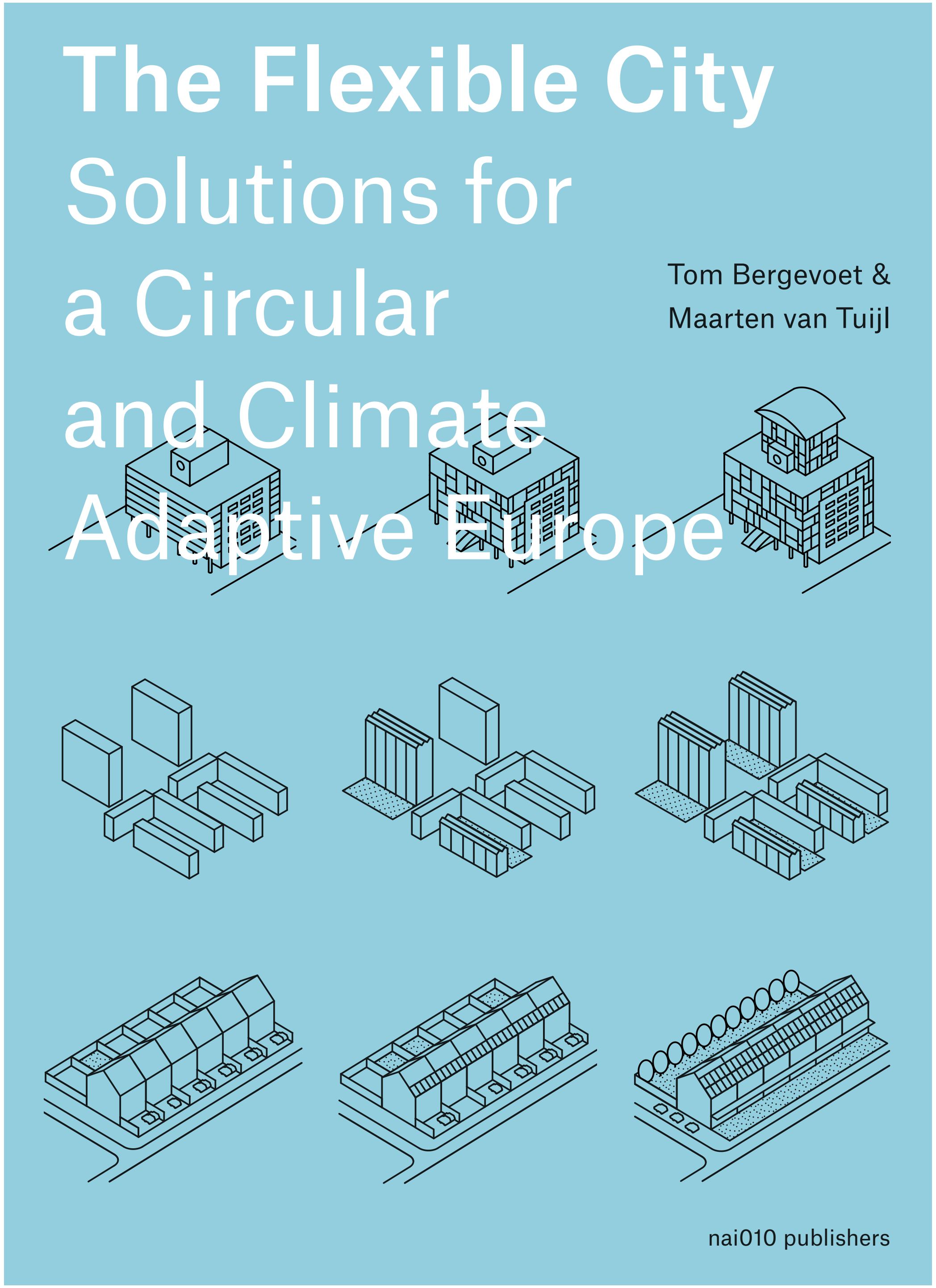


The Circular City

Meet and Learn

temp.architectureurbanism

zelfvoorzienende houten woning, Zweden

circulair bedrijfsgebouw de Omval, Amsterdam

hergebruik zorgcomplex, Haarlem

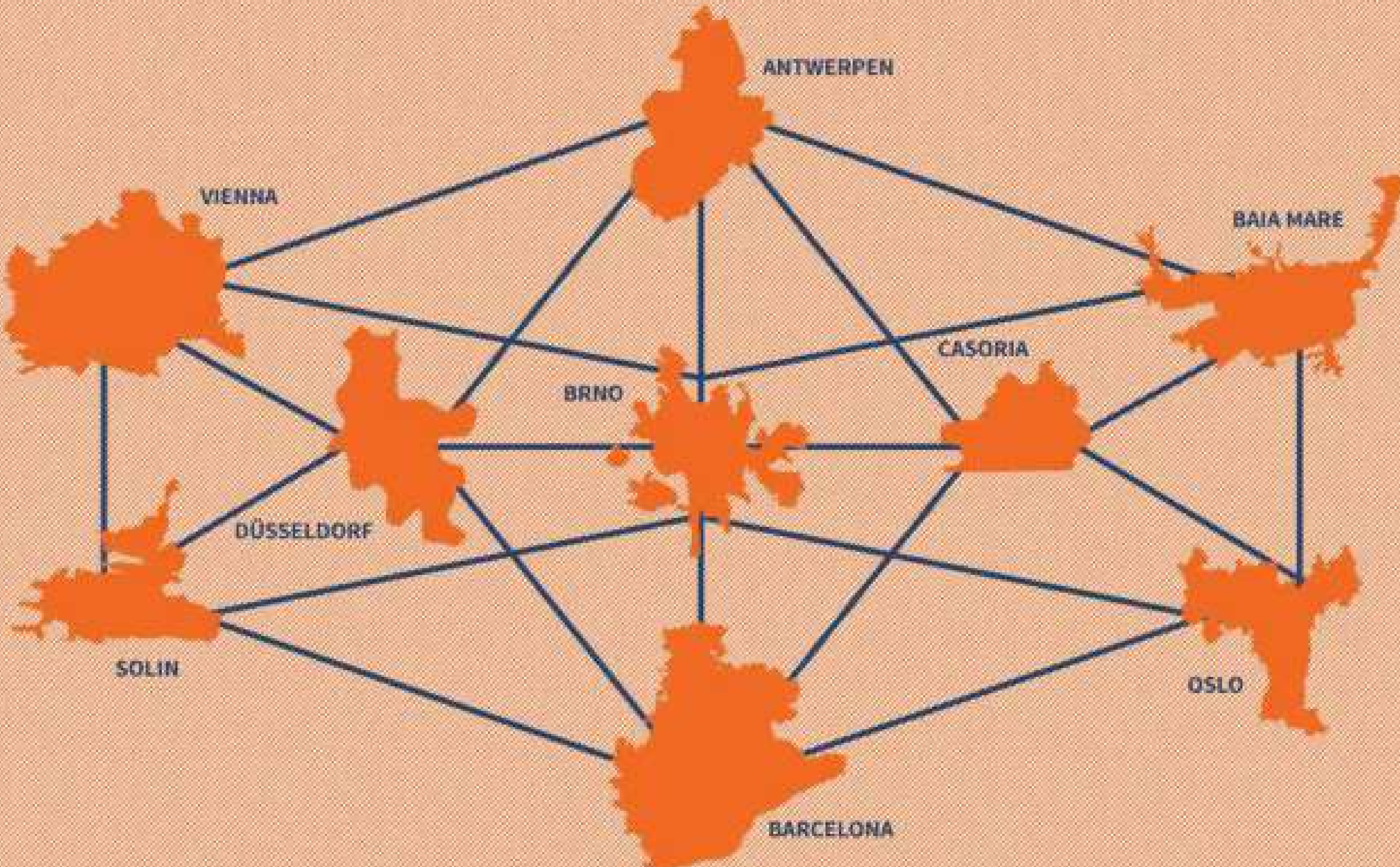
stedelijke verdichting, Amsterdam

temp.architectureurbanism

natuurinclusieve woonblokken Weespertrekvaart
ontwerp: Architecten Cie, Temp.architecture, Raumplan, Flux Landscape Architecture
opdrachtgever: VORM

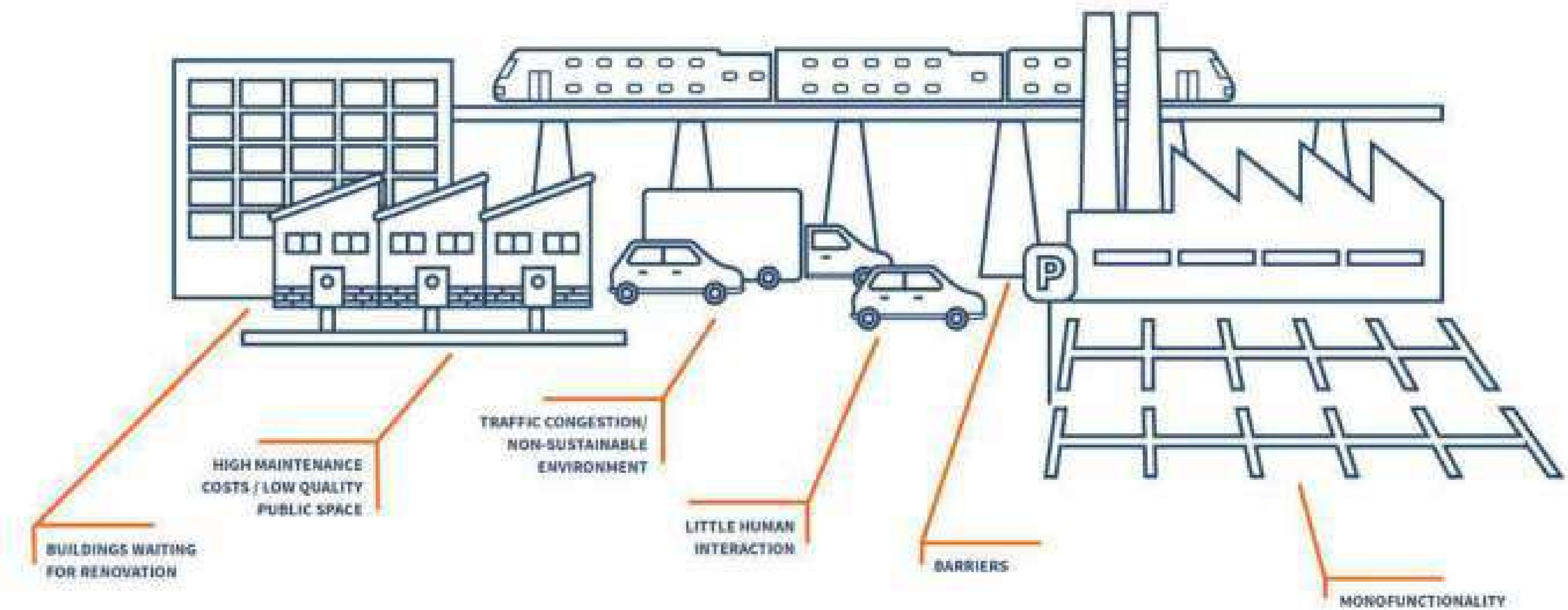
Circulaire (ver)bouw 162 sociale woningen “de Punt”
ontwerp: Temp.architecture
opdrachtgever: Ymere
oplevering: 2024-25

NETWORK OF CITIES

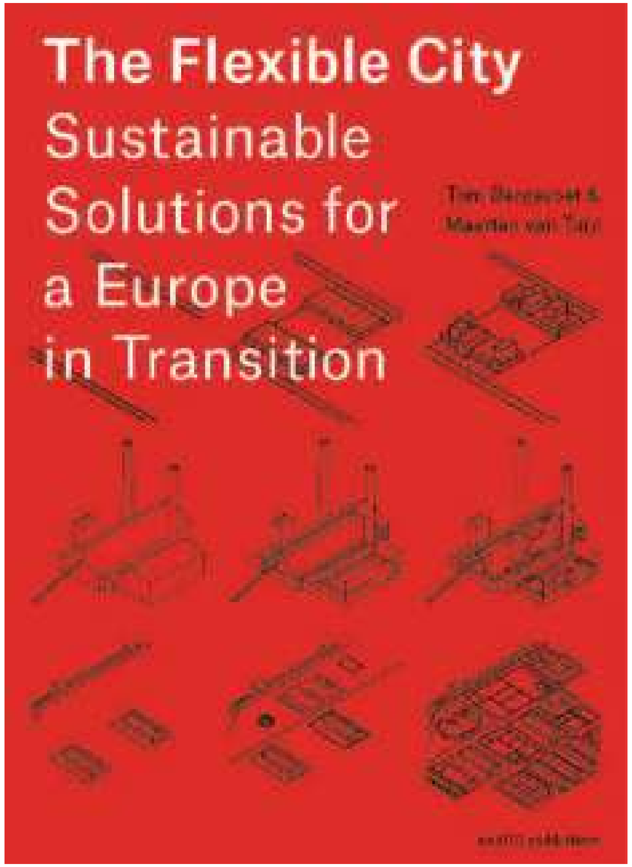


COMMON ISSUES

WE ALL HAVE COMMON ISSUES



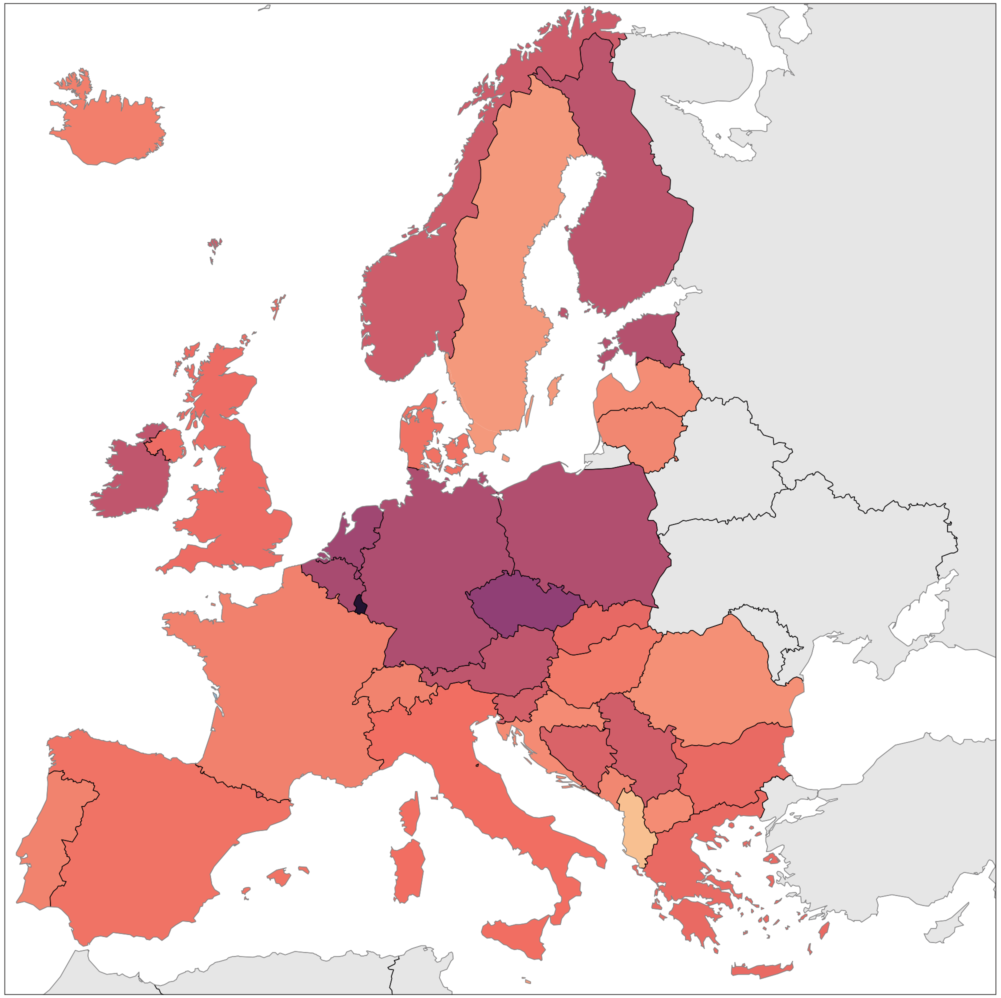
2013



2017

2023

Circularity



Carbon dioxide emissions per capita, 2019 (source: The World Bank)
(Carbon dioxide emissions are those stemming from the burning of fossil fuels and the production of cement. They include carbon dioxide produced during consumption of solid, liquid and gas fuels and gas flaring.)

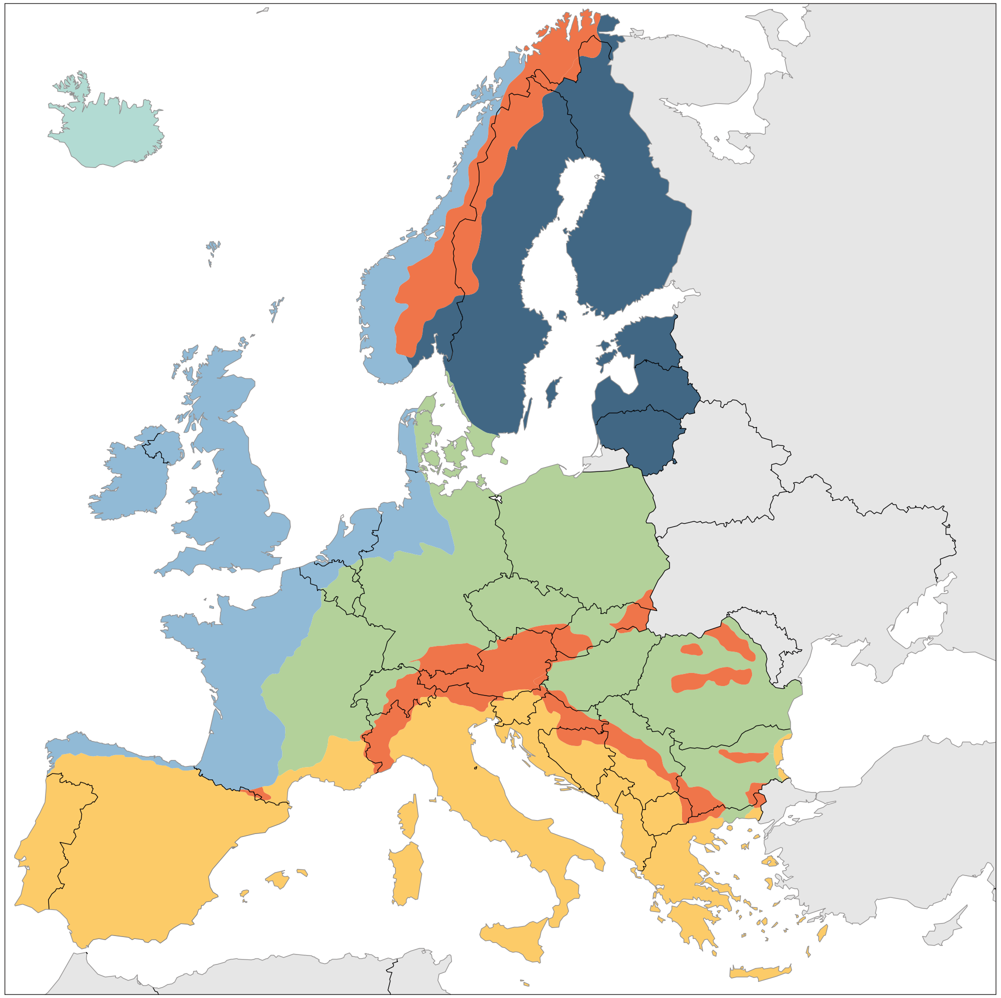
tCO2 / person / year

16

0

no data

Climate Adaptation



The impact of climate change on Europe (source: European Environment Agency)

Arctic: temperature rises much more than the global average; higher risk of biodiversity loss; risks to the livelihoods of local people

Boreal region: more heavy rain, less snow and ice; more rain and river flows; more risks of forest pests; winter storms do more damage

Atlantic region: more heavy rain; higher river flow; higher risk of flooding; higher risks of damage due to storms in winter; more bad weather

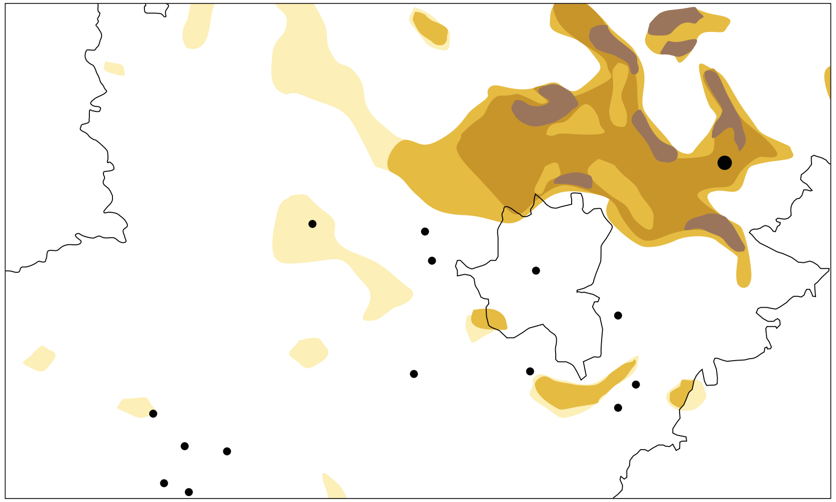
Continental region: more weather extremes; less rain in summer; higher risk of river floods; higher risk of forest fires; more energy needed for cooling

Mediterranean region: more heat extremes; less rain and river flows; higher risk of droughts; higher risk of biodiversity loss; higher risk of forest fires; more competition for water; lower crop yields; more energy needed for cooling; most economic sectors negatively affected; more people die because of heat waves

Mountain area: temperature rises more than the European average; fewer and smaller glaciers; high risk of species extinction; more risks of forest pests; more risks of rock falls and landslides; declining ski tourism

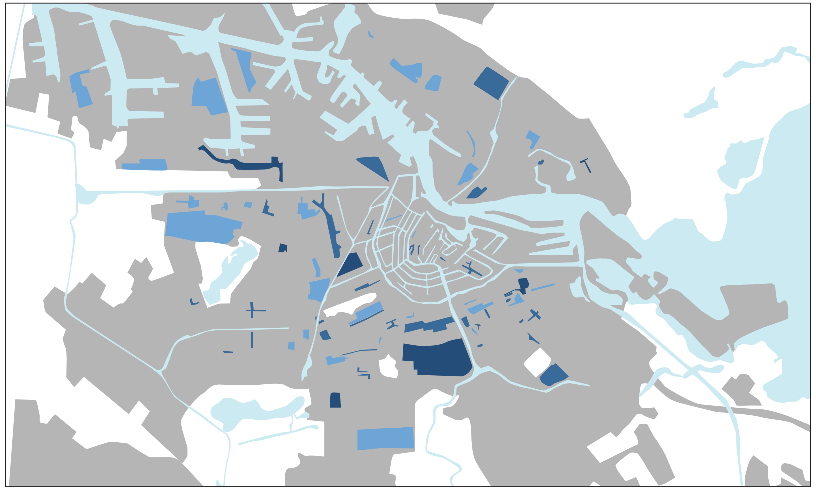
no data

Soil Pollution
Katowice, Poland



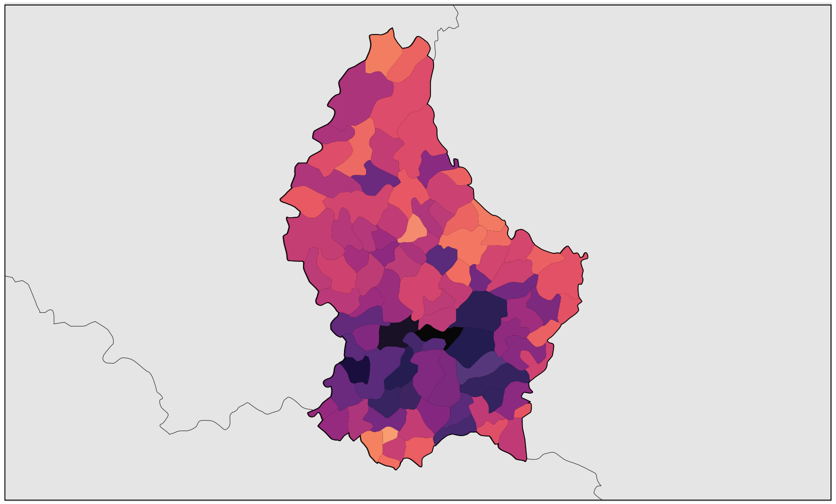
Silesian Voivodeship: soil pollution related to historical mines and heavy industries.

Rainwater Floods
Amsterdam, the Netherlands



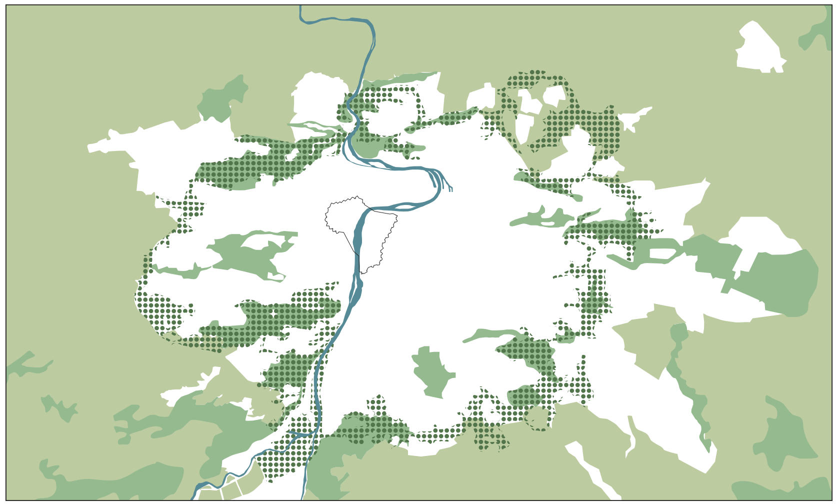
Amsterdam region: risk map regarding flooding due to heavy rainfall; in the highest risk areas, serious damage (property, roads, infrastructure) may be expected.

Carbon Emissions
Luxembourg, Luxembourg



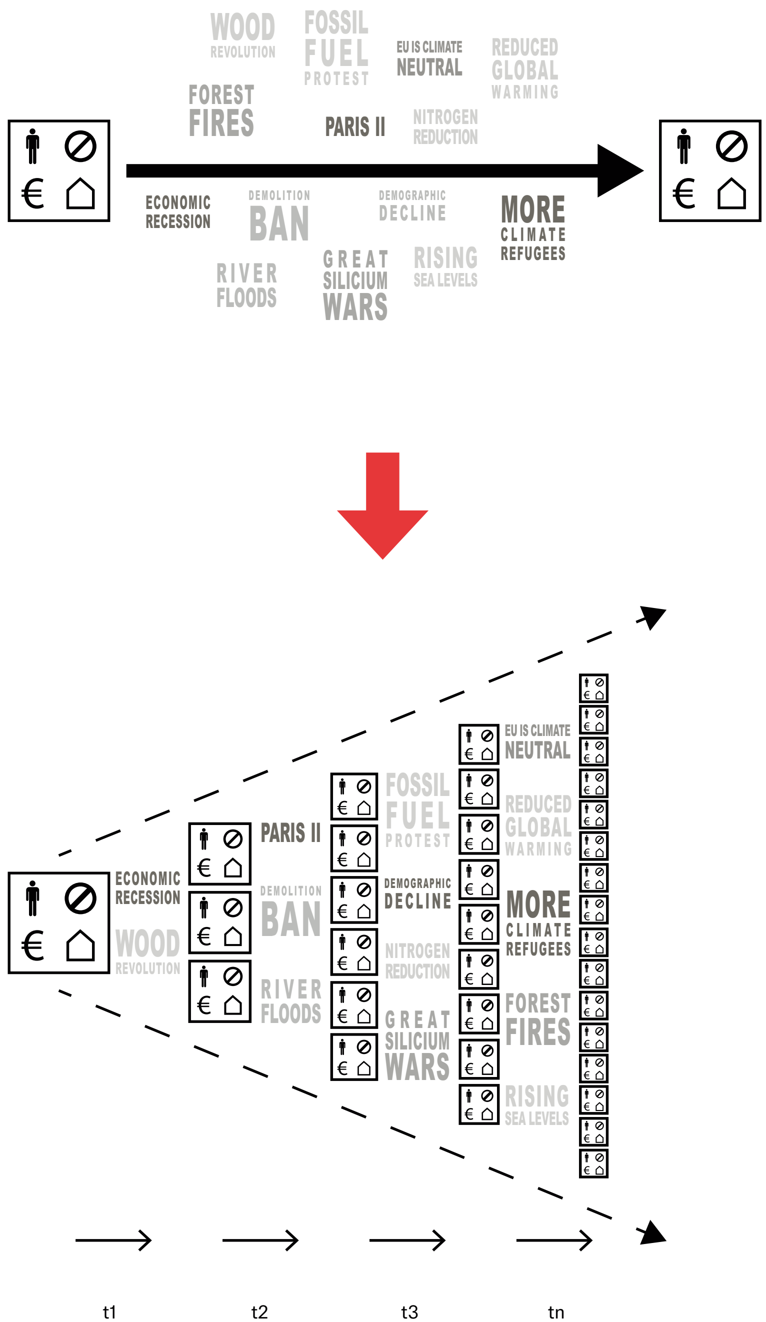
Luxembourg: local CO_2 emission – food consumption (2020).

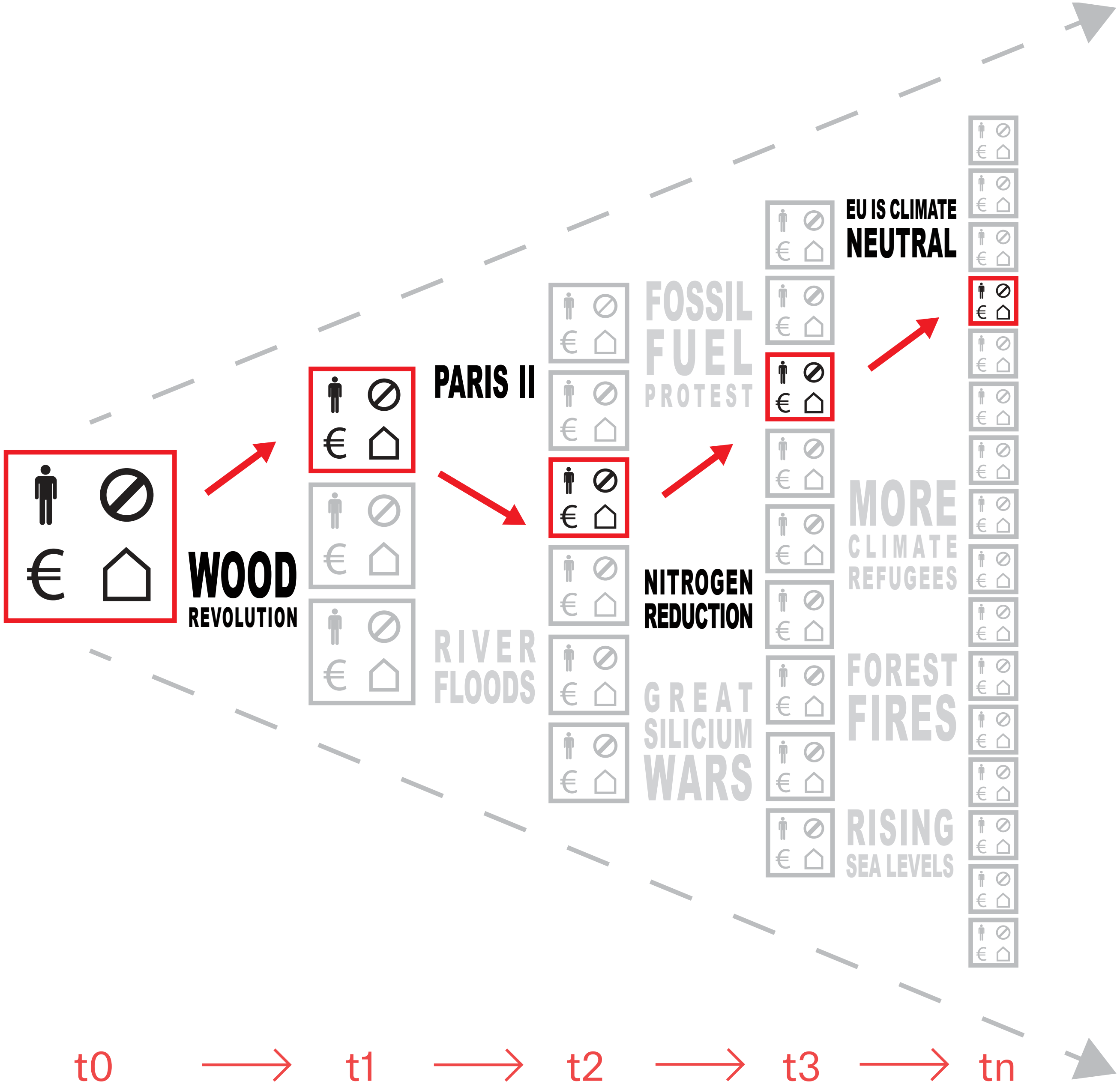
Biodiversity Decline
Prague, Czech Republic



2020: Prague plans to restore the green structure around (and within) the city, boosting biodiversity again.


foto: Holland in pixels


WOOD REVOLUTION
FOSSIL FUEL PROTEST
EU IS CLIMATE NEUTRAL
REDUCED GLOBAL WARMING
FOREST FIRES
PARIS II
NITROGEN REDUCTION
ECONOMIC RECESSION
DEMOLITION BAN
DEMOGRAPHIC DECLINE
MORE CLIMATE REFUGEES
RIVER FLOODS
GREAT SILICIUM WARS
RISING SEA LEVELS
t1
t2
t3
tn



WOOD
REVOLUTION
PARIS II
RIVER
FLOODS
FOSSIL
FUEL
PROTEST
NITROGEN
REDUCTION
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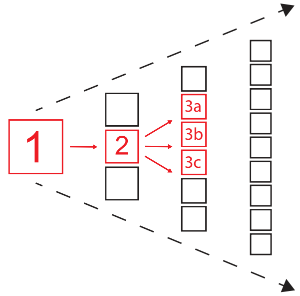
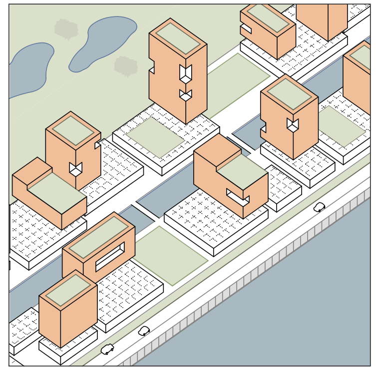
WARS
EU IS CLIMATE
NEUTRAL
MORE
CLIMATE
REFUGEES
FOREST
FIRES
RISING
SEA LEVELS
t0
t1
t2
t3
tn

Flexible Water Responsivity

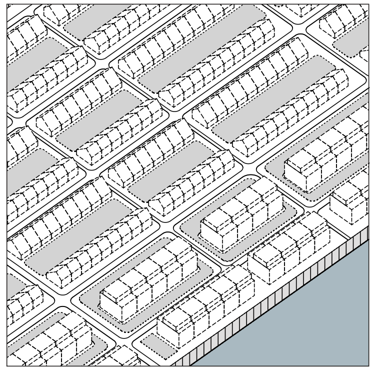
Water stress will become more apparent in the future due to climate change. This might be stormwater accumulation in depressed areas, inundation from polder systems or even flooding when dykes break.

This plan shows that the right flexibility can be reached by a strong accidentation of the ground level combined with smart basements for all buildings, introducing the possibility of a second ground floor.

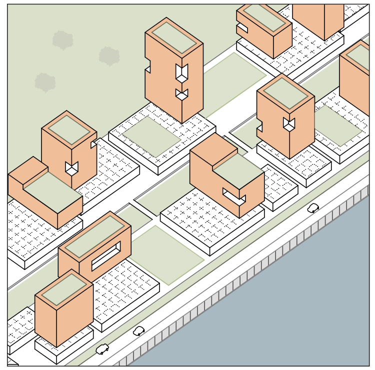




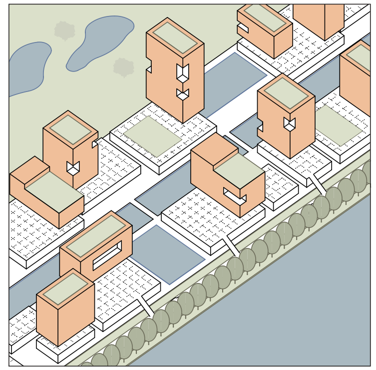
3a. Small fluctuations and surplus water can be stored in the lower parts of the accidented terrain. Traffic and daily life are unaffected.



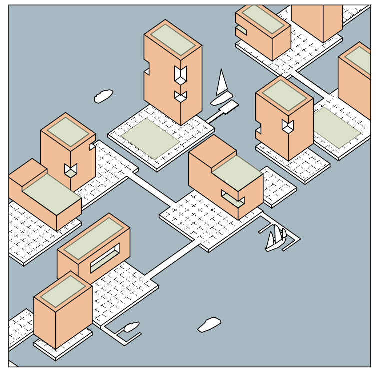
1. A generic housing plan is assessed as being too vulnerable to floods and is cancelled.



2. An alternative housing plan is realized with a strongly accidented ground level and smart basement storeys, offering the future possibility of a raised urban ground level.



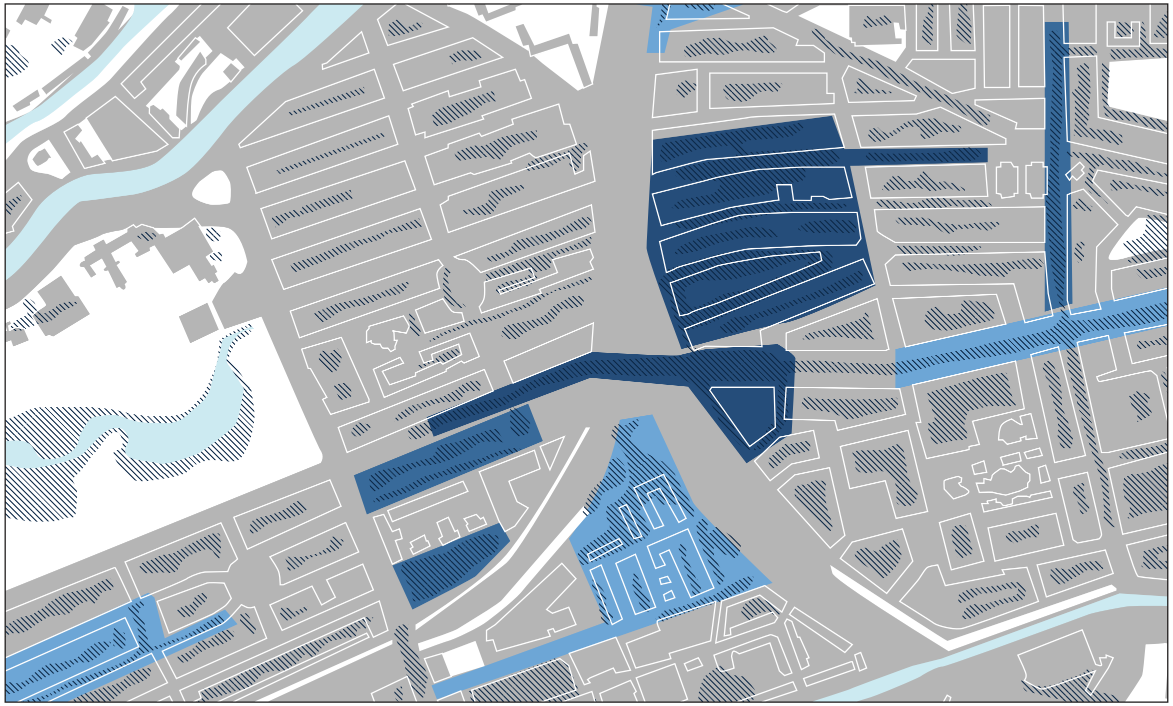
3b. Bigger fluctuations are blocked by the introduction of a massive dyke along the waterside.



3c. Vast fluctuations can no longer be prevented. The basements are dismantled, building materials are reused elsewhere and basement roofs become the urban ground level.

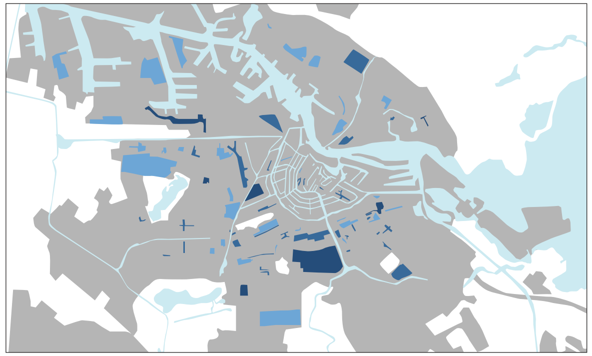
Rainwater Floods

Amsterdam, the Netherlands

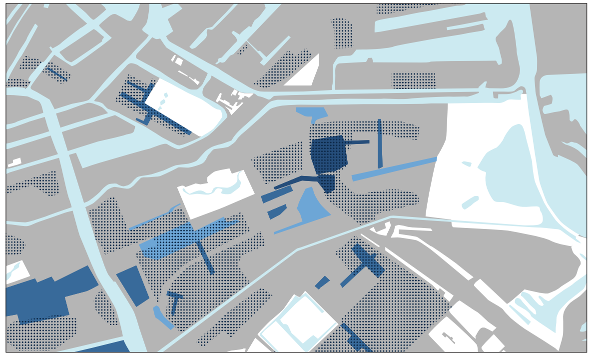


Amsterdam Oosterpark neighbourhood: expected flooding in the case of 120 mm rainfall in two hours.

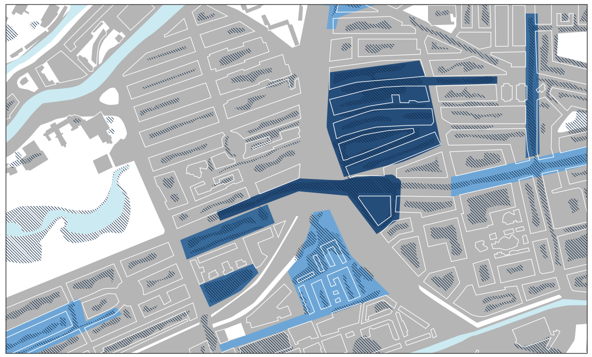
- very high risk of flooding
- high risk of flooding
- risk of flooding
- high groundwater level
- 100 – 840 mm flooding in the case of 120 mm rainfall in 2 hours



Amsterdam region: risk map regarding flooding due to heavy rainfall; in the highest risk areas, serious damage (property, roads, infrastructure) may be expected.



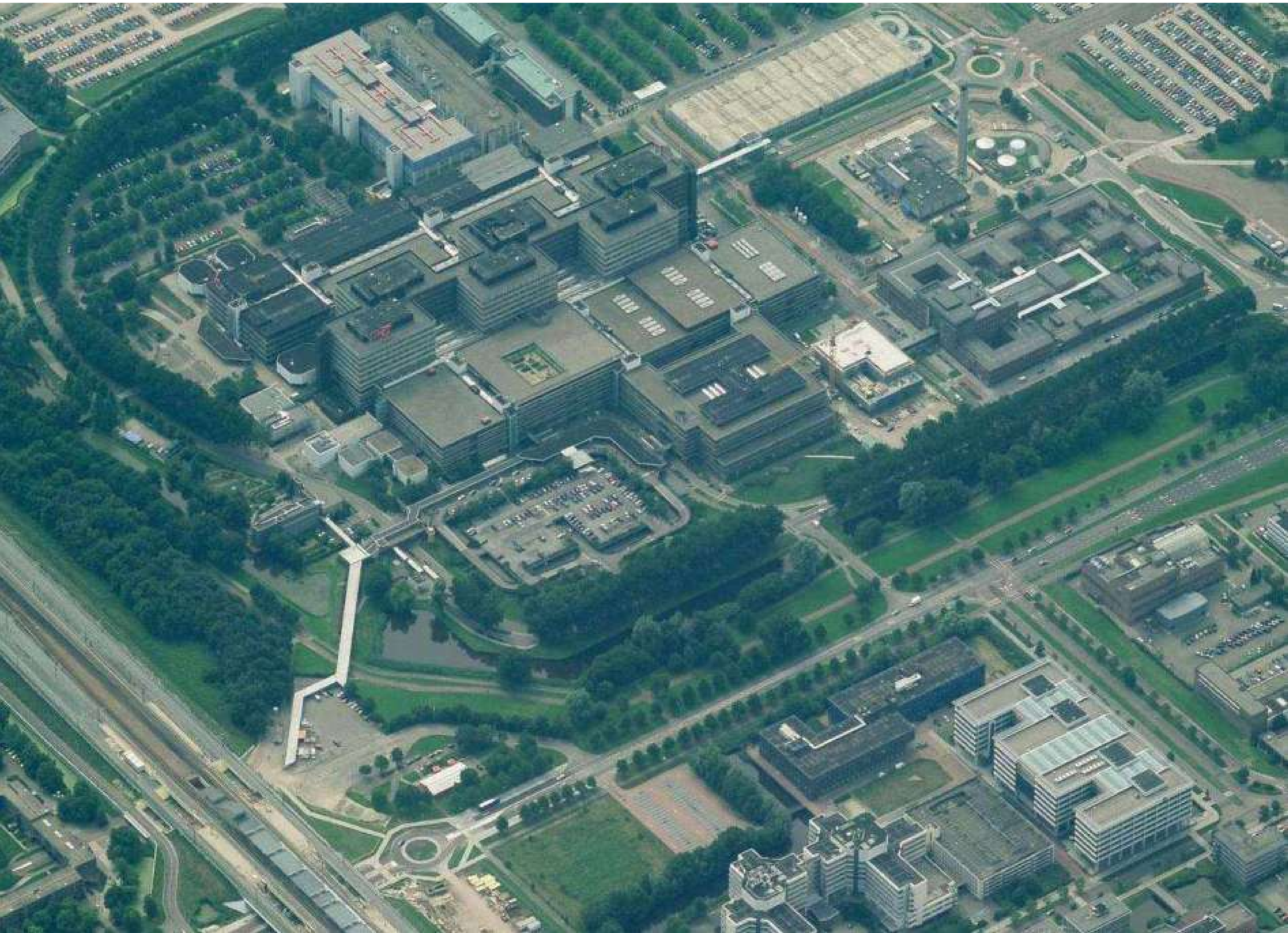
Amsterdam Central East part: risk areas related to groundwater levels.



Amsterdam Oosterpark neighbourhood: expected flooding in the case of 120 mm rainfall in two hours.

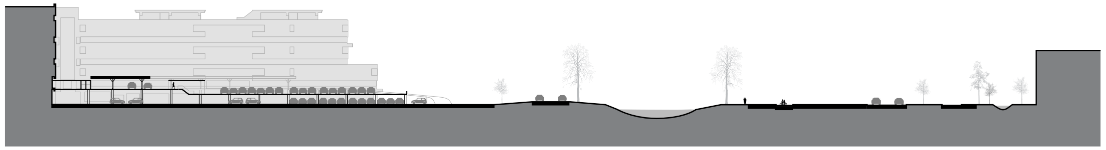
Example Projects

Local Flexibility	**Les Berges du Rhône** Lyon, France **Klimatilpasning Kokkedal** Fredensborg, Denmark **Super Blocks Eixample** Barcelona, Spain **Sara Cultural Centre** Skellefteå, Sweden **Hospital Entrance Area Amsterdam UMC, location AMC,** Amsterdam, the Netherlands **Cooperativa Agricoltura Nuova** Rome, Italy
Use-driven Flexibility	**IKEA Store** Vienna, Austria **Seestadt Aspern** Vienna, Austria **The People's Pavilion** Eindhoven, the Netherlands **Cité Maraîchère** Romainville, France **Atri** Sikhall Vänersborg, Sweden **Gent knapt op** Ghent, Belgium
Time-based Flexibility	**Resource Rows** Copenhagen, Denmark **Town Hall Extension** Korbach, Germany **Puukuokka Housing Block** Jyväskylä, Finland **The Triodos Bank** Driebergen-Rijsenburg, the Netherlands **Atelier LUMA** Arles, France **Crèche Justice** Paris, France

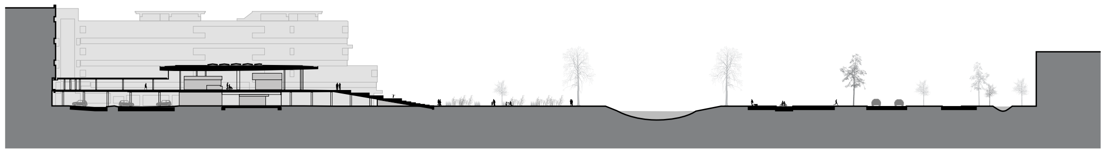


Hospital Entrance Area Amsterdam UMC, location AMC, the Netherlands

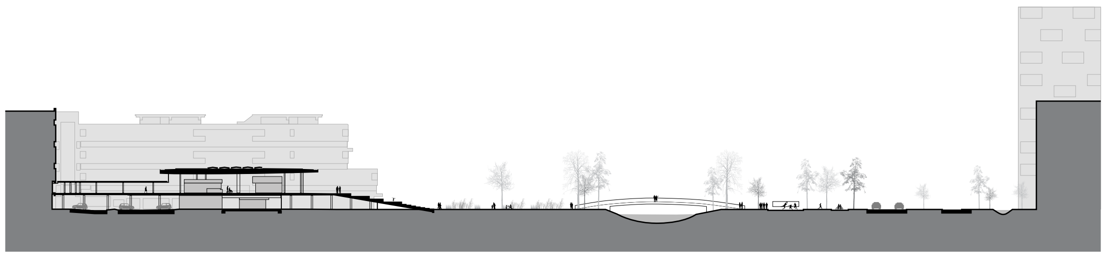
From a vast car park to a park for the neighbourhood



1. Though surrounded by city parts, the hospital building is isolated and gives a closed impression.



2. By redeveloping the entrance area of the hospital, the institute gets a clear and beautiful entrance area, offering a healthy and stimulating park for its neighbours.



3. The relationship between hospital and its surroundings is improved even further, extending the park and adding bridges.

Local Flexibility
Instruments: circular supply chains, sustainability protocol, capitalized risks, soil-sensitivity

Initiators: Amsterdam UMC, City of Amsterdam, Architectuur Lokaal
Design: Temp.architecture & studio Nuy van Noort in cooperation with studio Blad
Completion: 2022
Programme: park, pedestrian decks and entry pavilion

Because of their size, large public building complexes such as hospitals can significantly contribute to their neighbourhoods when they become more circular and climate-adaptive. By transforming a vast parking lot into a green and hospitable entry area, the Amsterdam University Medical Centres (UMC) Hospital turned its AMC building complex into a social inclusive, climate-adaptive, circular and healthy environment: an upgrade and inspiration for the whole neighbourhood.

The approximately 500,000-square-metre AMC building complex in Amsterdam was completed in the period 1981-1985 as the largest hospital in the Netherlands. The building was located outside of the city, in one of the lowest polders near Amsterdam, as a solitary, efficient and introvert medical machine. There were no buildings in the immediate vicinity. In the following decades, the city moved towards the hospital. While new buildings surrounded the complex, the new urban environment did not establish a successful relationship with the hospital. Seen from the immediate vicinity, the entrance area was hidden behind a huge parking garage, giving an intimidating rather than a welcoming impression. As the entrance was mainly designed for handling car traffic, both pedestrians and cyclist felt lost.

In 2015, the parking building at the front of the AMC location was completely worn out and therefore demolished. This literally and figuratively gave space to rethink the entrance to the AMC on a more fundamental level. The real estate department of the hospital defined the ambition to create an entrance zone that no longer represents the hospital as an introverted medical machine, but as an open and hospitable meeting place in the heart of twenty-first-century society. The changing circumstances in the immediate vicinity offered the opportunity to review the impact of this redevelopment in a broader context, redefining the relationship with the immediate environment too. These ambitions and opportunities were base for a design competition, organized in 2017.

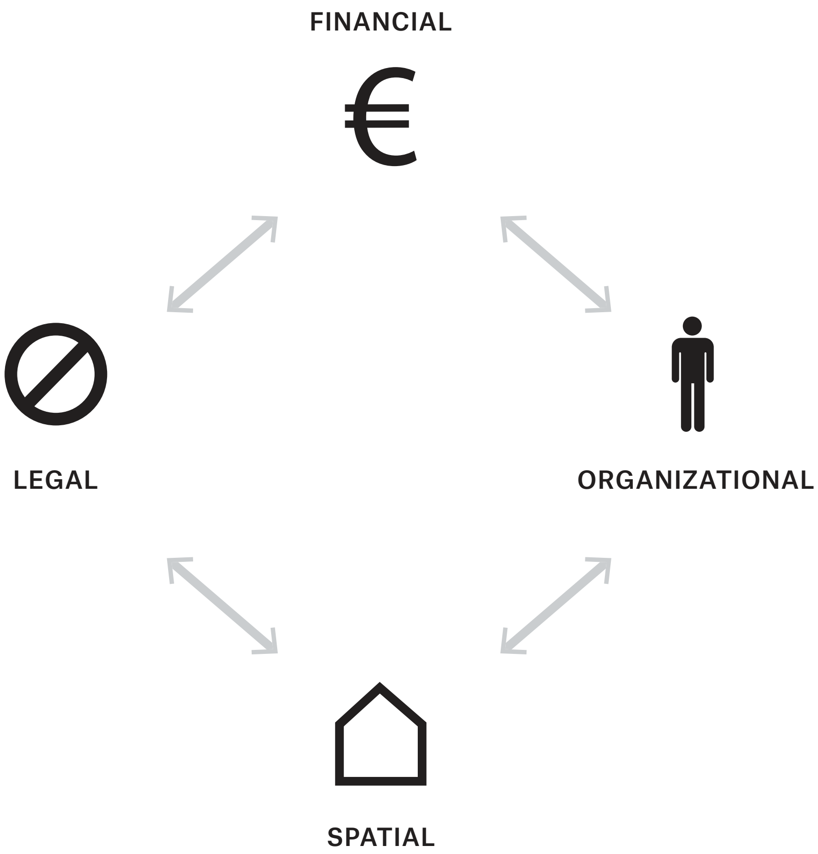
The winning design proposal was delivered in 2022. On the site of the large parking garage, there is now a park with green views and routes between the hospital and the surrounding neighbourhood, improving water drainage of the whole entrance area at the same time. The layout of the greenery offers a clear orientation and encourages time and time again to move and meet, so that the health and well-being of patients, employees, students and local residents are central. Centrally positioned in the entrance park, a pavilion offers a new, well-organized entry to the huge brutalist building complex, differing from it in size, form and materialization. A pedestrian deck, flanked by flowers and plants, links the entry to the nearby train station and offers pedestrians a safe walk to the entry without encountering cars.

Being the largest hospital in the area, the facility is key in case of regional calamities such as accidents or floods. Because the entrance zone, where all ambulances enter the complex, used to be one of the riskiest spots in Amsterdam in terms of rainwater floods, making the restructured entry zone climate adaptive was an important part of the assignment.

Organizational
In this project, excessive rainwater and obsolete trees were not seen as waste, but as bases for a circular

Instruments for a Flexible City

3.5 Legal Instruments



Local Legal Flexibility

- CAR BAN
- PURPOSE-SPECIFIC FREEZONE
- SUSTAINABILITY PROTOCOL

Use-driven Legal Flexibility

- LAW CHANGE MOTIVATION
- GUERRILLA GARDENING
- CUSTOMIZATION

Time-based Legal Flexibility

- MATERIAL PASSPORT
- EMISSION LIMITATION
- DEMOLITION BAN

SOIL-SENSITIVITY
Local Spatial Flexibility

Local soil conditions determine the risks caused by climate change. By carefully taking these soil conditions into account in the design, risks can be reduced.

SOIL-SENSITIVITY
Local Spatial Flexibility

Local soil conditions determine the risks caused by climate change. By carefully taking these soil conditions into account in the design, risks can be reduced.

Why?
Cities must anticipate climate change and respond with interventions to help them withstand future changing conditions. Understanding the role soils can play in supporting these interventions is key to determining effective measures.

Soil quality either stimulates or frustrates the way we can cope with challenges such as flooding, drought, heat stress, forest fires or decreasing biodiversity. For example, soil that is naturally water-impermeable needs adapted building methods to prevent ground floors from being flooded after heavy rains. Subsoil that hardly retains moisture is an easy basis for forest fires. Human interventions, such as building, excavation, paving or planting vegetation, seriously affects the capacities of the soil. Awareness of both its natural capabilities and the effects of human actions is dearly needed in order to develop climate-adaptive, future-proof cities.

How Does It Work?
Risk identification and mapping of the soil is the first step to adapting the built environment to environmental changes such as flood conditions and heat stress. Depending on the state of the ground, the next step is to identify implementable strategies that support resilience. A well thought-out, clever design of soil-related uses such as squares, parks, roads and private gardens can effectively suppress the impact of extreme weather conditions. In case buildings cover the ground, the role of the soil could be taken over by re-arranging rooftops as green spaces or gardens. Green roofs reduce heat stress and capture large amounts of rainwater. Otherwise, buildings can also secure stability in changing soilscapes by detaching the base of the building from the ground beneath it, such as stilt houses or floating cities.

Example: Floating University, Berlin, Germany
The 'Floating University' in Berlin is an ephemeral structure in the centre of Berlin, built onto a disused rainwater retention basin at Flughafen Tempelhof. The wooden construction is not actually floating but is planted into the concrete floor of the artificial lake. Throughout the years of disuse, the basin has developed its own ecosystem with a large variety of plants, species and different layers of soil. This is a vital component of the architect's design and style of building. By elevating the structure with stilts, the ecosystem can keep evolving beneath the platforms. Simultaneously, the structure is safe from the risks of high-water flooding and protects the building's materials from the water. The architects and builders from the collective use the months with low precipitation for the construction of new elements of the sustainable structure. During these months, the basin is drained and it is possible to continue the construction of new paths and platforms. Once the construction is completed, the floating university returns to hosting its interdisciplinary programme of activities. By adapting to the existing landscape and recognizing its benefits and risk factors, this construction successfully uses a landscape that would otherwise be uninhabitable.

The project describes itself as a 'unique ecosystem', a self-led collective, which invites the public to take part in educational and academic workshops, lectures and events. Founded in 2018, the architects of Raumlabor invited a collective of students, designers and neighbours to join the construction. The ever-evolving wooden structure is altered and upgraded every year. The site is a place to inform, challenge and create a discourse, all in the context of the risks, strains and chances of global warming.

The Circular City

focus on building construction

1. ADAPTIVE BUILDINGS

- dry knots
- detachable construction
- facilitating reuse of materials
- program neutral
- reducing future waste

2. BIOBASED BUILDINGS

- based on natural cycles
- regrowable materials

3. BUILDINGS OUT OF WASTE

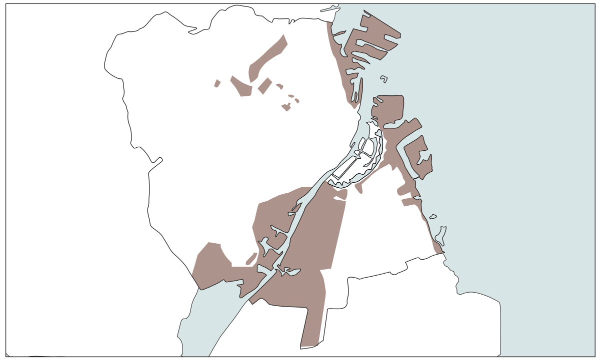
- reusing current waste

Waste Excess

Copenhagen, Denmark

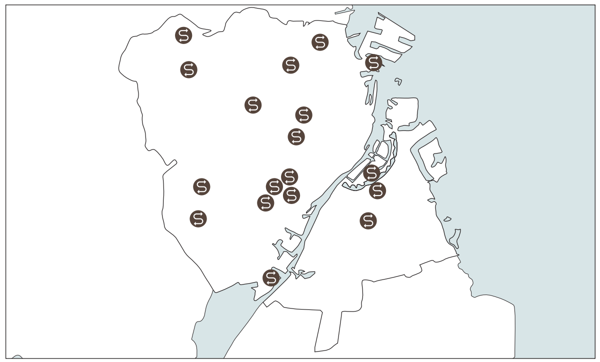
Copenhagen municipality and surroundings: waste incineration plants with their distribution networks for electricity and district heat.

- transmission pipeline
- Vestforbrænding district heating area
- Vestegnens Kraftvarmeselskab district heating area
- Centralkommunernes Transmissionsselskabdistrict heating area



Copenhagen municipality: landfill areas.

Copenhagen municipality and surroundings: waste incineration plants with their distribution networks for electricity and district heat.



Copenhagen municipality: recycling centres, recycling hubs or swap centres, where Copenhageners can bring their unwanted belongings to be repaired or used as a resource for new products.

DEMOLITION BAN

Time-based Legal Flexibility

Legislation that prevents existing building structures to be demolished, reducing the environmental impact of the building industry.

DEMOLITION BAN
Time-based Legal Flexibility

Legislation that prevents existing building structures to be demolished, reducing the environmental impact of the building industry.

Why?
The construction and demolition industries are major contributors to global waste production and greenhouse gas emissions. In particular, the production of concrete skeletons, a commonly used building technique, generates significant emissions because of the chemical process involved. Furthermore, the demolition of such structures, especially those made as monolithic, poured concrete structures without demountable joints, results in a high energy consumption, high greenhouse gas emissions and an increase of landfill waste.

Moreover, the depletion of finite raw resources like chalkstone, pebbles and sand, crucial components in creating concrete, is another consequence of the construction and demolition process.

A possible solution to reduce waste production and conserve existing structures is implementing a demolition ban. Such legal limitations would help minimize the construction and demolition industries' environmental impacts while preserving structures that have already contributed significantly to emissions during construction.

How Does It Work?
Currently, no European country has a demolition ban yet, but the European Union is proposing to develop legislation that would prohibit the demolition of buildings with concrete structures. As opposed to being demolished, these structures would have to be thoroughly renovated. A future demolition ban could possibly follow the legal framework of monument-protecting legislation, that is already widely accepted in most European countries.

The effect would not only reduce waste production but also provide a greater incentive to design new concrete structures with a more serious focus on adaptability and flexibility. The proposed approach entails prioritizing building renovation over demolition and retrofitting new constructions to enhance their longevity and functionality.

By limiting the possibility of demolition, legislation would encourage the adoption of sustainable practices, ultimately leading to a more circular economy.

Example: Tour Bois-le-Prêtre, Paris, France
The Tour Bois-le-Prêtre is a 16-storey tower block located on the outskirts of Paris, originally designed by the French architect Raymond Lopez and constructed in the early 1960s. After decades of neglect and ageing, the building required significant efforts to bring its apartments up to modern standards. While the French government initially considered demolishing the tower, it ultimately organized a competition to solicit proposals for renovating the structure. The French Architects, Lacaton Vassal, won the competition with a proposal that had a cost lower than that of demolition and new construction and increased the living area of each apartment by approximately 40 per cent without raising rents. Their proposal was a radical transformation that involved adding new floors to the periphery of the existing building, creating additional living space, and enclosing balconies and terraces. The project also included replacing the small windows with large, transparent openings that offered stunning views of Paris.

Today the Tour Bois-le-Prêtre serves as a model for addressing the challenge of rehabilitating mass-produced housing developments across Europe from the 1960s and 1970s and as a testament to the value of clever thinking and ingenuity in revitalizing neglected urban areas. Jean-Philippe Vassal and Anne Lacaton's design demonstrates how renovations and modernizing existing structures can be a resourceful, sustainable and durable way to avoid demolitions and improve our built environment.

1. ADAPTIVE BUILDINGS

Examples:

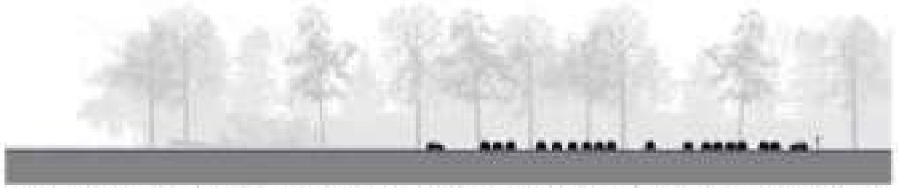
- Triodos Bank, Driebergen (NL)
- IKEA Store, Vienna (AU)

The Triodos Bank, Driebergen-Rijsenburg, the Netherlands

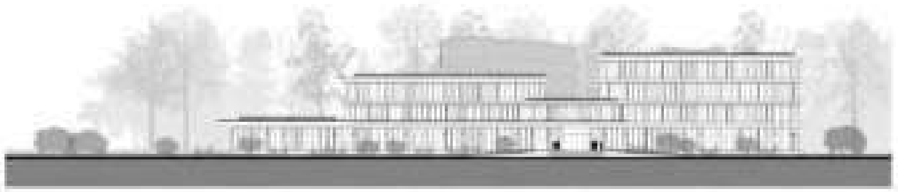
From a bank for money towards a bank for materials

Time-based Flexibility

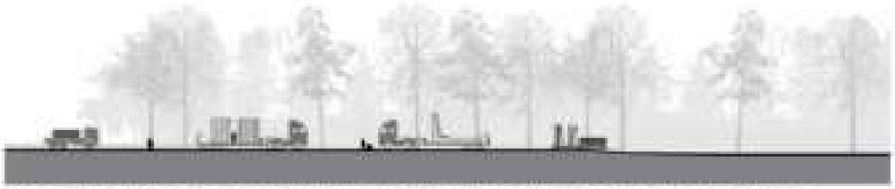
Instruments: design output monitor, material passport, upcycling, biobased building



1. Although the Reehorst estate is very green, the estate is in a rather poor condition and needs maintenance.



2. The Triodos Bank building is built as a completely demountable bank for materials. The project adds new landscape qualities to the Reehorst estate as well as an increase of its biodiversity.



3. When the building is no longer in function, it is demounted, leaving no traces behind in its green surroundings.

MATERIAL PASSPORT
Time-based Legal Flexibility

Identifying certificate for building materials that helps understand their origin and possible future.

MATERIAL PASSPORT
Time-based Legal Flexibility

Identifying certificate for building materials that helps understand their origin and possible future.

Why?
The building industry is currently based on a constant supply of new materials. As a result, the construction sector is accountable for the largest consumption of primary materials. Due to a lack of natural resources, however, it is increasingly important to reuse existing material goods.

Persistent, recurring problems regarding the reuse of building materials are their availability and questions about their origin and quality. When the intention is to reuse materials in a building project, how can it be ensured they arrive in time? What is their actual quality and how can the contracting company guarantee its condition and lifespan? Finding appropriate answers to these questions requires organizational systems that support and enable the reuse and recycling of materials.

By utilizing a centrally registered Material Passport (MP), available materials intended for reuse can be effectively traced and identified. When the passport includes comprehensive data on location, availability and age, contractors can easily plan their circular building projects and are able to make promises about the quality of the materials.

How Does It Work?
Ideally, the Passport is registered in an accessible database before the material is used in a building structure. The building then acts as a 'material bank' and once it is demounted, or altered, there is a detailed inventory of all the materials, components and resources in the building as well as their location. Thus, materials are not only to be part of a building, but also have an independent value outside of the current construction.

In theory, this system acts similarly to a library. By categorizing, documenting and identifying books, these can be lent out to different users. Every book is listed digitally in an organized system and, in its physical absence, is traceable to its current owner or location. Due to this system, books don't have to remain stationary but can be lent out to different users and locations. Like books, materials would remain accessible for generations. After the use of a resource in one construction, it could be repurposed, in another building or product. Again, the material would be registered, documented and saved digitally to trace its location and current owner.

Currently, the Material Passport is primarily used in individual projects, but it is promoted by the EU Horizon Europe Framework Programme. If a Passport is obliged for every single building element in future building legislation, circular building could easily become the starting point for all our building projects.

Example: Nest, Duebendorf, Switzerland
The Nest building, the flexible structure of which was designed by Gramazio Kohler Architects, is a building laboratory that demonstrates how to incorporate both recycled materials and flexibility into a new construction. The core of the building is made from a simple concrete backbone with three horizontal platforms, on which single modules are inserted that are demountable if the function of the building changes. The individual units have been designed for maximum sustainability; they are built from materials that are fully recyclable, reusable or compostable.

All materials used are stored in a material database and can be returned to the material cycle if the building unit chooses to change its function. This allows the structure to evolve with time without creating material waste.

2. BIOBASED BUILDINGS

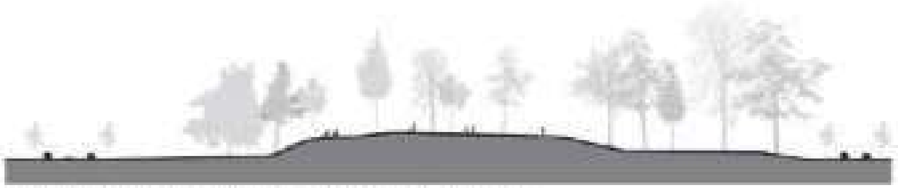
Examples:

- PUUKUOKKA, Jyvaskyan (FIN)
- Atelier LUMA, Arles (F)

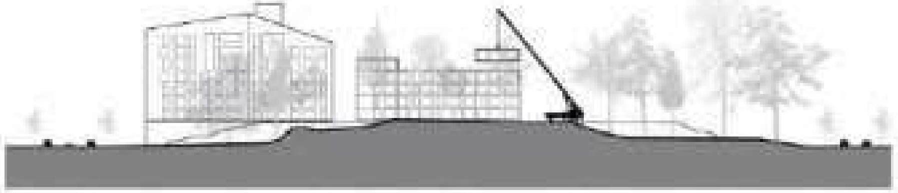
Puukuokka Housing Block Jyväskylä, Finland

From carbon-dioxide-emitting buildings to carbon-capturing buildings

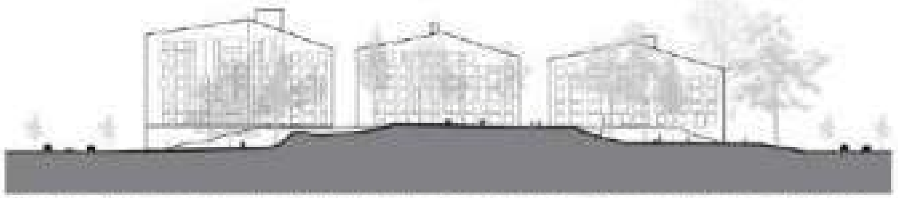
Time-based Flexibility
Instruments: innovation booster, customization, life cycle finance, modular building



1. Jyväskylä has a natural hilly bedrock landscape with pine trees.



2. The eight-storey Puukuokka Housing Block is built with prefabricated CLT modular units, exploring the potential of this structural, biobased building material.



3. Based on the lessons learned building the first building, the other buildings are erected, completing the housing complex and respecting the site.

MODULAR BUILDING

Time-based Spatial Flexibility

Building with repetitive, easliy transportable and combinable modules.

MODULAR BUILDING

Time-based Spatial Flexibility

Building with repetitive, easily transportable and combinable modules.

Why?

Conventional building tends to be a bit impracticable. Raw building products are transported to a building site where they have to be stored, waiting for the right moment to get assembled in unpredictable weather circumstances. This traditional process produces lots of greenhouse gases, has a negative impact on the immediate surroundings of the building site and its quality depends on local circumstances.

Modular buildings, on the other hand, offer several advantages over conventional building types. The production of modular building elements takes place in factories, where it is easier to collect and store building products. Since circumstances in the factories can be better controlled, the precision and quality of the building element is usually higher than building elements that are manufactured on site. Furthermore, this type of manufacturing offers better control over waste and emissions. Working conditions for builders are better too.

The use of prefabricated building elements can also increase cost-effectiveness. Especially when manufactured in large quantities, savings in materials, energy, and labour costs can be made. In addition, shorter development and construction times offer the advantage of being able to respond quickly to changing space requirements. It is easy to imagine the modules being moved to another location after some time for reuse, representing a form of circular use of building materials.

How Does It Work?

The development and construction process of modular buildings begins with the planning phase. In this step, the customer's demands are determined, and a design is made. Once the decision for a final design has been made, the building elements are prefabricated in factories, either in series or customized. However, it should be noted that modular construction requires more permanent building facilities, such as factories and warehouses, than traditional construction, which is mostly done on temporary sites. Therefore, modular construction is more cost-effective when the flow of production is regular and unceasing.

Prefabricated modules are transported as finished products to the construction site where they are assembled. This shortened and cleaner construction process impacts the environment less than conventional construction. If renovations become necessary after some time or if the spatial requirements change, the buildings can be dismantled into their individual elements and taken away. In the factories, the individual elements can be disassembled or renewed and adjusted before being reassembled elsewhere.

Example: Modular School Buildings, Berlin, Germany

To address the shortage of classroom capacity, Berlin's education and housing authorities collaborated with private architects to design a modular building type that can be used to extend existing school buildings. On ready-to-build spaces of school sites, these buildings can be constructed within six to ten months and have a service life of at least 50 years.

The assembly of the off-site prefabricated building elements is accomplished according to individual demand in four standard sizes with 12, 16, 22 or 24 classrooms, associated group workrooms and an optional cafeteria. Since 2013, the Berlin administration has completed approximately 80 of these modular school buildings, and 60 more are in the planning stages, with newer models consisting of wooden building elements. In case student numbers decline in the future, the buildings can be dismantled at short notice and the individual modules used for other purposes. The students can then be accommodated in the existing main school buildings.

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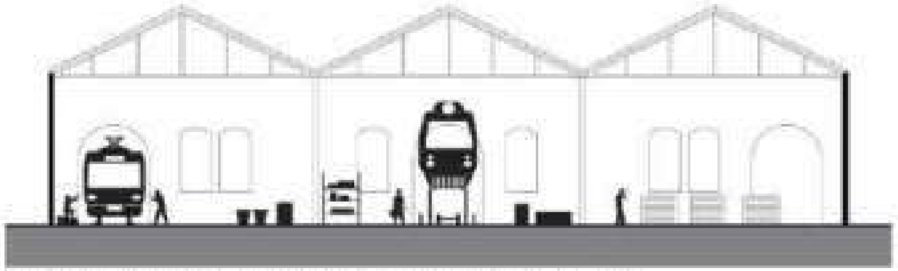
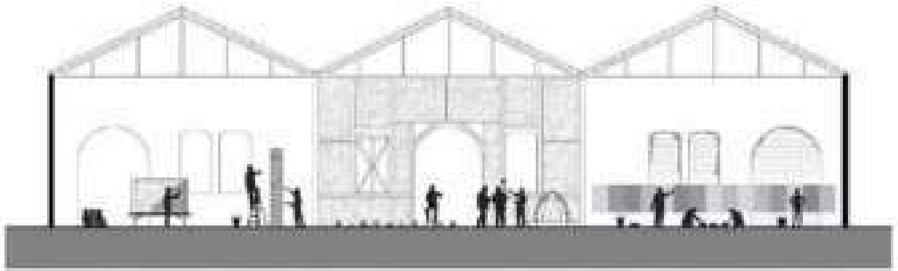
Atelier LUMA, Arles, France

From a former industrial production site to a laboratory for bioregional production

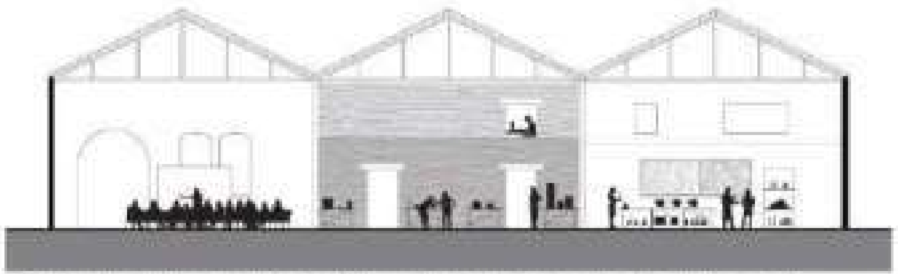
Time based flexibility
Instruments: circular supply chains, sustainability protocol, subsidy, biobased building



1. The Magasin Electrique building is part of an industrial railway site in Arles.



2. After a period of vacancy, atelier LUMA uses the building as a research and prototyping lab for bioregional materials.



3. The resulting building remains a space for experiment and, consequently, will never be finished.








BIOBASED BUILDING

Local Spatial Flexibility

Building with materials that are organic, renewable and mostly plant-based such as wood, grass or hemp and therefore have a minimal carbon footprint.

BIOBASED BUILDING
Local Spatial Flexibility

Building with materials that are organic, renewable and mostly plant-based such as wood, grass or hemp and therefore have a minimal carbon footprint.

Why?
Modern building materials are mostly stony (concrete, brick) or metallic (steel, aluminium). These raw materials have a large carbon footprint due to the energy-intensive production process involved in extracting them from non-renewable sources such as chalk, pebbles, bauxite or iron ore. In contrast, biobased materials are derived directly from organic resources and are renewable. Wood for example, under sustainable forest management, can be an endless resource. Such materials are intended to fully reintegrate back into the environment, creating zero waste. On top of that, biobased materials may have a positive carbon footprint because they can store carbon. Biobased buildings could therefore contribute to the reduction of carbon dioxide emissions instead of being only consumers of resources.

Besides their low environmental impact, biobased building materials can contribute to healthier indoor spaces. Certified materials made from natural resources do not emit harmful emissions and can furthermore regulate humidity and absorb pollutants, ultimately improving indoor air quality.

How Does It Work?
Although biobased building materials are getting more popular, their integration into the construction industry is not yet widespread. Designing and building with these materials often requires a creative and innovative approach that goes beyond traditional construction methods. As contractors, investors and building owners are not yet familiar with biobased materials, they often have doubts about their performances and qualities. Some also consider it a risk if biobased materials will meet legal building requirements.

Out of all the layers that make up a building, the structure has the most significant impact on carbon dioxide emissions. By creating a timber structure, we can greatly enhance its carbon storage potential. Building a demountable timber structure facilitates the future recycling of materials. Cross-laminated timber (CLT) has the technical possibilities for using wood as a structural material in complex or high-rise structures. Regarding the building's envelope, the most common biobased method is using prefabricated timber-framed elements or solid timber components, combined with biobased insulation such as cellulose, straw or cork. Such a method requires increased wall or roof thicknesses (compared to conventional insulation products) in order to achieve a highly insulated envelope.

Biobased cladding and interior finishing include wood, bamboo, straw, clay finishes and compressed-grass panels. If exposed to water, a protective coating may be required.

Example: House of Nature, Silkeborg, Denmark
Located next to a forested area, the building serves an educational purpose, for teaching about nature and outdoor life. Aiming to fully integrate the design with the natural environment around it and reflect its educational programme, the building was constructed using only biobased materials.

The foundation of the building is made of screw piles and a wooden deck, minimizing its impact on the ground. The wooden structure is visible both inside and outside, seamlessly blending in with the surrounding forest. The facade is inspired by traditional architecture, combining oak columns with cladding made of shingles from acacia wood. The structure is well-insulated with wood fibre boards used for thermal insulation and cardboard-based material used as a vapour barrier. By using demountable fixations only, a future disassembling of the building structure is easily imaginable.

The end result is a warm and inviting building that has a natural look and immersed in the surrounding landscape: an inspiration to its visitors.

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3. BUILDINGS OUT OF WASTE

Examples:

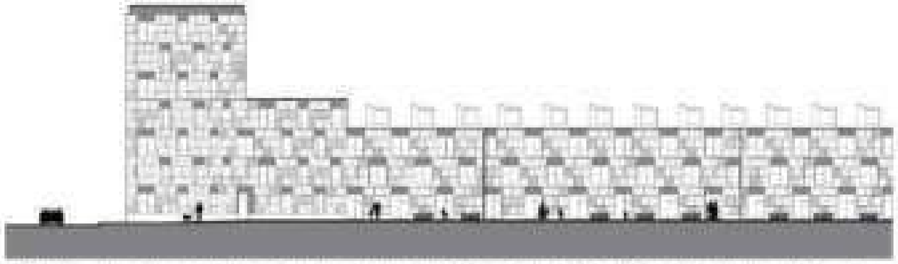
- Resource Rows, Copenhagen (DK)
- Town Hall, Korbach (D)
- Peoples Pavillion, Eindhoven (NL)

Resource Rows, Copenhagen, Denmark

From waste out of a building to a building out of waste

1. The Carlsberg Brewery is demolished and afterwards, the Copenhagen Metro removes temporary structures such as scaffolding.

2. Materials are harvested and brought to the new construction site.



3. The Resource Rows project – a brand new housing block – refers of the city's past by showing its reused materials.

Time-based Flexibility

Instruments: circular supply chains, material passport, upcycling, reinterpretation

€+€

RE-INTERPRETATION
Time-based Spatial Flexibility

A different interpretation of an existing building structure.

RE-INTERPRETATION
Time-based Spatial Flexibility

A different interpretation of an existing building structure.

Why?
Challenges related to climate change often require innovative solutions that seem to run counter to conventional structures and practices. When implementing such innovations, the potentials of existing structures are often neglected. In urban development in particular, it is even a widespread practice to eliminate already existing structures to enable the creation of new solutions.

Re-interpretation, on the other hand, aims at integrating existing structures as an elementary part of problem-solving rather than as an obstacle in finding solutions. Successful forms of re-interpretation are often inspiring examples of circularity, showing how existing structures can be used for a purpose other than their original one.

Successful re-interpretations can contribute to the creation of climate-resilient cities by significantly reducing the need for new construction and thus resource consumption compared to demolition and new construction, thereby minimizing environmental impacts. Re-interpretations often lead to the revitalization of neglected structures, in which diverse social functions can be housed without taking up more space. The creation of newly interpreted spaces can also result in the emergence of innovative places that have an identity-giving character for residents and can have a lasting positive impact on a neighbourhood.

How Does It Work?
Re-interpretations require a high degree of creativity and usually relate to building structures that no longer meet the contemporary requirements of a changed environment. In order to develop successful concepts, therefore, precisely such spaces or objects must first be identified, and their building structure examined in detail in terms of its strengths for possible alternative uses.

Setting circularity as a standard for future redevelopment asks for innovative concepts for new building structures, anticipating their re-interpretation once they become outdated in the future due to changing circumstances. Examples of structures that should already include possibilities for future re-interpretation are underground parking facilities in urban areas that are introducing traffic-reducing measures, or office spaces in locations that are witnessing changing work patterns and require new functions.

Example: Energy Bunker, Hamburg, Germany
After the former flak bunker in Hamburg's Wilhelmsburg district stood empty for over 60 years following the end of the Second World War, a conversion and reuse concept was developed and implemented on behalf of the Hanseatic City of Hamburg as part of the International Building Exhibition, which took place in Hamburg from 2006 to 2013. The central challenge was to put a massive and inflexible building, built to be indestructible, to a new use after losing its original function of protecting residents from air raids.

In 2013, the remodelled building was opened as an energy bunker, producing clean energy from renewable energy sources for around 2,000 households in the neighbourhood. At the heart of the project is a two-million-litre water storage tank that serves as a large heat buffer in the energy bunker and as the heart of a local heating network. Complementing the technical functions, a café including a viewing platform was built at a height of 30 metres to attract visitors. The re-interpretation has succeeded in transforming a historic building that seemed obsolete into a centre that presents innovative and forward-looking solutions for energy supply.

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REUSED MATERIALS MEDIATOR

Use-driven Organizational Flexibility

Mediator between available materials, coming from demolition or renovation projects, and initiators of building activities.

REUSED MATERIALS MEDIATOR
Use-driven Organizational Flexibility

Mediator between available materials, coming from demolition or renovation projects, and initiators of building activities.

Why?

Circular building materials are those that are repurposed, reused, or recycled. These materials can include everything from reclaimed wood and bricks to recycled steel and concrete. By reusing these materials, builders need fewer new materials and therefore reduce the environmental impact of construction.

The first implementation of building materials and products, right after they are newly produced, is easy, because the products are delivered straight from the factory to the building site in exactly the right quantity and quality and at exactly the right time. Reusing these materials, however, is harder. Re-implementation of products and materials in large building projects comes with the problem that the demanded materials should be available at the right moment and with the right quality. Mostly, there is a mismatch between the supply and demand of these second-hand materials. As building processes are strict in both planning and quality, these mismatches are problematic. A mediator can match supply and demand for circular building, so that construction can progress according to plan and stay within budget. They can use their expertise and network to identify suppliers who can provide the required materials and negotiate fair prices.

How Does It Work?

Circular building material mediators play a vital role in promoting the reuse and recycling of building materials in projects. By facilitating the adoption of circular materials, these mediators can help reduce waste, minimize environmental impact and support sustainable building practices.

Mediators can build a network of suppliers, builders and other stakeholders in the construction industry who are interested in using circular materials. By bringing these stakeholders together, mediators can help identify potential sources of materials and create a marketplace for buying and selling these materials. Databases can include information on the quality and availability of materials, as well as their price and location. Opening these databases to potential project partners increases the chance for a match. The closer the old location is situated to the new building project; the smaller the impact of transport on emissions and costs. An effective mediator has access to sufficient storage space, so that the period between disassembly and reuse can easily be bridged. Mediators can offer consulting services to builders and architects to help them identify the most suitable circular materials for their projects by providing organizational, legal or technical guidance on how to integrate these materials into the building process.

Example: Zinneke, Brussels, Belgium

The socio-cultural organization Zinneke in Brussels was accommodated in a historic building that used to be a printing workshop. Instead of using new materials for the renovation, the architects of Ouest Architecture chose to reuse as many building materials as possible, including doors, windows and flooring, which were all cleaned and refurbished for use in the new design. Building materials coming from other buildings and sites were reused too. Rotor, a specialized Brussels-based organization played a crucial role as a mediator between the architects and the suppliers of reclaimed materials. Rotor helped identify potential sources of materials, negotiate prices, and coordinate the transportation and delivery of materials to the construction site. They also provided technical assistance to the architects, helping them identify the most suitable materials for their design.

€→€

UPCYCLING
Time-based Financial Instrument

By discovering uses that add value to poorly valued waste materials, circularity and reuse become a be- nificial alternative for the conventional, linear way of producing materials.

€→€

UPCYCLING
Time-based Financial Instrument

By discovering uses that add value to poorly valued waste materials, circularity and reuse become a beneficial alternative for the conventional, linear way of producing materials.

Why?
The current economic production system is becoming increasingly problematic. Firstly, it relies heavily on the extraction of finite natural resources, which are being depleted at an unsustainable rate. This leads to a range of negative environmental impacts, including deforestation, water pollution, greenhouse gas emissions and climate change. Secondly, the current economic production system is based on a linear model of production and consumption, where resources are extracted, processed into goods, and then discarded as waste. This model generates enormous amounts of waste and pollution, which harms the environment and human health more and more.

Upcycling is a model of production and consumption that aims to minimize waste and resource depletion. Basically, the idea is that waste can be transformed into a valuable resource, creating a closed-loop system that reduces environmental impacts and creates new economic opportunities while fostering economic development and social equity.

How Does It Work?
One way to upcycle materials and products is to repair them when they are at the end of their 'first' lifespan. Good examples of this way of upcycling are the dismantling and reuse of components of buildings, vehicles or electronics. Another way of upcycling is by discovering uses that add value to poorly valued or waste materials. Instead of disposing of these materials, they can be repurposed or transformed into new products. Good examples of this are the use of rags as building insulation and the processing of scrap wood into furniture. The circular economy is critical for achieving sustainable development goals and ensuring a more resilient and equitable future for both the planet and its inhabitants. However, it must be said that many production systems are not suited yet for circularity and therefore consider circular production as an alternative that is more expensive.

Example: APPLAUSE, Ljubljana, Slovenia
Invasive alien plant species pose one of the greatest challenges to European ecosystems. They threaten native vegetation, destroy agricultural land and cost the European economy billions of euros every year. Many of them are removed on a daily basis, mainly by burning. In Slovenia, there are no special landfills for invasive alien plant species (IAPS), so all collected biomass is sent to incinerators.

The APPLAUSE project in Ljubljana brings a completely new approach to the challenge of waste biomass. IAPS are seen as a resource and the starting point for a new business model: through large-scale education and awareness campaigns, citizens are encouraged to participate in the harvesting and use of IAPS. Educational campaigns encourage and teach them how to harvest and collect alien plants, which can then be processed at home or at a processing centre. Collected IAPS are used in three main ways: at home (e.g., food, dyes), in guided workshops (e.g., to make wood or paper products) and in artisanal laboratories (e.g., to make innovative products with market potential in social enterprises, employing vulnerable groups).

As a Zero Waste City, Ljubljana has recognized the potential to establish a systematic participatory model that uses collected biomass to develop new sustainable products. Thanks to this platform, Ljubljana successfully employed circular production to control IAPS, instead of incinerating them. The project has trained at least 2,350 citizens and collected over 45,000 kilogrammes of alien plants to be used in wood and paper production.

CIRCULAR SUPPLY CHAINS

Time-based Organizational Flexibility

Production processess in which residuals are not turned into waste, but somehow are brought back into the process, reducing or even eliminating toxic emissions and polution.

CIRCULAR SUPPLY CHAINS
Time-based Organizational Flexibility

Production processes in which residuals are not turned into waste, but are somehow brought back into the process, reducing or even abolishing toxic emissions and pollution.

Why?
Our current economy is largely run by systems that convert raw materials into waste, be it energy, water, consumer goods or construction. In contrast to such linear processes, the circular economy makes these systems circular. Resources left over at the end of a process are no longer considered to be waste, but are reused and fed back into the system, with the goal of building circular supply chains.

By reusing and recycling resources in circular systems, the demand for resources can be significantly reduced, as it is no longer necessary to constantly add new resources to the system. Circular supply chains can thus ease the burden on existing infrastructure and help reduce harmful emissions by lowering the need for fossil fuels. In a circular food system, for example, food waste can be converted into renewable energy sources and fertilizer.

Circular supply chains often are realistic and viable when implemented in small-scale geographic units such as neighbourhoods or blocks. Such decentralized systems often provide better solutions to local challenges than large-scale systems. Citizens can more easily connect to and benefit from such systems, helping to build (partly) self-sufficient and resilient communities.

How Does it Work?
The implementation of circular supply chains requires the restructuring of processes providing energy, water, food, (building) materials and waste-collection. In order to successfully transform such systems, it is necessary to understand conventional flows and the role stakeholders play.

Only based on this knowledge can existing infrastructures be adapted accordingly. A circular supply chain for energy might include, for example, solar cells or an underground heat and cold storage. A circular supply chain for water will surely include the sufficient collection of rainwater, perhaps combined with a system that splits grey water from dirty water. A circular system for food might imply the introduction of local collective gardens and possibilities for interchange. Recycling (building) materials requires a materials mediator and recycling facilities and repair shops. Purely circular supply chains might differ radically from what we are used to. However, a mix of conventional and circular supply chains is quite conceivable as well.

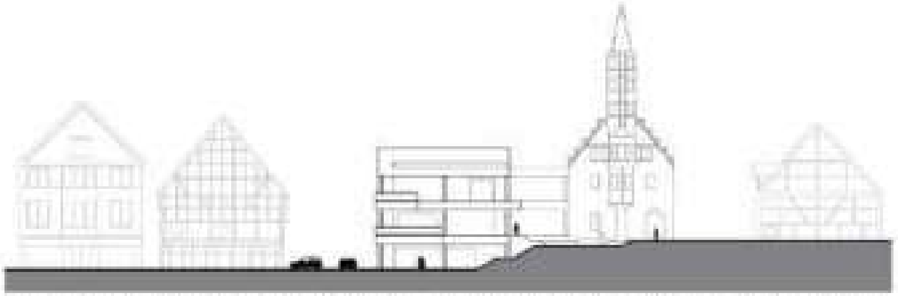
Since the restructuring of production processes is often initially associated with high costs that only pay off in the medium to long term, government financial incentives make sense in order to encourage private actors to make corresponding investments. However, equally important as the actions of public and private institutions is the behaviour of consumers. They determine whether they use recyclable products or repair services, or even take action themselves and implement small-scale circular systems in private.

Example: Garden Streets, Antwerp, Belgium
The garden streets in Antwerp are minor roads in which circular water cycles have been established. The streets are traffic-calmed and largely unsealed with the help of water-permeable paving. Rainwater from the roofs of the buildings is channelled into the numerous green spaces along the streets or collected in underground infiltration systems.

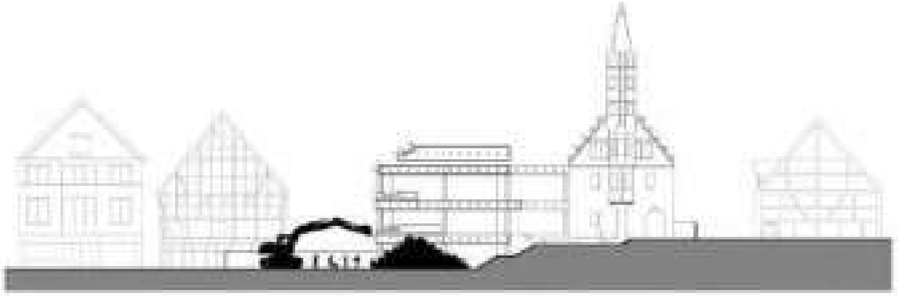
The collected water can be reused by all residents with the help of pumps and no more rainwater has to be discharged into the sewage system, which reduces the load on the corresponding infrastructure. The greened and calmed climate streets also serve as new meeting places for social interaction.

Town Hall Extension, Korbach, Germany

From a modernist town hall made out of concrete to a contemporary town hall made out of that same, reused concrete



1. The modern and brutalist building structure of the Korbach Town Hall does not fit well into the medieval old town.

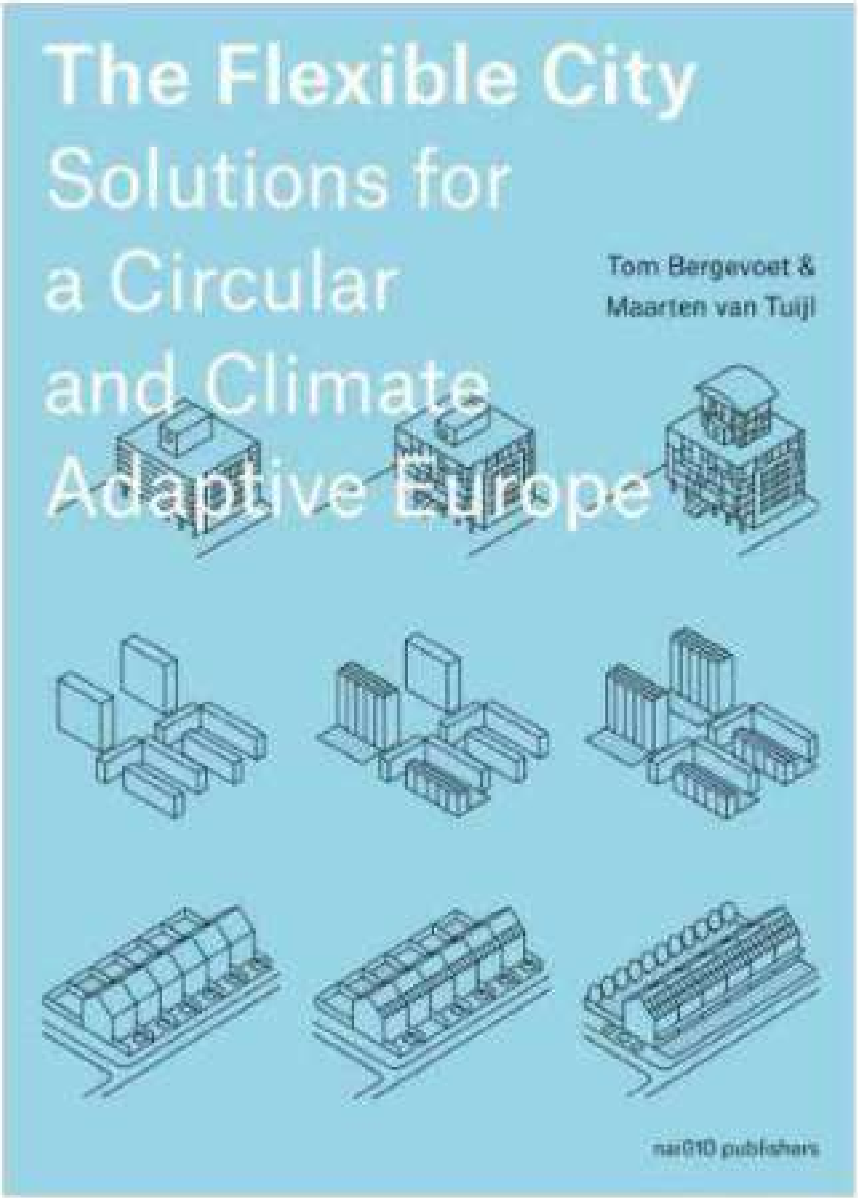


2. The brutal building structure is demolished and its building materials are carefully kept and inventoried.

3. A new town hall, that fits much better into the medieval old town, is built using the old town hall's materials.

Time-based Flexibility

Instruments: reused materials mediator, customization, upcycling, re-interpretation



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QUESTIONS:

How can the reuse of existing raw materials and residual materials be scaled up?

What are the challenges?