependent children. It allows the elderly to keep a degree of independence whilst maintaining a social and collective life. It offers new residential opportunities to working people whose children have left home. Pooling a large amount of equipment and meals offers substantial savings to the residents.
The programme includes over 400 m² of communal areas, including a kitchen, library, sewing room, carpentry room, laundry room, dining hall, and more. Residents take turns performing chores like grocery shopping, cooking, and cleaning and organise group activities in the building and in the wider community (reading, film dates, etc.). Three other programmes have been built in Stockholm due to the success of the operation.

DESIGNING A RESPONSIBLE CAMPUS

3

In order to make housing more sustainable and liveable, household housing costs should be reduced, occupants' health should be protected, and the environmental impact of housing should be reduced. To address these challenges, technical innovations (connected objects, new building methods, etc.) are being combined with efforts to encourage residents to live in a more environmentally friendly way.

More generally, housing in the future needs to be more resilient to tackle the major challenges affecting society now and in the future, including the need for massive emergency housing for migrants and adapting to climate change. ∎

MORE AFFORDABLE HOUSING TO REDUCE HOUSEHOLD SPENDING

Housing: the main household expense

In the European Union in 2015, households spent 24.4% of their budget on average on housing and home maintenance (rent, purchasing and construction expenses, and fees). Housing is the greatest expense for households and far outpaces the cost of transportation (13%) and food (12.3%[16]).

In 2015, the French paid more than the European average, allocating 26.4% of their budget to housing behind Denmark (29.4%) and Finland (28.2%). By far, housing is the expense that increased the most over a ten-year period, growing by 1.9 points in Europe and 2.3 points in France.

However, these figures represent the average and are not reflective of disparities. On average, owners who have finished paying off their home loans spend less on housing than renters or homeowners who are still paying their loans. In 2016, in France, nearly two out of three homeowners (out of the 57% of households who own their main residence) had fully repaid their home loans. This explains why for the wealthiest 20% of households, transportation, and not housing[17], represents the largest expense.
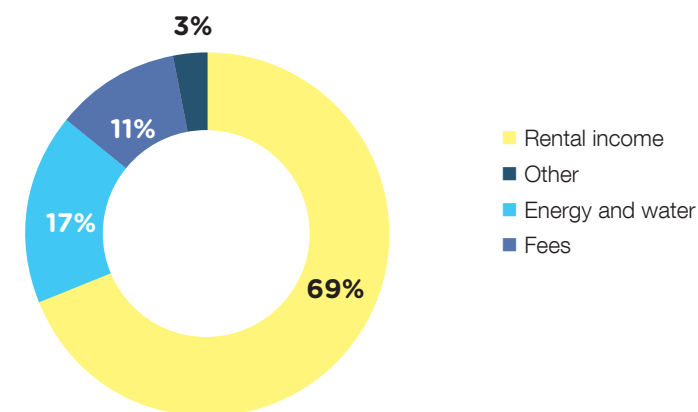
There are also regional disparities. Housing costs depend on geographical factors (cities, suburbs, rural, etc.) and the relationship between supply and demand within a given area.

A growing number of households are faced with excessive housing costs or energy insecurity

The burden of housing costs weighs heavily on lower-income households. Since its 2016 edition, the Fondation Abbé Pierre's report on inadequate housing has incorporated the concepts of excessive housing costs and an inability to heat one's home to better understand insecurity and its relationship to housing.

According to the latest report, 5,732,000 dedicate over 35% of their income to housing expenses and earn 65% of the poverty level (i.e. 650 euros per month per unit of consumption)[18]. This figure jumped by 42% between 2006 and 2013, which can be explained by that fact that housing costs are rising faster than incomes are increasing[19].

Similarly, the number of people reporting they have been cold at home during the year due to insecurity (poor insulation, inadequate heating, or financial hardship) increased by 25% over this same period, riding from 6,134,000 to 7,697,000 people.

In 2014, basic housing expenses, including rent, fees, energy, and water, amounted to

€337.3 billion in France[20]

Basic housing expenses in France in 2014

- 3% Other
- 11% Fees
- 17% Energy and water
- 69% Rental income

■ Rental income
■ Other
■ Energy and water
■ Fees

Source: Societal portrait, INSEE, France

A path towards more affordable rent, lower home ownership costs, and/or savings on fees

Solutions are being developed to reduce the cost of housing for both prospective homeowners and renters. The aim is to protect households' purchasing power by making rent affordable; this is achieved by reducing the cost of home ownership and/or by providing savings on fees.

Separating land and buildings to reduce the cost of home ownership

The practice of separating the ownership of the land and the building to reduce purchasing costs is widespread in certain countries. In the United States, the Community Land Trust model was developed in the 1970s. It aims to help lower-income households own their homes by making them solvable; this is done by reducing the price of housing by taking a different approach to land costs.

The model takes a unique approach to real estate ownership in which families own their home but rent the land, which is owned by the administrators of the Community Land Trust. This alternative to private land ownership that relies on a non-commercial approach to land is gaining traction in certain countries, including the United Kingdom, Canada, Australia, and Belgium. The 2014 ALUR Law (Housing Access and Renovated Urban Planning Law) used this model as a reference when creating the Office Foncier Solidaire (OFS — Community Land Office). The organisation purchases plots of land and allows property developers, social housing providers, and cooperatives to build housing.

The land is rented to the OFS for 99 years for €0.50-1 per month. Home owners save around 20-40% compared to normal market prices. Only households whose income does not surpass the social home ownership limit can take part in this system.

Against this backdrop, Lille decided to offer its first "community lease programme" in late December 2017. Through this system, households only own and pay for their homes. The housing units affiliated with this operation and located in the Lille city centre are sold at €2,100/m² instead of the average €5,000/m².

[16] Eurostat, Household expenditure according to consumption, November 2016

[17] France: a societal portrait, INSEE, 2016 edition

[18] The state of inadequate housing in France, Annual report #22, Fondation Abbé Pierre, 2017

[19] National Housing Survey, INSEE, 2013

[20] INSEE

Housing as a source of income

The gig economy refers to a new economic model based on the commercialisation of individuals (free-lancing) or their property (car, housing, equipment, etc.).

Given the exponential growth of this economic model (especially in city centres), housing could become a source of extra income.

Airbnb, which lets individuals rent their house or a part of their house, is the most well-known option, but many other platforms let users make money from their place of residence. OfficeRiders, for example, lets individuals rent their unoccupied homes to remote workers during the day.

The originally uncontrolled development of this model resulted in certain harmful effects on cities and their citizens. In the case of Airbnb, in addition to the unfair competition created by some users who provide professional services without having to follow sector-specific regulations, cities are especially worried about the effects of an excessive supply. It can be much more profitable for a landlord to rent a home for a short time to several tourists than to rent it to a local resident for a long time. As a result, the supply of available homes decreases.

The legislative framework for these services was recently strengthened to limit these abuses. In the city centre of Paris, homes cannot be rented out more than 120 days out of the year to ensure the supply is exclusively used for short-term rentals. Similarly, rental income is now taxed, and the relevant platforms have had to inform users of their fiscal obligations since July 2016.

The legislation makes a clear distinction between income generated through the gig economy and income that's part of the sharing economy, which is based on solidarity and cost sharing. When the user-organiser participates in the activity and pays a portion of the cost, the revenue is not taxed. For example, someone who uses the platform Vizeat, which helps friends organise a meal, doesn't have to declare their spending or income if they share the cost of the party with the other guests.

Efforts to reduce costs

In addition to rent or the price of purchasing a home, the costs related to living in an apartment or residence represent a significant share of the household budget.

Retrofitting homes with improved insulation and training residents to adopt habits to cut down on their water and energy waste have both a positive impact on the environment and on the household budget. Some stakeholders take it a step further by implementing actions aimed at achieving "zero costs" on the collective and individual level. Examples of these actions include asking residents to clean communal areas, manage the trash, and keep up the areas around the outside of the building in order to reduce rent for everyone.

Lowering costs by asking renters to manage communal areas themselves

In the apartment building located at 6 Passage Degrais in Paris' 19th arrondissement owned by the social housing provider Batigere, the six household living in the residence take an active part in maintaining the communal areas. In this apartment, which doesn't have its own building manager, the families take turns cleaning, taking out the trash, changing light bulbs, and reducing energy use. The goal is to strengthen the sense of community within the building and work towards "zero costs" (except for water and electricity).

User-finished housing

What if there was a third option in addition to social housing and purchasing a home via the traditional path? Some experiments are exploring the concept of new, unfinished housing. The principle consists of buying a new home with concrete, no interior walls, and no coverings at a price that is substantially below that of the traditional market. The purchaser then finishes the home. The system requires a buyer who is able to carry out and finalise the work and live in a building that's under construction for a period of time.

Shell buildings: new, unfinished housing

The Brazza neighbourhood in Bordeaux will be home to 8,000 residents in a decade. Out of the project's 4,950 housing units, 499 will be "shell buildings", i.e. new and unfinished homes. The owner purchases the apartment with the basic fittings (a sink and a bathroom unit that includes a shower, toilet, and a sink), network connections, and a light source. They then design the apartment's layout and do the work themselves, including finishing the electrical wiring, installing interior walls, and decorating. The concept lets people become homeowners for less with a purchasing price that ranges from 2,100 to €2,400/m² compared to an average of €3,600/m² for traditional homes in the same area.

"COMMUNITY-CENTRED HOUSING": A PROGRAMME CREATED BY ACTION TANK ENTREPRISE & PAUVRETÉ
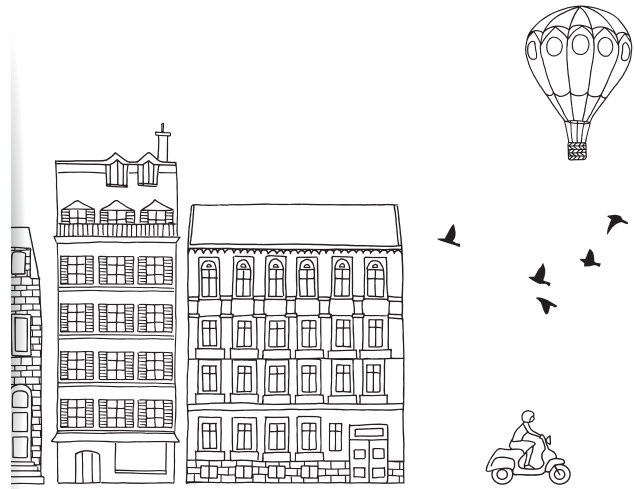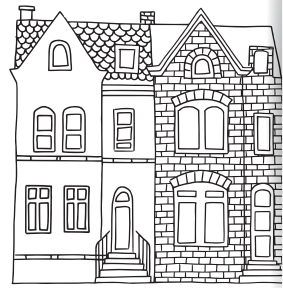
Xavier Rodarie,

Regional and Inclusive Economy Development Manager at Bouygues Bâtiment Ile-de-France

What is Action Tank Entreprise & Pauvreté and why did Habitat Social decide to join forces with it?

Created in 2010 by HEC's Social Business Chair, Action Tank Entreprise & Pauvreté is a laboratory for social experiments designed to develop a more inclusive economy.

It brings together companies, charities, and academia to work towards a common goal—reducing poverty and exclusion in France by developing economically sustainable projects that can be rolled out on a large scale.

Habitat Social joined Action Tank in 2012 in order to encourage its ecosystem of stakeholders to bring their talents to bear on its "Solidarity Housing" project, the goal of which is to help regions build housing units that are as affordable and suitable for their citizens as possible. Another target of the project is to provide housing while also upholding the values of the inclusive economy, i.e. targeting populations that are struggling with poverty or social exclusion, working with stakeholders to design the final product, and focusing on social good instead of profit.

What was the inspiration for this project and what are its goals?

This project began in response to the housing crisis in the Paris region, where the supply of available units is much lower than estimated need. The level of housing is also ill suited to demand, and 350,000 households have a disposable income (once all housing expenses are deducted) that is below the minimum threshold recommended by the Paris regional authority, i.e. €14 per day per consumption unit. In an effort to help resolve this crisis, the project aims to reduce the overall cost of social housing and optimise the disposable income of future residents while also ensuring the building's quality and the economic viability of the operations.

Your solution is to replace the current method of housing design with a new process based on analysing the real needs of a given region. How would such a method work?

Every time we start a new project, we focus specifically on the town in question by analysing what is needed in the region.

We start by assessing whether or not the region's housing supply matches demand in order to identify the most needed type of housing as well as the profiles of the applicants who are having the most trouble gaining access to social housing. The mismatch between supply and demand can be quantitative (i.e. not enough studio apartments to house unmarried and childless applicants), qualitative (i.e. the cost of three- and four-bedroom apartments is too high for couples with children), or both at the same time. This analysis makes it possible to single out the populations who are most often excluded from social housing and to offer policy suggestions for the region.

For each type/target population duo identified, we use models and an analysis of local data to set a goal amount for the cost of rent plus utilities to reduce the exclusion rate for the target populations. This amount, which is shared with the city's housing director, is used as the goal when designing projects and developing a business plan.

When starting a housing construction project within the municipality, we assess the overall cost of the building over fifty years with help from a modelling tool provided by Action Tank and Habitat Social and then measure the gap between that amount and the target cost of rent plus utilities. To reduce overall costs, we design the project in collaboration with all relevant stakeholders, including the project owner, local authority, project coordinator, legislators, builders, operators, and renters. We also operate on every level (land development, construction, financing, and use and maintenance) and optimise our choices, i.e. selecting very hard floors, asking renters to do some maintenance work, opting for an individualised cold water bill, etc.

What is the status of the project now and have you received feedback?

Three towns (Guyancourt in Yvelines, Grigny in Essonne, and Stains in Seine-Saint-Denis) have offered us plots of land to pilot our operations in accordance with this method and evaluate the result.

We have formed the teams for these projects and are starting the design phase. Before concluding the experiment, we will need to evaluate the impact of the first construction project in order to confirm that overall costs do indeed decrease. We will also look at whether our target populations are effectively helped and if residents have increased disposable income as a result.

> " Habitat Social joined Action Tank in 2012 in order to encourage its ecosystem of stakeholders to bring their talents to bear on its "Solidarity Housing" project, the goal of which is to help regions build housing units that are as affordable and suitable for their citizens as possible. "

DESIGNING HEALTHY AND STREAMLINED HOUSING

Poor insulation and ventilation: the main complaint with housing

In 2013, in France, 10% of homes, i.e. 2.8 million housing units, had three or more defects (humidity on the walls, flooding, poor exposure, etc.)[21] according to objective comfort indicators, which sometimes conflict with the perception of the individual household.

Indeed, only 6% of households lived in homes which they considered to be unsatisfactory or very unsatisfactory according to their own criteria. This difference can be explained by the wide variety of factors that can affect a person's perception of the comfort level of their home, including an individual's tolerance level and environmental factors like their relationship with the neighbours, feeling of safety, the home's location, and more.

Uncomfortable temperatures, a lack of acoustic insulation, and poor aeration and ventilation are residents' main sources of dissatisfaction with their homes[22]. These issues must first be addressed to improve occupants' satisfaction level. Poor soundproofing is an especially troublesome nuisance in day-to-day life—so much so that is one of the main reasons for moving.

Soundproofing is the only interior comfort criteria included among residents' reasons for moving, which generally have to do with life goals (own a home, move to a larger apartment, etc.).

Interior air quality: a real public health challenge

Several scientific studies have shown that atmospheric pollution isn't the only source of danger when it comes to human health.

The air inside buildings can also be contaminated by a wide variety of pollutants, including carbon monoxide, radon, asbestos, volatile organic compounds (benzene, chlorinated solvents, etc.), animal allergens, and mould. Products used for building, decorating, furnishing, cleaning, home improvement projects; heaters and hot water production equipment; the presence of pets; and habits such as tobacco, candle, and incense use are all potential sources of pollution.

Interior air quality (IAQ) is becoming an increasingly important public health issue, especially given that we spend a large amount of our time inside enclosed spaces.

The issue first became a topic of concern for buildings that welcomed members of the public after France's Grenelle 2 Law mandated IAQ surveillance. At first, only certain buildings will have to comply with the law. However, it will be expanded to include all buildings that host the public between 2018-2023. A growing number of actors is now working to have housing included within the scope of the law as well.

According to a recent comparative study carried out by Ademe regarding public IAQ policies, France is one of the world's leading countries in terms of actions aimed at improving IAQ[23].

Other best practices being followed in other countries include a law in South Korea that makes it mandatory to measure the levels of several pollutants upon delivery of new buildings with over 100 housing units and another in Sweden that implemented regular and mandatory checks of new and existing ventilation systems in collective housing units and individual homes with a dual-flow mechanical ventilation system.

Interior air quality can be improved through a series of complementary actions: selecting materials and furniture that isn't harmful to the residents' health, diagnosing and measuring the concentration of pollutants, maintaining systems, and teaching users about the issue and how to adopt preventative behaviours and habits.

[21] Housing Survey, INSEE, 2013

[22] "The French and the quality of their housing today", IPSOS survey for Qualitel, 2014 and "The French rate their homes", Qualitel poll, 2017

[23] International public policy benchmark to protect and improve interior air quality, Ademe, September 2017

Foobot: a smart device that helps improve IAQ

Foobot is an object that lays flat and is around 20 centimetres tall. It changes to one of six colours ranging from blue to orange depending on the level of pollution in the area where it's located. Its air censor measures several factors, including temperature, humidity, carbon monoxide, carbon dioxide, volatile organic compounds, and fine particles. In addition to providing pollution alerts, the device provides personalised advice based on its ability to memorise and anticipate spikes in interior pollution. The device connects to Wi-Fi and can be controlled from a smartphone application.

Air Malin: an educational carrying case from Agence Régionale de Santé Grand Est

These carrying cases can be used to teach children over the age of eight as well as teenagers about the importance of indoor air quality. It helps them spot sources of pollution in a home, identify behaviours and products that might impact it, and teaches them about preventive measures they can take to improve indoor air quality. The cases includes a board game and information about fun activities kids can do to conduct experiments and demonstrations as a group.

The Interior air quality observatory

Founded in 2001 by French public authorities, the Interior air quality observatory's mission is to improve people's knowledge about interior pollution, measure it, raise awareness among professionals, and educate the general public. The observatory carried out a major campaign to measure indoor pollution in 567 randomly selected housing units between 2003 and 2005 and published a brochure aimed at raising awareness among building residents. Entitled "Best practices for good air: a few tips for improving air quality inside your home", the brochure talks about fuel-fired equipment, tobacco use, cleaning, maintenance, humidity, mould, ventilation, aeration, and pets.

Powering the energy transition with bold political goals

In 2012, in France, the residential sector accounted for 30% of the country's energy consumption, and the building sector (both residential and commercial) generated 18% of its greenhouse gas emissions [24].

These figures explain why France's Energy transition for green growth law (TEPCV law) emphasised thermal renovations and the construction of highly energy-efficient buildings. Published in August 2015, this law set a series of targets, including that all housing would be rated as a "low-consumption building" by 2050 and that energy insecurity among households would drop by 15% by 2020.

Improving energy performance through building renovations

In terms of improving the energy performance of buildings, the TEPCV law stipulates that 500,000 buildings will undergo energy renovations every year starting in 2017 and mandates the renovation of private residential buildings that have an energy rating of G or F by 2025.

The assistance package created to help reach these goals combines the zero-interest eco-loan (éco-PTZ), energy transition tax credit (CITE), the financial contribution of energy providers via energy savings certificates (CEE), and third-party financing companies that have agreed to loan money to individuals who would like to renovate their homes for improved energy performance. Some can be combined with assistance

offered by the "Habiter Mieux" (Live Better) programme launched by the French national housing agency (ANAH) in 2013. Over 200,000 households have already benefited from the programme, receiving facade and roof insulation, new windows, new heating appliances, and more. The Guarantee fund for energy renovations created by the TEPCV law guarantees that individuals who own existing homes and co-ops will receive loans (zero-interest eco loan and the Habiter Mieux eco-loan).

24 Observation and Statistics Service, Commissariat-General for Sustainable Development
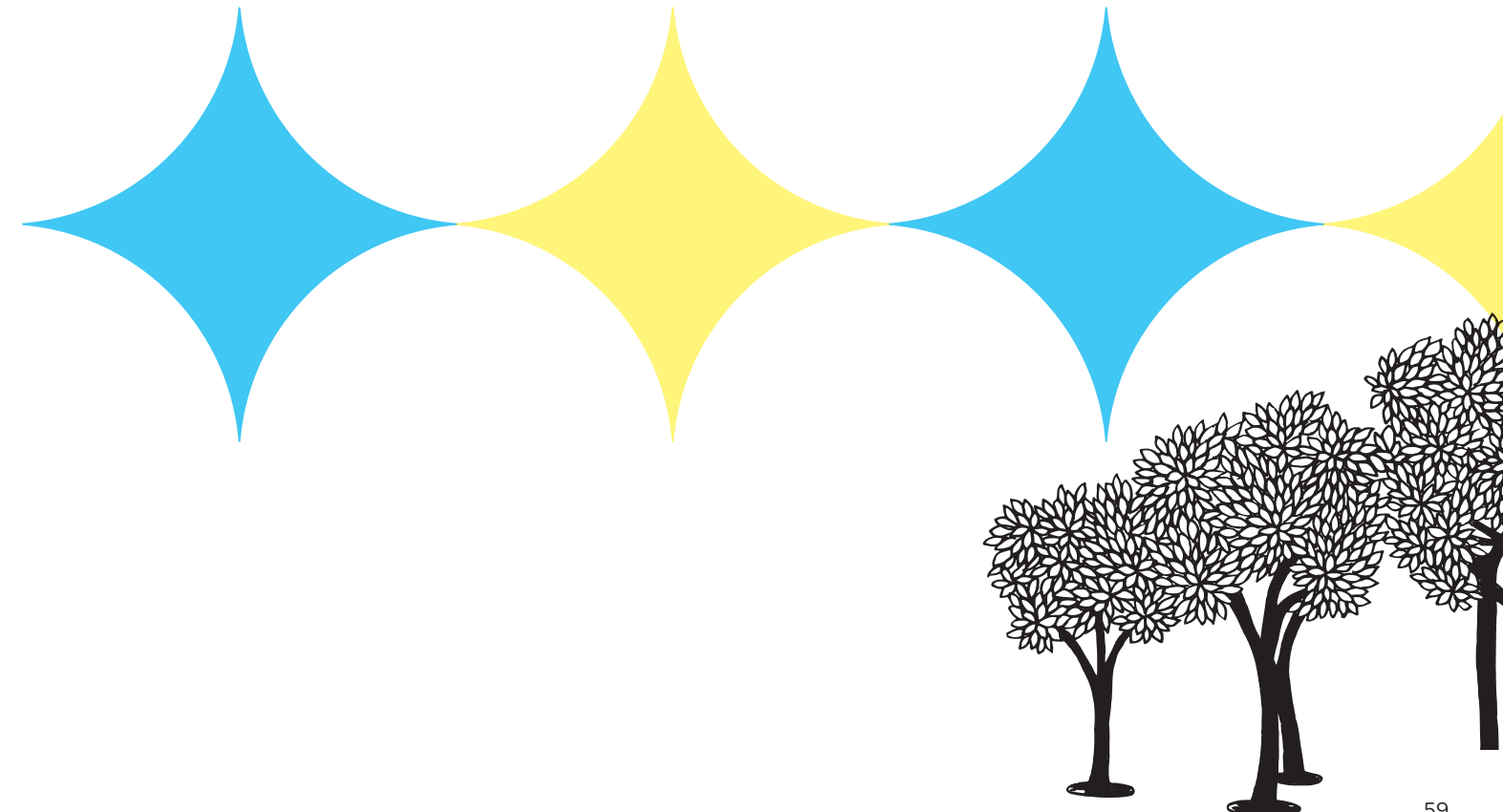
The next regulation will focus on thermal and environmental concerns

The RT 2012 disrupted energy performance by limiting the energy consumption of any new building to 50 kWhep/m² per year. In keeping with the TEPCV law, the future 2020 Responsible building regulation (RBR 2020), which will come into effect starting on 1 January 2021, will be more ambitious and more adopt a more comprehensive approach:

■ By mandating that all new buildings be energy-positive, i.e. that their primary energy consumption level is less than the amount of renewable energy produced by the building;

■ By incorporating not just a building's energy performance but also its environmental performance (by accounting for carbon);

■ By taking into account all uses (heating, cooling, lighting, hot water, and consumption of electrical and household appliances) and the building's life cycle (calculating the amount

of grey energy will account for the energy and materials used during construction).

Launched in November 2016, the E+C- label (positive energy and carbon reduction) acts as a stepping stone towards this new regulation. Designed in collaboration with associations that carry the existing HQE (High Environmental Quality), Effinergie, and BBCA (Low-Carbon Building) labels, it identifies four levels of energy performance for energy-positive buildings and two levels of environmental performance regarding greenhouse gas emissions.

■ With respect to energy, the first level recognises a building's improvement compared to the current requirements set by the RT2012, either in terms of energy efficiency or due the building's use of renewable energy to operate. The final level refers to a building that has a zero or negative energy balance for all uses and produces renewable energy for the rest of the neighbourhood.

■ Regarding carbon, the first level seeks to encourage construction stakeholders to analyse a building's life cycle and reduce its impact. The next level up recognises

operations that work to reduce the carbon footprint of the materials and equipment used.

The implementation of this label corresponds to a national experimental phase overseen by the French government and the High Council for Construction and Efficiency. The purpose of this phase is to test the ambition and feasibility of these performance goals in real life.
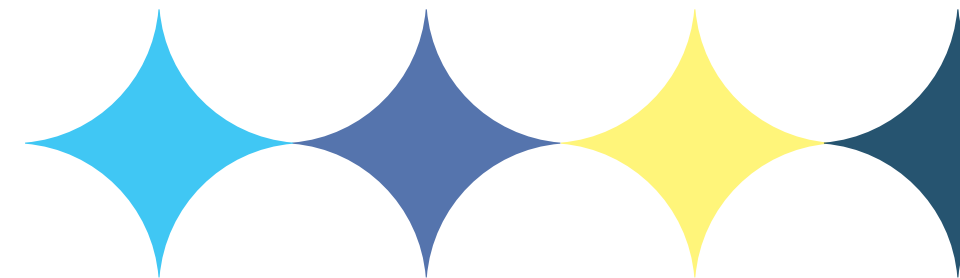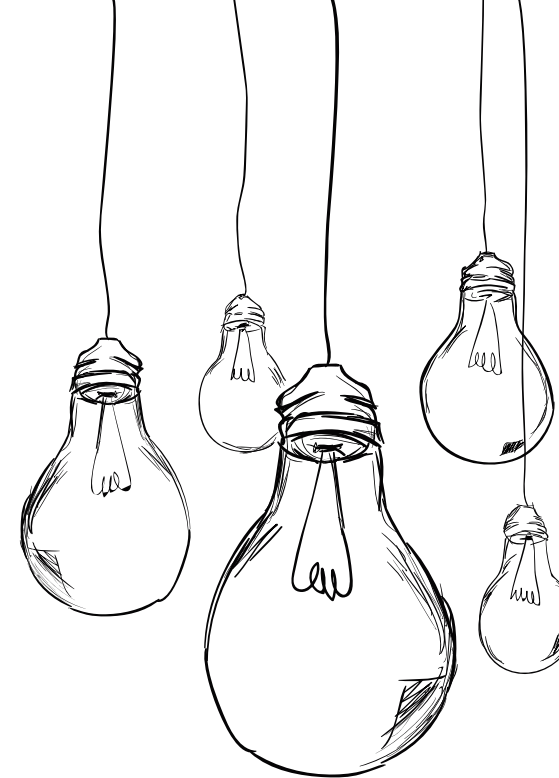
Housing is becoming an energy producer

Transforming housing into a source of renewable energy offers a way to reach the latest set of energy-related goals.

Solar energy is an especially promising option. Solar panels can be installed on buildings to convert sunlight into electricity, or thermal sensors can be used to convert sunlight into heat to power a building's solar water heater systems. On average, solar panels and thermal panels pay for themselves after 12-15 years and 10 years of use, respectively.

A recycled wood floor that converts steps into energy

Until now, experiments with electricity-producing floors have been limited to sidewalks or public areas due to their high cost. However, researchers at the University of Wisconsin-Madison are working on a floor concept that could be installed in homes for the same cost as a regular floor. Their solutions uses triboelectricity, which is similar to the phenomenon that produces static electricity, through the action of two materials rubbing together. Inexpensive cellulose nanofibres are incorporated into the floor. Some are chemically treated, and when they come into contact with the untreated nanofibres as someone walks across the floor, an electrical charge is produced.

The digital water heater

This concept uses heat generated by IT servers to create hot water for collective-use buildings. A Nantes Métropole Habitat residence was equipped with this system in May 2016 to provide the 40 housing units in the building with hot water. The landlord can purchase heat at a low cost (each hot water heater provides 22 megawatts per year). The only disadvantage for the landlord is the size of the equipment. There has to be enough space for the modules and the hot water tank, which isn't always possible in an existing building.

Individual and collective self-consumption is gaining traction

Up until 2016, in France, most of the electricity produced by individuals at home (typically through solar panels) was sold back to utility companies (EDF, local utility companies, etc.).

The French government does not prohibit the self-consumption of this energy, meaning individuals or buildings that produce it can use it themselves. However, it's more profitable to sell the energy back to the grid than to use it due to the fact that the purchase price for the electricity is higher than the price paid to the utility company.

As a result, self-consumption is not very widespread, unlike in Germany, where self-consumption had become the de facto model for any new photovoltaic installation in the residential sector as early as 2012 due to strong pricing incentives.

The advantage of this practice is that is leads to a reliance on renewable energy and prevents the transportation of electricity over long distances.

In France, the situation started to change in 2016 when an ordinance was passed regarding the self-consumption of electricity and later ratified by the law dated 24 February 2017 and its application decree on 28 April 2017. The law separates individual and collective self-consumption:

■ An individual self-consumption operation refers to a situation in which producers use all or a part of the electricity produced by an installation for themselves and at the same site. The self-consumed electricity can be used instantly or after being stored.

■ A self-consumption operation is collective when one or several producers provides electricity to one or several consumers. Through their connection to a legal person (association, cooperative, co-ownership organisation, etc.), the parties collectively self-consume the electricity by sharing the energy produced from a single public electricity distribution station. The legal person determines how the energy is distributed, and the utility company manager allocates electricity to each participant accordingly.

These changes to the legislation should help self-consumption in the French housing market take off, especially given that the sale of electricity by a producer to a consumer will be partially tax exempt in the case of collective self-consumption operations. With this system, producers will be able to earn enough to achieve a return on their investment. Consumers are encouraged to take part in the system because the price of electricity is equal or less than that offered by traditional utility companies.

Les Souffleurs: Bordeaux's first collective self-consumption operation

In Bordeaux, the social housing provider Gironde Habitat, the electrical supply network manager Enedis, and Inelia, a company specialised in the development of solar panel projects, conducted an initial collective self-consumption operation in the "Les Souffleurs" building located in the neighbourhood near the city's train station. In October 2017, 260 m² of solar panels were installed on the roof and connected to the six meters located in the building's communal areas. In the second half of 2018, the 60 apartments in the building will also be connected to this source of local energy production. The installation should cover nearly 30% of the building's electricity needs. The results from this experiment will be analysed by a network of experts as part of a project aimed at studying the impact of solar energy self-consumption.

Strombank: treating energy storage like a bank account

Carried out in Germany between 2014 and 2016, the Strombank project tested a decentralised energy storage system that operated like a bank account and used a system of deposits and withdrawals. Fourteen homes and four companies were equipped with solar panels, an energy production meter, a consumption meter, and an application that allowed users to manage their energy accounts. When a user reached their maximum level of storage, any additional energy was fed back to the grid. Once a user's account became empty, they could use electricity produced by other participants. By pooling energy storage and making the energy management process more efficient, the system was able to significantly increase the rate of self-consumption among participants.

Brooklyn Microgrid: a smartgrid that uses blockchain technology

Launched in 2016, the Brooklyn Microgrid is a decentralised, community-based energy production and consumption project. Covering Brooklyn's Park Slope, Gowanus, and Boerum Hill neighbourhoods, it was developed by the joint venture TransActive Grid, which is made up of Lo3 Energy companies (who created the solar energy grid) and ConsenSys (specialised in the development of apps that use blockchain technology). The electricity is generated from solar panels installed on the roofs of homes. Residents can share the energy among themselves in real time using the blockchain platform Ethereum, which keeps track of the energy produced, monitors where it goes, and secures transactions.

ABC©: ONE STEP CLOSER TOWARDS HOUSING OF THE FUTURE

Thierry Juif,
R&D project manager of the ABC building concept

> " The ABC© demonstrator in Grenoble is the product of several years of R&D. ABC uses innovative technologies and procedures designed to manage an apartment building's energy and water and provide residents with a high level of comfort. Residents helped develop the project by participating in sociological acceptability studies for the proposed innovations. "

A...for autonomous

Work towards energy and water autonomy and optimise waste management.

B...for building

Incorporate and oversee targeted performance types, use digital modelling (BIM), and rethink how we build.

C...for citizen

Support residents, who play a key role in reaching autonomy; help foster social ties and sharing; and re-invent usage.

What is the ABC© project?

ABC© (Autonomous Building for Citizens) will be the first energy-positive, all-use collective housing operation in France.

This cutting-edge project located in Grenoble will be made of two buildings with 62 apartments that incorporate innovative and value-creating technologies. The buildings will be more than 70% self-sufficient in terms of energy and water consumption. The project will also reduce the buildings' footprint on urban infrastructure by a factor of three.

What are the project's goals?

The ABC© project is designed to explore the following:

■ The technologies and new uses required for self-consumption and independence, whether partial or total, when it comes to a building's energy and water needs. This approach requires a high level of efficiency and foreshadows what cities will look like in the future, both in terms of their spatial design and how behaviours and lifestyles will adapt to a post-carbon reality.

■ The technologies and new uses necessary to drastically reduce household waste and convert it into energy.

■ The construction methodologies and techniques for buildings in the future.

■ New living centres capable of improving our dense urban habitat.

Concretely, what is being done to achieve energy and water independence and optimise waste management?

The ABC© project incorporates a number of innovations covering all aspects of housing of the future, including environmental, technical, economic, and social innovations.

Exceptional efficiency:

■ Building with a passive shell
■ Use of bio-sourced materials (exterior insulation made out of cork)
■ A+++ appliance pre-fitting
■ Efficient bathroom appliances and grey water showers

An efficient use of resources:

■ Renewable energy production (288 MWh) using solar panels
■ Collection of rainwater, purification and use for consumption

Incorporation of the circular economy into the core of the project:

■ Self-consumption of renewable energies and energy storage using batteries
■ Re-use of grey water
■ Use of heat generated by grey water
■ Optimisation of household waste (recycling and composting)

Ultimately, the building will by over 70% energy independent (passive energy, all uses) and reduce its water consumption by a factor of three.

In addition to the project's environmental innovations, how will it address social and societal issues?

Future residents will be involved in the earliest stages of the project via focus groups so their expectations can be better met. The project will also encourage residents to form a community by providing shared spaces such as a community garden, common room, showroom, event room, shared green space, and more.

There will also be a social network for mutual help and solidarity among neighbours.

Soft mobility is a key part of the project, which will provide one bicycle parking spot per resident in dedicated areas.

What about certifications?

The project will also try to obtain the following certifications:

■ Effinergie E+C- Label (E3C2 level obtained)
■ Gold level of the WELL housing label, which is centred on the health and well-being of residents.

Handover is scheduled for December 2019.

> " In terms of architecture, ABC© represents an entirely new paradigm. Whereas buildings have always been designed in opposition to the natural environment to protect residents from the rain, sun, and wind, ABC© buildings are constructed to capture the sun and rainwater and take the energy they need to operate from their environment "

Denis Valode,
Architect of the Building ABC© concept, from the Valode & Pistre Architecte

Espaces Info-Energie and regional energy renovation platforms

Launched in 2001 by the French Environment and Energy Management Agency (ADEME), Espaces Info-Energie (Energy Information Centres) are located throughout France and are aimed at advising and raising awareness among the general public regarding energy renovation project, energy consumption, and renewable energies. Regional energy renovation platforms are a complementary system that offers a technical advisor, a resource centre, tools, and a training programme to help individuals and co-ops complete their energy renovation projects.

The "Positive-energy families" challenge

Teams made up of several households represent their town, neighbourhood, or company and compete against each other to see who can save the most energy in terms of heating, hot water, electricity, and travel. With support from a coach trained in energy conservation, each team tries to use 8% less energy compared to last winter by changing their habits and taking simple steps. Over 41,000 families have taken part in the challenge since it was created in 2008 and have saved an average of €200 on their bills. The challenge is supported by the association Prioriterre in collaboration with the CLER (Energy Transition Network).

Atelier Solidaire: DIY events for residents

Located at the centre of the Empalot neighbourhood and hosted by the Compagnons Bâtisseurs, Atelier Solidaire offers residents DIY workshops (tiling, carpet laying, shelf-building, furniture building, etc.) and trainings on energy and water conservation. Atelier Solidaire also offers a collection of tools that residents can borrow to carry out their renovation projects themselves and apply the steps they learned during the trainings. In addition to helping with projects to improve a home's aesthetics, comfort, and personalisation, the goal is to gradually teach residents about the importance of conducting energy-focused renovations in their homes.

The project was implemented with neighbourhood residents as part of a partnership between Toulouse Métropole, Toulouse, Toulouse Métropole Habitat, EDF, CAF de Haute-Garonne, Centre social d'Empalot, Leroy Merlin, and Compagnons Bâtisseurs.

Making users play a key role in the success of energy improvement efforts

Users play a key role in improving energy performance. No amount of regulatory incentives, financial aid packages, technical solutions and innovations can outweigh the effect of the user's role and behaviour, which play a decisive role in any system's success.

Actions are being carried out everywhere in France to raise awareness about using energy efficiently and adopting eco-friendly behaviours—two challenges that concern all citizens. They sometimes take the form of competitions or fun events like the "Positive-energy families" challenge, thereby increasing participation and reaching a wider audience.

Other efforts target more specific goals, such as energy renovation. In addition to increasing awareness and providing financial aid, the idea is to reach out to residents to understand their needs, questions, hesitations, and fears when it comes to taking this kind of step. Atelier Solidaire, which is run by Compagnons Bâtisseurs in a neighbourhood undergoing urban renewal in Toulouse, helps residents gradually take on energy renovation projects.

The role of the resident can even extend to that of a "maker" when they become personally involved with the construction project. Assisted self-renovation is a mutual and joint agreement between a resident and a provider in which the resident identifies what work needs to be done with help from the provider and does it to the best of his or her ability with help from friends, family, and volunteers. A study from the Ile-de-France Institute of Urban Planning and Organisation (IAU) emphasises the potential of this

approach in certain rural suburban areas in the Paris region in which public policies sometimes struggle to provide assistance to lower-income homeowners who want to renovate their homes[25].

[25] Supporting self-renovations. An innovative approach for rural areas, IAU Ile-de-France, February 2017

Improving energy performance with a digital housing upkeep and maintenance record

Developed by the Sustainable Building Plan and introduced by the TEPCV law, the digital housing upkeep and maintenance record is now mandatory for all new homes whose construction permit was submitted after 1 January 2017 and will be mandatory for all renovated homes starting on 1 January 2025.

It is designed to give households the information they need to correctly use and maintain their homes. The record contains technical diagnostics, such as information on electricity, asbestos, and more. It allows households to better understand, use, and manage their homes and should help them take steps to keep them in optimum condition.

To help implement this new regulatory requirement, the Digital Construction Transition Plan launched a call for projects in June 2016 to create a prototype and roll out the digital record. Out of the twelve applications selected, the association Qualitel was the first to launch its prototype in collaboration with the Caisse des Dépôts, the Higher Notary Council, SMA, and La Poste. The record is available on a website and a mobile application; there, users can find a description of their homes, documents about the apartment (and co-op if applicable), and a multi-year schedule featuring all operations regarding the apartment (construction, maintenance, etc.). Users can get assistance via an online chat tool. The first fifty records were created in April 2017.

The prototypes and experiments of the twelve applicants will provide the basis for the implementing orders that will specify the content of the digital record.
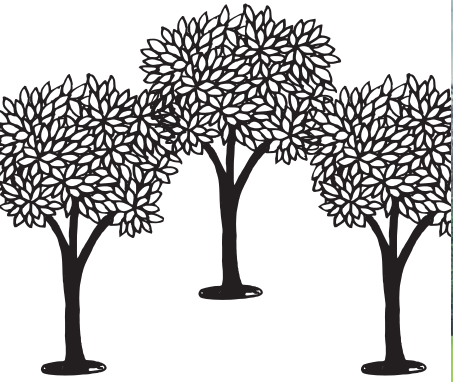
Bioclimatic Architecture

Bioclimatic architecture is a method of designing buildings that takes into account the location's geography, environment, and climate.

The goal is to make maximum use of the natural elements and landscape to save energy, maintain a comfortable temperature, control humidity, and promote natural lighting within a home. In this type of project, the heating and air conditioning systems are designed to take into account the home's sun exposure and natural air circulation. Rooms that don't need to be as warm (corridors, rarely used rooms, utility room, etc.) are placed to the north, while living areas are concentrated along the southern walls and feature large windows and bay windows to capture the sun's light and heat. Certain materials and colours also absorb more heat than others. For example, red brick has a better absorption coefficient than rough concrete. To conserve heat, it's better to use darker colours on the walls that receive direct sun exposure.
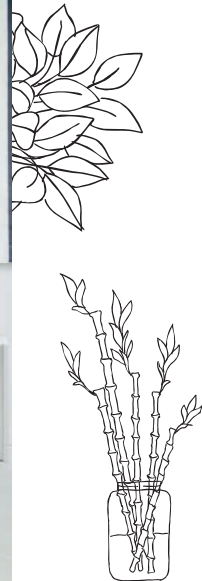
East Gate in Harare (Zimbabwe): natural ventilation inspired by termite mounds

Inaugurated in 1996, this office building is an example of bioclimatic architecture that uses biomimicry. In other words, the architect took a page from the natural world to create a building that was more efficient and adapted to the local climate.

The goal was to design a building that didn't require air conditioning. The architect based the design on termite mounds, which feature a ventilation system that decreases the temperature of the air inside the structure during periods of intense heat. The system uses a central chimney located above the nest. Hot air is drawn upwards due to its light density and evacuated from the structure, generating an air current in the lower parts of the nest. The termites then regulate the temperature by digging holes at ground level, which can then be covered up to keep heat inside the mound.

East Gate creates a similar air flow thanks to the presence of 48 large chimneys. The building's structure is also optimised to limit the effect of the sun's rays. No window is directly exposed to the sun. They are set in from the facade and protected by a curtain of plants. In addition, the use of brick and concrete, two materials with a high thermal capacity, also helps regulate the temperature. At night, when the outside air becomes colder than the air inside the building, the walls release the heat acquired during the day. They become cool overnight, and in turn help decrease the building's temperature during the day.

HOUSING AS A
SOURCE OF WELL-BEING

"Hygge": the philosophy of wellness at home

Hygge, or the Danish word for feeling cosy, has become quite popular in the last few years. Many works have been written about this life philosophy, which focuses on small moments that help improve wellness and quality of life.

It's a part of a larger push for happiness, which is evidenced by the large number of studies published on the topic[26]. When applied to housing, the concept refers to the idea of having a cocoon, an oasis of peace, and a source of well-being where one can feel safe. Hygge celebrates a warm, friendly approach that's especially relevant in winter when families tend to spend more time at home.

The heightened interest in decorating and the changes to the products offered by home appliance brands are evidence of the rising importance of wellness and togetherness in housing. This change is especially evident in the bathroom. While it was once a functional space centred on hygiene—one that was small or even non-existent in some older buildings—the bathroom is considered a space for relaxation by nearly 60% of French people[27]. More beautiful materials are being used in this room, including wood furniture and floors, and more modern appliances offer an even greater level of comfort (Italian showers, Jacuzzi bathtubs, recessed bathtubs, and more). The bathroom is also a space dedicated to beauty—an important activity in a society that values the body and communicates a specific ideal, which explains the popularity of certain practices such as dieting, cosmetic surgery, and body building.

The bathroom has become a place for self-care, as summarised by the approach that confirms the transformation of the bathroom into a "wellness room". This transition emphasises a relatively common drawback in bathrooms: a lack of natural lighting.

Even though home is associated with refuge and wellness, that doesn't necessarily imply a withdrawal from the rest of the world.

Quite the opposite—the home is also a place for togetherness, and the French happily welcome friends and family into their houses. In fact, hosting is the third most common use of the living room, behind watching TV and relaxing[28].

This particular room is popular for its size, which allows it to become a genuine living space that can change to accommodate residents' needs. Nearly one-third of French people regularly change the layout of their living rooms[29]. The living room is seen as the "public" part of the home. In this multi-functional room, many activities are possible. Increasingly, the concept of "hiving" is being used to describe this phenomenon.

2 out of 3 people prefer spending time at home than outside[30]

According to **37 %** of French people, the primary purpose of planning out a living room is to provide comfortable seating[31]

[26] Read the works of the Happiness Economy Institute, http://economie-bonheur.org/publications/

[27] Sorgem Study for Jacob Delafon, 2015

[28] Study by the Nelly Rodi agency for the Paris Trade Show, 2017

[29] See comment 30

[30] "The shift from a 'cosy' home to a 'living-room' home: the French people's passion for decorating", 2014 IPSOS study for But

[31] See comment 30

From home automation to smart housing: improving wellness with technology

Home automation, which lets users manage a variety of home functions (thermostat, lighting, alarms, video surveillance, doors, shutters, etc.) from a central control unit at home, is now being replaced by the smart home, which makes it possible to remotely control connected devices at home online or via a mobile app. The current technical challenge resides in making these systems interoperable so all functions can be managed from the same place.

This system makes life easier, improves users' comfort, and helps facilitate home management, such as by making it simpler to control energy consumption, for example. Making sure this technology is helpful requires a thorough understanding of people and the provision of suitable uses and connected devices. According to one estimate, by 2020 there will be 50 to 60 billion connected devices in the world, or six on average for every person.

In addition to selecting connected devices that meet each person's needs, the programming of these devices needs to be improved to accommodate the desired use. Just a few of the wide variety of potential uses is a device that automatically shuts off the heat when a window is open, remotely unlocks the front door, places a light switch within arm's reach, and switches a room to "evening" mode (coloured lights, speaker settings, etc.).

The Ekko smart mirror

This mirror doubles as an interactive multimedia platform that lets you check the news or weather and listen to the radio and YouTube playlists. Sensors located on each side of the device display the various options available on the mirror's surface. Each family member can have their own profile and create their own settings.

Ma Smart Home

This online platform helps users configure their very own smart home. It lets residents choose from a variety of functions offered by home automation technology, including security, energy savings, comfort, ambiance, and more; offers the corresponding solutions (alarm, smart thermostat, speakers, lighting, etc.); and provides a cost estimate. All devices are guaranteed to be compatible with each other, which is one of the service's strong points.

Nature and well-being

65% percent of French people would like to have more green space in their neighbourhoods[32]. This figure is even greater among residents of large cities. Multiple studies agree on the mental and physical benefits of vitamin G, or the "green vitamin", which refers to greenery, sunshine and nature in general.

In both the individual and shared housing sectors, features like green roofs, rooftop deck gardens, green interior and exterior walls, and kitchen gardens and landscape gardens are become increasingly popular. This is far from a new development. Certain groups of people, such as the Vikings, used these same techniques to insulate their homes and limit the spread of fire. Their homes were partially buried in the earth to shelter them from the wind and covered with a layer of lichen, grass, and small shrubs. In fact, countries in northern Europe were the first to re-introduce the idea of green roofs. In 2002, 13 million square metres of green roofs were reported in Germany (on all types of buildings), compared to 150,000 m² in France[33].

In addition to positively impacting the emotional and psychological well-being of residents and neighbours, these techniques offer multiple environmental benefits:

- **Insulation and soundproofing:** green roofs reduce exterior noise and naturally regulate the temperature;

- **Anti-pollution measure:** through photosynthesis, plants trap carbon dioxide and toxic particles in the air;

- **Water filtration:** green features facilitate rainwater management by regulating the amount of water the building receives (the plants consume some of the water);

- **Reduction of the urban heat island effect,** which refers to the fact that cities warm up faster than their environment due to the multiple sources of heat in a city setting, a phenomenon that contributes to global warming;

- **Increased biodiversity:** green features promote the presence of birds and insects in an urban environment.

Bosco Verticale, Milan's forest towers

Inaugurated in Milan in 2014, these two, 27-floor towers designed by architect Stefano Boeri feature over 20,000 plants and trees, or the equivalent of two hectares of forest. The plants were selected and placed based on their ability to withstand wind, their preference in terms of moisture and sun exposure, and the rhythm of the seasons. The trees on the balconies provide shade in the summer but lose their leaves in winter to allow sunlight to enter the space. In addition to creating green space within a city to promote the well-being of residents, this initiative helps improve local diversity and remove pollution by absorbing CO2. The concept has since caught on in other cities in Nanjing, China, and other project are underway in Villiers-sur-Marne near Paris and other Chinese cities.

Bosco Verticale - Milan

[32] The French and the neighbourhood of the future, Ipsos for Altarea Cogedim, June 2015

[33] CSTB

A NOVEL APPROACH
TO BUILDING

With collaborative process, new materials, and new construction techniques, the construction phase for buildings is being disrupted by societal and technical innovations.

BIM: a collaborative process that ensures the digital continuity of a building's lifecycle

BIM (Building Information Modelling), is a collaborative process that facilitates interactions between all stakeholders in a project and ensures digital continuity between the design, construction, renovation, maintenance, and operation phases of a building. The data from the design phase are used in the construction phase, and the construction data help dictate the management of the building's lifecycle.

BIM uses digital models that represent a building's physical and functional characteristics through 3D modelling and pair them with a collection of data about the structure (e.g. location of the equipment, composition of a wall, etc.). All the stakeholders involved in a project (owner, architects, consultancy firm, engineers, technicians, providers, etc.) can work on the same models in real time. In addition to helping with coordination, BIM offers a better bird's-eye view of the what remains to be done to finalise a project.

3D modelling gives shape to the future building before it is built. When combined with virtual reality technology, it lets the viewer imagine being in the actual building. This tool can pave the way for more participatory methods.

Co-designing with future residents is another type of collaborative process that is gaining traction in the housing construction sector. It gives the final user more weight in the relationship with the owner and project coordinator.

New building techniques to reduce construction time and increase site safety

In addition to helping advance the digital transition, robotics and prefabrication open up a new ways to experiment with how buildings are created.

Philarmonie de Paris

3D printing

3D printing is based on an additive manufacturing method that gradually adds materials until the desired object is created. This is the opposite of subtractive manufacturing, which starts with a larger shape and makes the desired object by removing material.

With 3D printing, there is practically zero material lost, which helps reduce waste. This automated manufacturing method could transform jobs. Because it's relatively easy to use and thanks to the innovative software interfaces that control the machines, 3D printing is a technology that's rather easy to adopt, which in turn makes it easier to train and support site workers during this transition. 3D printing also helps improve working conditions because it makes tasks less difficult to complete and increases safety at the construction site. This manufacturing solution also promises to reduce construction times. During the Nantes Digital Week in September 2017, the Yhnova project (see inset) built a 95 m² house in just three days using 3D printing, while a traditional approach would have taken an estimated three weeks.

The benefits of robotics

Robotic tools could help improve working conditions on a construction site in a variety of ways. For example, asbestos-removing robots help reduce workers' exposure to asbestos dust.

The Yhnova project: a house built using 3D printing

In September 2017, the Yhnova project achieved a major milestone by building the walls of a 95 m² house using 3D printing. The project was part of the structural works "Gros-Œuvre 4.0" R&D programme led by Bouygues Construction and involves identifying, updating and implementing the structural works techniques of the future.

Dubbed Batiprint 3D and patented by Nantes University, the 3D printer consists of a robot featuring a polyarticulated arm and spout. The spout is used to dispense a liquid polymer (polyurethane), which hardens when it dries to form a wall of two parallel lines a few centimetres apart. The robot then pours concrete into the space. The materials are deposited one layer at a time in accordance with the digital model. In this particular case, the house was Y-shaped with rounded walls and corners.

This social housing demonstrator designed for Nantes Métropole Habitat will be rented after a year-long testing period. The home will be equipped with sensors and automation technology that will measure and analyse how the materials behave as well as their thermal and acoustic properties.

Industrialised construction

Modular, pre-fabricated, and industrialised construction are three terms that describe a type of construction method that uses individual modules built in a factory and then transported to the build site for assembly.

These methods use the types of materials used for traditional construction projects (steel, concrete, and wood) and can now be used to make a wide variety of buildings. In the housing sector, they can be used to building collective and individual housing. Eighty to 90% of the construction can be completed in the factory. The remaining 10-20% consists of assembling the modules and taking into account limitations created by the site and the specific characteristics of the project. This procedure saves a significant amount of time since the modules can start to be manufactured in the factory at the same time as the site is being prepared (during the earthworks phase, for example). The industrialised construction process also makes quality control easier. The module prototypes are approved before they are mass-produced and the quality of the product is checked when it leaves the factory. Other advantages of this building technique include lower costs, the possibility of personalising the modules (finishing, colours, etc.), and a cleaner construction site (less waste stored on site). The market for modular buildings is growing; the number of square metres sold amounted to 499,000 m² in 2016, a 3% increase compared to 2015[34].

Logelis' Fanfan house:

Built in less than 4 months in a small housing project near Valence in Drôme. In all, 80% of this house was pre-fabricated (except the tiles and finishes), including a factory-built panel system featuring the box-outs needed to create the electrical system, the carpentry, the insulation, and much more. Four modules are needed to build a 100 m² home. Logelis offers two modules (20 m² and 40 m²) that can be arranged however the customer wants.

Circular economy

The goal is to combine these new building techniques with practices that are a part of the circular economy. The idea is to take a step back from our current linear model, which stems from the industrial revolution and is based on "a principle of simple value creation that extracts resources, processes them, consumes them, and throws them away, [which, when] combined with mass consumption and exponential demographic growth, puts a significant strain on our natural resources and regions"[35].

The circular economy, however, approaches the environment as a set of regulating forces that must be preserved and with which our methods of production and consumption must be in line. This approach doesn't simply treat natural resources as "reserves" that need to be saved. Instead, it seeks to produce and consume in a controlled and responsible manner to avoid destabilising natural systems.

Waste management practices, including the reduction of waste, re-purposing, re-use, and recycling, are one of the pillars of this model. They have been combined with new building techniques to create experimental projects, such as the disassembly and re-use of modules as part of an industrialised construction process (Cougnaud Construction) and the recycling of the cement and fibre glass from building waste to create a "green" ink used in 3D printing (the Chinese company WinSun Decoration Engineering Co).

These experiments are sure to become more commonplace if builders are to reach the goals set by the TEPCV law, which requires 70% of all construction waste to be recycled or re-used by 2020. This is a necessity given that the construction sector generates about 40 million tonnes of waste every year in France alone, with more than 90% of that waste coming from demolition and rehabilitation works.

Re-purposing, re-use, and recycling

■ At item is re-purposed when it maintains its initial form and function (e.g. a door taken from a demotion site that is used as a door again in a new project);

■ Re-use refers to items that maintain the same form but change their function (e.g. a door taken from a demolition site that becomes a part of the siding in a new project);

■ The raw material of a piece of waste is recycled when it is used to make a new item (e.g. shavings that are compacted to make wood pellets).

[34] Data from members of the ACIM (Association of Modular and industrialised Construction)

[35] The Circular Economy. A tool for achieving sustainable regional development, Ademe, June 2017

L'Appart' Upcyclé: building an apartment room from waste and products at the end of their lifecycle

The "L'Appart' Upcyclé" (Upcycled Apartment) hackathon challenged participants to create upcycled products and an entire apartment room from waste and products at the end of their lifecycle. The event took place in December 2017 at the Leroy Merlin TechShop in the Paris region. Fifty participants formed teams to devise a new use for materials provided by Bouygues Construction, Suez, and Leroy Merlin, who are collaborating on this project through the Ideas Laboratory, a multi-partner innovation platform.

Re-using concrete in an urban renewal project

As the winners of the "Transformative Architecture" call for projects launched in 2015 by Caisse des Dépôts and Union Sociale pour l'Habitat, the social housing provider OPH 93 (Seine-Saint-Denis Habitat) and the architect association Bellastock re-used the concrete taken from two demolished collective housing buildings to complete an outdoor paving project and build the benches, plant boxes, and walls of a utility building at the same site as part of an urban renewal project.

New materials

Bio-sourced materials are obtained from renewable raw materials originating from plant or animal biomass. They differ from eco-materials like earth and stone, which, though natural, are not considered to be bio-sourced because they are not from the living world.

Bio-sourced materials have a wide variety of applications in the construction sector. They are used as insulation (wood, plant or animal wool fibres, cellulose wadding, hay bales, etc.), mortar and concrete (hempcrete and concrete from wood, linen, etc.), panelling (plant fibre particles, compressed straw, etc.), plastic composite materials (matrices, reinforcements, loading structures), and chemical treatments (glues, additives, paint, etc.).

The use of these materials helps reduce a building's environmental impact thanks to their ability to store carbon and protect health (e.g. sheep's wool absorbs formaldehyde, a volatile organic compound that can be found in furniture, decoration, and cleaning products). Bio-sourced materials also come from renewable sources and generally require less energy to manufacture than traditional materials. They provide an alternative to the use of non-renewable resources like sand (one of the primary components of concrete), which might soon be in short supply[36].

The concrete sector generates a significant amount of greenhouse gases. This is largely due to the use of the cement. Currently, for every 1 kg of cement produced, nearly 1 kg of CO_2 is emitted into the atmosphere[37]. This figure could decrease in the future thanks to ongoing research into producing innovative types of cement that emit less CO_2 or even consume it.

Bio-sourced materials aren't a perfect solution, either. In fact, they aren't necessarily 100% natural, and some do impact the environment. They might have been chemically treated for use in the construction sector or transported over long distances. To evaluate their environmental impact, it's important to take into account their grey energy, i.e. the energy needed to extract, process, manufacture, transport, use, maintain, and recycle these materials. On the other hand, while these materials, especially wood, are being increasingly used in building projects, the industry is not yet fully structured and is not yet able to provide the product on an industrial scale for a reasonable cost.

An office building turned into a student residence and insulated with straw

On Rue du Colonel Pierre-Avia in Paris, a former office building that is now home to an emergency shelter will be transformed into a student residence by the social housing provider Paris Habitat. The insulation will be made out of bio-sourced materials; the building's wood cladding will cover caissons packed with straw.

Silva Tower, the first ever wood-framed building over 50 metres tall

The 18-story, 50-metre-tall Silva Tower, under construction in Bordeaux and slated for completion in 2019, will be one of the tallest wooden buildings in the world. Presented during WoodRise, the first international conference for mid- and high-rise buildings that took place in Bordeaux in September 2017, this tower, which is supported by a primary structure of giant timber posts, is made up of 80% wood.

36 "Sand rarer than one thinks", United Nations Environment Programme, March 2014

37 Technical architecture – concrete "Reducing CO_2 emissions", Le Moniteur, May 2016

DESIGNING RESILIENT BUILDINGS

The Paris Agreement, which entered into effect on 4 November 2016, requires signatory nations to keep the average temperature rise well below 2°C compared to pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

If the temperature were to increase by 2°C, the rising sea levels throughout the world could impact regions now inhabited by 280 million people according to Climate Central, a non-profit foundation. In these conditions, the resiliency of cities, and therefore of homes, will be put to the test due to rising sea levels and severe weather events such as storms, heat waves, floods, landslides, and more. Some regions that are especially impacted by rising sea levels are taking the subject very seriously and launching experiments. Hamburg, a city cut in half by the Elbe, is one such example.

Whether in the form of deeper foundations and more rigid structures capable of withstanding landslides or cooling techniques that use less energy, building engineering must anticipate changing needs and regulations. Regulations currently aimed at cold temperatures could focus on warm temperatures in the future. According to the climate scientist Jean Jouzel, Paris could experience Madrid-like temperatures and Marseille's weather could resemble that of Andalusia by 2060 due to "climate migration". The challenge of creating a comfortable home for the summer, especially during heat waves, would subsequently become a key issue.

Living small and off the grid

The Tiny House movement originated in the United States and is now gaining traction of both sides of the Atlantic.

It began to take off in 2002 with the creation of the Tumbleweed Tiny House Company in the US. Tumbleweed was the first company to build and market these types of micro-homes. While these small, nomadic homes have always existed (mobile homes, caravans, camping cars, yurts, living vans, tepees, etc.), the tiny house stands out in that it's a real house with all the trappings of one, including a roof, walls, heating system, etc. It is designed to provide residents with a place to sleep, wash, cook, store items, host friends, and have fun.

The movement offers up the tiny house as an alternative form of housing and a way to adopt a more environmentally friendly and less consumerist lifestyle free from unnecessary excess — a requirement given the small size (10-40 m²) of these comfortable and functional homes. Tiny homes are green due to their building materials. Wood is commonly used and typically sourced locally.

Tiny homes can be made energy independent with the installation of solar panels and a rainwater collection and treatment system. Off-the-grid models are typically mounted on wheels and allow residents to move their homes from place to place using a towing vehicle. Other models are built on foundations and connected to the grid.

The Tiny House movement is becoming extremely popular is certain regions. One such area is Silicon Valley in the United States.

The housing shortage created by the mass recruitment of employees by the high-tech industry, which is growing faster than the pace of new housing construction, has led to sky-rocketing prices. Some households have been unable to cope. This crisis is also affecting employees in the tech sector, as evidenced by a regular stream of articles describing workers who are forced to live in a van or in a parking space. For economic reasons or to escape the terrible traffic in the area, some people have opted to move into a tiny home. Whether due to a life philosophy or a lack of other options, the reasons for the tiny home are very diverse!

Temporary solutions for crisis situations

Small, lightweight, and inexpensive tiny homes have proven to be a source of inspiration for the Parisian association Quatorze, which has been working on collaborative solutions against inadequate housing and extreme insecurity for many years.

Their IMBY ("In My Backyard") initiative, which advocates the opposite attitude of NIMBY, or "Not In My Backyard", or when residents oppose a local project that would benefit the community but might negatively impact their way of life, consists of identifying homeowners who have available land and are willing to let the association install a tiny home in a few days' time by organising a community build project. These homes are then used as emergency housing for people in precarious situations, including immigrant refugees. This medium-term solution gives them the time they need to find a long-term home.

This is just one of the many initiatives being implemented to meet the emergency housing needs of international migrants and refugees. According to the UN, there were 244 million migrants and refugees in 2015, i.e. 3.3% of the world population; this figure had increased by 41% since 2003 [38]. The migratory crisis is being felt especially strongly in the European Union, where some countries are trying to implement policies and solutions to house and support these new arrivals. Techniques and initiatives incorporating a certain level of flexibility could provide an appropriate response when sufficiently fine-tuned and paired with social support systems.

An emergency housing centre for migrants

The migrant housing centre, which opened in January 2017 in Ivry-sur-Seine, has space for 400 migrant women, families, and couples that come to the Paris region. This temporary housing solution helps these migrants stand down the path towards rebuilding their lives and achieving independence.

It is made up of six living units for 67 people each. The modules include homes that can be completely disassembled and reused as well as communal areas for dining and activities. Bouygues Construction helped Emmaüs Solidarit complete the project, which uses modular, wooden structures. This building approach is especially suited for emergency housing projects because the construction is fast, flexible, and inexpensive.

38 UN, "In Safety and Dignity: Addressing Large Movements of Refugees and Migrants", April 2016

CONCLUSION

Major trends are changing how we live and act in the world. The demographic structure of western societies is changing as the population ages and life expectancies increase beyond anything we've seen before. Globally, new types of cities (frugal cities, smart cities, sustainable cities, etc.) are being developed to accommodate a constantly growing urban population. The traditional chessboard of actors is being disrupted by the growing power of online giants (GAFA, BATX, and NATU) and the development of new economic phenomena like uberisation and the sharing economy. Finally, citizens are determined to also have in say in this new balance of power by increasing their ability to take action, becoming empowered, and calling attention to the "user experience".

These trends are filtering into the housing sector and changing its form and function. New approaches to housing are being invented to accommodate the evolution and volatility of family structures. Some uses, like working, taking care of oneself, and exercising, that are typically associated with other types of places (offices, hospitals, gyms, etc.) are now being incorporated into the home, turning it into an all-around hub for life.

When it comes to creating the next generation of housing, a home's ability to adapt its space and uses has become a key issue.

The same holds true for cities and neighbourhoods. Reversibility, or the ability to transform a building (such as from an apartment building to an office, for example),

offers a level of flexibility that's useful for urban planning. Similarly, incorporating housing into the sharing economy and opening it up to a variety of different users makes it possible to intensify its use. These pragmatic approaches are rooted in the principles of the circular economy, which advocates saving resources from step one, increasing their lifespan, and optimising their use.

As a result, housing is becoming increasingly shared and communal. Some are even taking it a step further by making communal living a way of life, as evidenced by the rising popularity of flat-sharing, co-living, participatory housing, and communal areas inside apartment buildings.

Alongside these trends, digital technologies and the meteoric rise of connected devices offer a wide range of possibilities, including creating homes that are increasingly adapted to suit their occupants, allowing residents to co-design their future homes, fostering relationships between residents in the same neighbourhood, renting one's apartment to a third party, limiting energy and water waste, and organising the re-use of construction materials.

For Bouygues Construction, this report is a way to inspire our various stakeholders to take into account the societal, technological, economic, and environmental changes affecting housing of the future and promote the emergence of innovative projects that meet the needs of final users while also improving their quality of life.

ACKNOWLEDGEMENTS

Trendbooks

#1 Leisure time and the urban dynamic
#2 Promoting shared spaces in social housing
#3 Ageing well at home
#4 Digital cities, human design
#5 New campus models for a learning society
#6 Housing in the future

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