

# Luxembourg 2050 — Prospects for a Regenerative City–Landscape — Report Phase 2

University of Luxembourg (UL)

Luxembourg Institute of Science and Technology (LIST)

Centre for Ecological Learning Luxembourg (CELL)

Institute for Organic Agriculture Luxembourg (IBLA)

Office for Landscape Morphology (OLM)

# — Colophon

This report summarises the collaborative work of University of Luxembourg (UL), Luxembourg Institute of Science and Technology (LIST), Centre for Ecological Learning Luxembourg (CELL), Institute for Organic Agriculture Luxembourg (IBLA), Office for Landscape Morphology (OLM) and encompasses the teams' contribution to the International Urban-Architectural and Landscape Consultation "Luxembourg in Transition. Spatial Visions for the Zero-Carbon and Resilient Future of the Luxembourg Functional Region," initiated by the Ministère de l'Énergie et de l'Aménagement du territoire / Département de l'Aménagement du territoire (DATer).

**Principal Investigator**  
Prof. Dr. Florian Hertweck

**Coordination Committee**  
Dr. Enrico Benetto, Philippe Coignet, Dr. Thomas Gibon, Dr. Claudia Hitaj, Dr. Sabine Keßler, Dr. Markus Molz, Dr. Marija Marić, Karine Paris, Norry Schneider, Prof. Dr. Christian Schulz

**With contributions from:**

**University of Luxembourg (UL)**  
Aisha Abdullah, Eldin Babić, Tom Becker, Francelle Cane, Dr. Marianna Charitonidou, Dr. Estelle Evrard, Caroline Faber, Marielle Ferreira Silva, Prof. Dr. Jean-Régis Hadji-Minaglou, Prof. Dr. Joachim Hansen, Prof. Dr. Markus Hesse, Prof. Dr. Nikos Katsikis, Dr. Ariane König, Dr. Marija Marić, Prof. Dr. Markus Miessen, Saroj Neupane, Prof. Dr. Christoph Odenbreit, Simona Bozhidarova Popova, Dr. Rachel Reckinger, Prof. Dr. Christian Schulz, Prof. Peter Swinnen, Prof. Dr. Francesco Viti, Prof. Dr. Danièle Waldmann, Ivonne Weichold, Céline Zimmer

**Luxembourg Institute of Science and Technology (LIST)**  
Dr. Javier Babí Almenar, Dr. Enrico Benetto, Christian Braun, Dr. Elie Daher, Dr. Thomas Gibon, Dr. Claudia Hitaj, Dr. Jürgen Junk, Dr. Sylvain Kubicki, Ulrich Leopold, Dr. Lisette Cantú Salazar, Dr. Nicolas Titeux

**Centre for Ecological Learning Luxembourg (CELL)**  
Dr. Katy Fox, Dr. Markus Molz, Karine Paris, Norry Schneider, Jill Wengler

**Institute for Organic Agriculture Luxembourg (IBLA)**  
Dr. Sabine Keßler

**Office for Landscape Morphology (OLM)**  
Philippe Coignet, Lucie de Gori, Christelle Monnier

**Graphic Design**  
Lena Mahr, Marija Marić

**Rendering**  
Loic Morin

**Administrative Support**  
Brigitte Batyko  
Sara Volterrani

**Design Research Studio**  
In parallel to research, a design studio on the case study of Foetz has been led at University of Luxembourg by Prof. Dr. Florian Hertweck, Prof. Dr. Markus Miessen and Dr. Marija Marić

**Design Studio Students**  
Daniel Domine, Christos Floros, Marina Caroline de Araujo Marins, Nazanin Mirsharifi, Soroush Najarsaleh, Andreea-Alexandra Paraschiv, Piotr Pawliszyn, Kalpana Dushyanthi Piyadigamage, Simona Bozhidarova Popova, Raphaela Sarah Aurelia Sauer, Vivian Torres, Diana Valentina Zarnescu

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# — Introduction

Last summer—just before the second wave of the Covid-19 pandemic—we came together as designers, planners, scientists, experts, practitioners, and activists to respond to the Ministry of Energy and Regional Planning’s ambitious call for tender “Luxembourg in Transition.” The task to develop prospects for the socio-ecological transition of Luxembourg’s functional area was both demanding and enjoyable. Demanding, because the design of the transition challenges us to take into consideration many different dimensions, vectors and themes: transscalar spatial dimensions and different time horizons, vectors of natural science and humanities, existing planning and regulatory frameworks of a transnational territory characterised by a very specific history, governance, economy, and culture. The task requests the interaction of many different expertises—yet current planning practice does not even manage to think together spatial planning, urban planning, urban design, and architecture—and has no experience in such a remotely interdisciplinary collaboration.

But the call was also enjoyable, not only because we learnt a lot from this interdisciplinarity, but also because decarbonisation—probably the greatest challenge of our time—asks us to rethink space through time, based on these imperatives. Reducing greenhouse gases by as much as 90 % implies developing entirely new methods, strategies, and narratives in an extremely unbalanced, relational and energy-consuming territory. And that requires creativity.

According to Rob Hopkins, we are capable of dramatic change, but we fail, because we have largely lost our most important tool: the human imagination, the ability to look at things as if they could be different and ask—what if? What if we put an end to fuel tourism? What if cities were car-free? What if commercial zones became neighbourhoods? What if there were no more urban motorways? What if there were no more shopping malls? What if there was no more industrial agriculture? What if we no longer sealed the soil?

In our first report to this call, we focused on the construction of a transition metric that proves that the proposed strategies lead factually to decarbonisation and greater resilience by 2050—and not just suggestively, as is often the case in design prospects. From the very beginning, we had the ambition not to think of this metric only in terms of sectorial bricks, but to develop a system of strategies that treats decarbonisation and social and ecological resilience in a holistic and contextual way. For us, three basic principles are crucial to the construct of this metric: Sufficiency, which means not only relying the transition on technological progress, but building on the culture and economy of a Less is More; Spatial Justice in a relatively prosperous territory, albeit characterised by social and spatial inequalities today; and Regeneration as the third overarching principle, which means the exclusive, consistent and strategic transformation of what is there.

In this second phase, we focus on the translation of the metric and strategies into space. If our metric, through its holistic claim, also covers strategies that do not have immediate spatial effects, it was now a question of crystallising those strategies that inherently contain a spatial dimension, and of giving these strategies a shape—by developing a prospect that implements the translation of different imperatives in a phased and staged model, curated intensities along a realistic timeline. Accordingly, one could describe the present work with the concept of metamorphosis: how things and spaces transform from a fossil form into a sustainable form in different time horizons. This way of thinking in different time horizons is also not yet very common to spatial planning disciplines, which are still all too often stuck in normative master planning regimes. However, it is obvious that this metamorphosis is not just about planning or design. It is also about the practices of this transition: how this transformation towards a sustainable era is supported by governance structures. Moreover, it interrogates how it is accepted and lived by the people. We believe that civic empowerment is crucial for the success of the transition. Therefore, our work is not only concerned with the implementation of decarbonisation strategies and the preparation of the territory for the impacts of climate change, but also with the use of the spaces that become available due to these strategies.

The transition, like any fundamental change, needs (counter)spaces in which alternative practices and economies can flourish. Therefore, it was of central importance for us to present alternative post-fossil practices in text and image in this report, in order to use these narratives to engage in a productive dialogue with citizens while demonstrating that “much of less” could potentially lead to “much of more.” In workshops, we have already discussed our approaches with citizens and experts from the region and incorporated many suggestions. But for us, these workshops are only the beginning of a process that will initiate a co-design of the Transition.

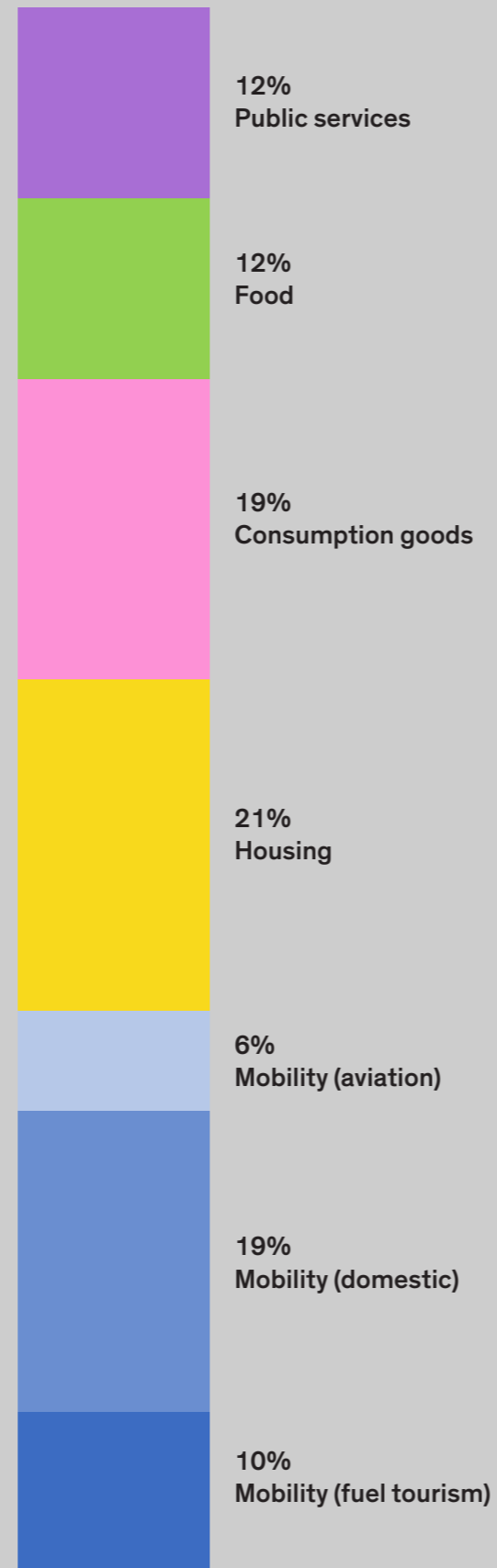
Our work is thus a narrative of doing things differently, which is reflected in planning, metrics, and practice according to the composition of our team. Building on the three basic principles—sufficiency, spatial justice, and regeneration—we have defined guiding principles ranging from the archipelago to the city of proximity, less than no net land take, porosity, triple zero in the building sector, food sovereignty, to a regional sharing economy and transition governance.

The principle of prospects or prospectives is to first develop a narrative for a distant date—in this case 2050—and then define the immediate transitions and draw conclusions about what needs to change in terms of economy and governance today rather than in the distant future. This report could therefore only be relegated to the realm of utopia if one is of the opinion that the governance structure

or the Luxembourg business model are not fundamentally changeable or ready for a paradigm shift. This is indeed our central line of attack: what we are proposing here is all feasible, and in this sense not utopian. But the goals require both a large-scale societal consensus as well as an unprecedented political will geared at a truly disruptive change towards a resilient and sustainable future.

This report is structured around four major chapters: first, we describe the Transition Method, i.e. the Why and the How of the Transition—with the presentation of alternative scenarios and our postulates, the definition of the scales and territories of intervention as well as the potentials of the transnational territory. We then show the strategies of the different themes defined in the first report on a territorial scale, from Urban Regeneration to Agro-Ecology to Energy Transition—the What of the Transition. The third chapter is about the spatialisation of decarbonisation and resilience strategies in different specific spaces, i.e. the How and Where of the Transition. We place particular emphasis on always presenting the triumvirate—planning, metrics and practices. In the final chapter, the strategies, spaces and themes then come together to form a territorial Figure of Transition: an Archipelago 1.6TCO2—a low carbon and resilient city-landscape.

# 16 CO2



2021

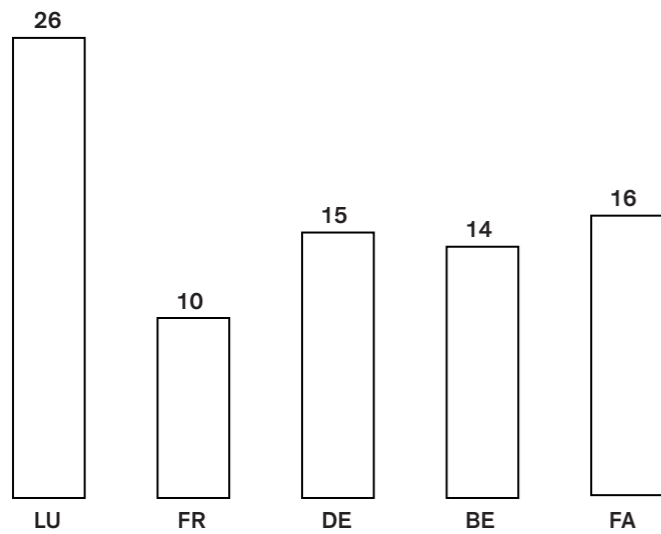
# 1.6 CO2



2050

## — Decarbonisation Challenge

In this proposal we lay out a path for decarbonisation that keeps us within other environmental boundaries (water eutrophication, air pollution, and material use) and ensures social and spatial justice. We measure environmental impacts using a life-cycle scope. The 2020 carbon footprint of the functional area (FA)—constructed as the population-weighted average of the footprints of Luxembourg, France, Germany, and Belgium—consists mainly of emissions from the mobility and housing sectors, followed by consumption goods, food, and the public sector. Our set of strategies addresses emissions from each of these sectors. At 16 t CO2 eq per capita per year, the carbon footprint of the functional area is 10 times higher than the 2050 target of 1.6 t CO2eq emissions per capita per year to meet the Paris Agreement and keep global warming below 2°C. The target is thus clear, and while the 90% reduction required is staggering, the resilient decarbonisation path we propose is still something we can look forward to, since it is built on the premise and promise that in life less is more.



2021 Carbon Footprint (consumption-based, t CO2/capita/year)

01 —

TRANSITION

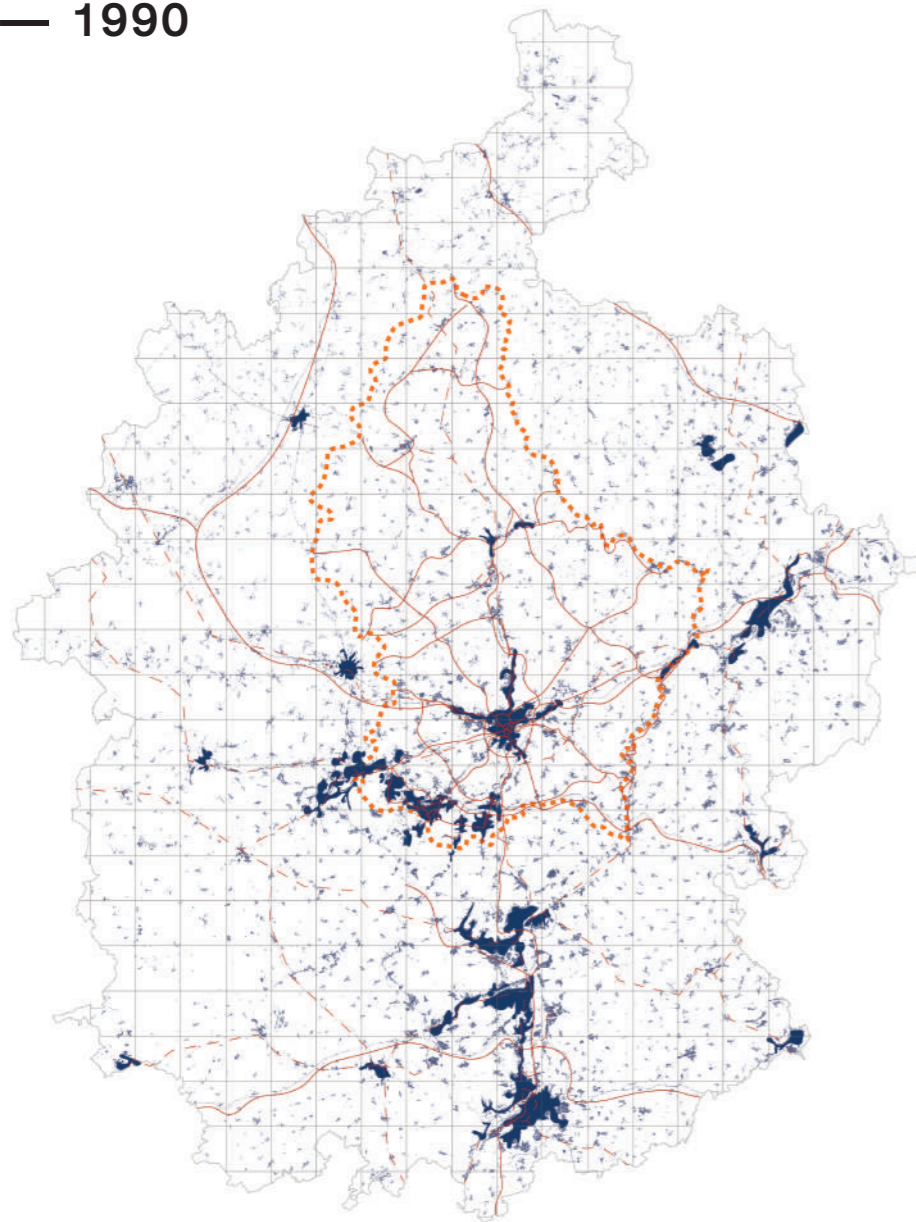
METHOD

## — Smart Growth Scenario

**The best way to predict the future is to design it—so goes Richard Buckminster Fuller's famous phrase. Since we cannot predict the future, but nevertheless want to design it, prospective planning has to investigate different scenarios. The most likely scenario under current political, economic and regulatory conditions is “smart” growth, which aims at maintaining the chosen path of economic and demographic growth by making it “smarter” and greener by means of technological innovation and development. The circular economy, smart city and building concepts, artificial intelligence as well as blockchain technology promise to optimise resource and energy flows, and—by relaying on renewable energy production—to generate so-called qualitative and environmentally friendly growth. But does this strategy, as manifested by the Rifkin report, really no longer have a negative impact on climate, biodiversity and resources? We have doubts.**

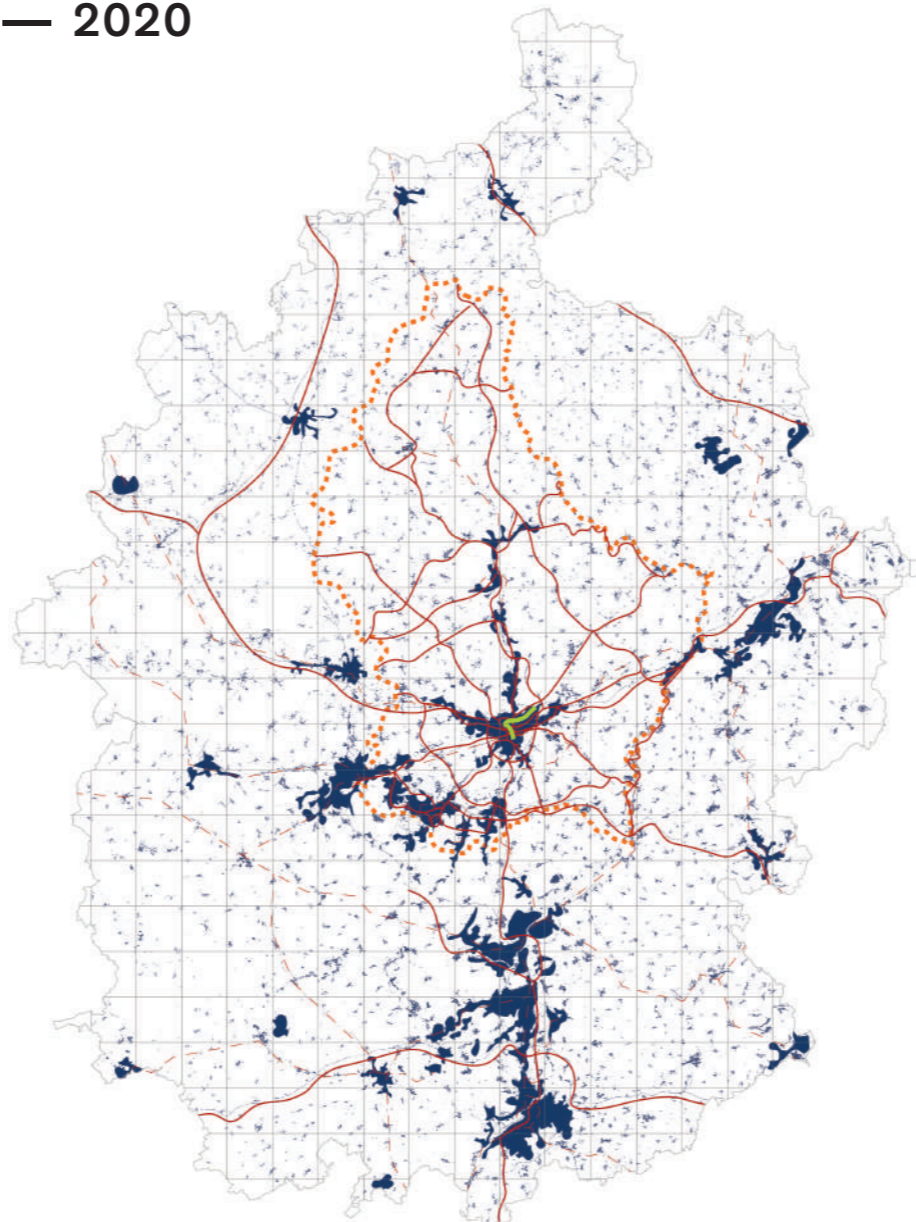


— 1990



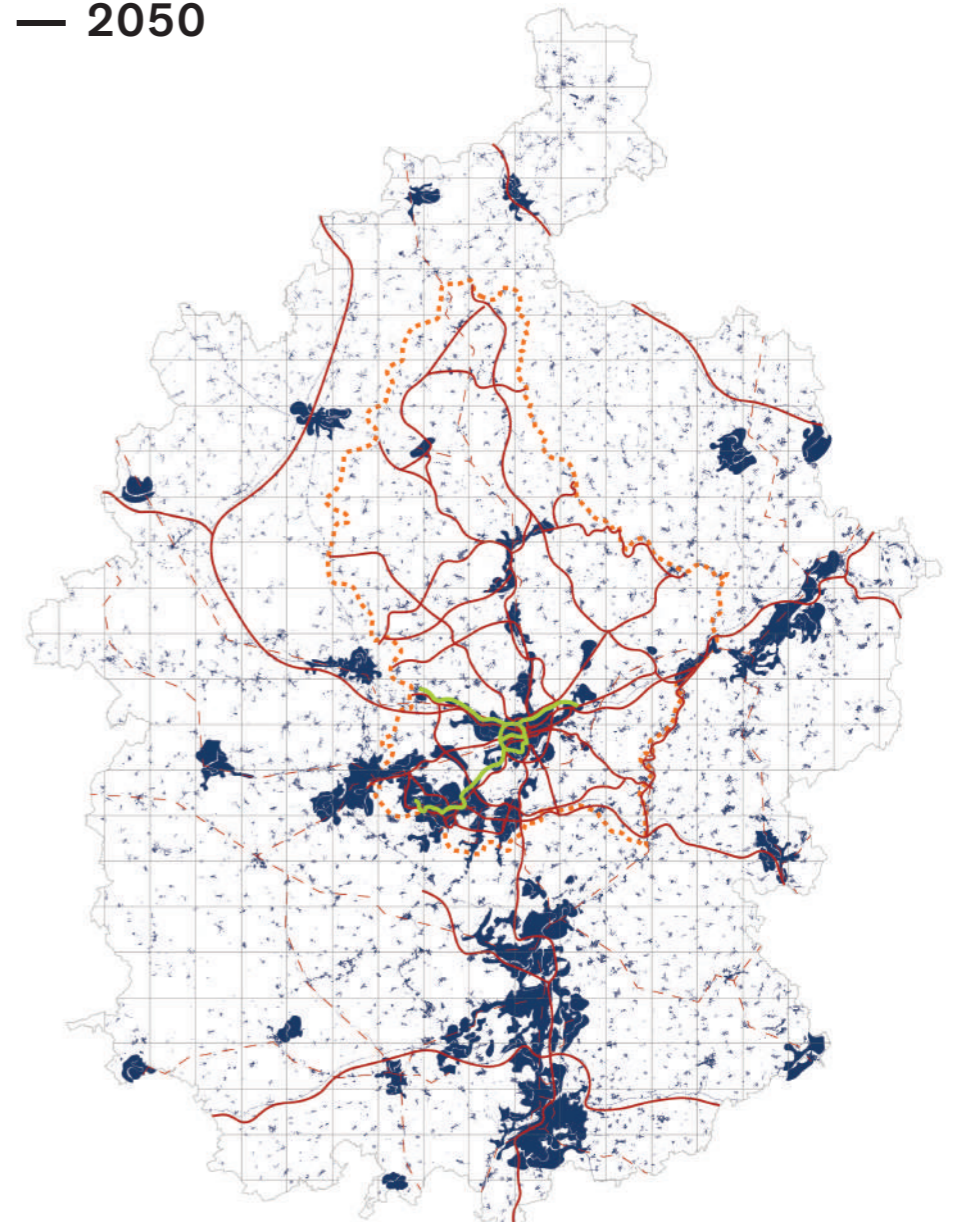
— 1990: Although 2050 seems very far away—and reassures many that ecological concerns are not that urgent—given the slowness of land development and urbanism, it is indeed a rather short period of time for the transition. It will be more disruptive than soft-landing in many respects. Before looking at possible futures for 2050, it is worth looking back 30 years and reviewing what this territory was like then, and, hence, how it has changed already. Luxembourg country counted 384,000 inhabitants, the yearly demographic growth was about 1,3 %, or 5,100 new inhabitants per year. Annual economic growth was 10,4 % and the number of jobs 211,000 (in 1995). In 1985, there were only 17,000 cross-border commuters increasing to over 100,000 in 2001 (52,000 from France, 27,000 from Belgium, and 14,000 from Germany). The national car fleet stood at 180,000 in 1990. GHG emissions in 1990 amounted to 12,8 Mt CO<sub>2</sub>eq with the iron and steel industry contributing 50 %. Emissions dropped to 8.78 Mt CO<sub>2</sub>eq in 1998 (5 % from iron and steel), peaking at 13.3 Mt CO<sub>2</sub>eq in 2005. The amount of land classed as artificial or sealed was about 220 km<sup>2</sup>, agriculture about 158 km<sup>2</sup> and woods about 117 km<sup>2</sup>. About 60% of forest trees were undamaged.

— 2020



— 2021: Today, we are able to witness how this territory has developed over the last 30 years. Luxembourg country counts more than 600,000 inhabitants, the yearly demographic growth is about 2 %, or roughly 13,000 new inhabitants per year. Economic growth was 2,3 % in 2019 and the number of jobs counts 477,000. There are more than 200,000 daily commuters (100,000 from France, 50,000 from Belgium, and 50,000 from Germany), 430,000 cars, 10,5 Mt CO<sub>2</sub>eq. emissions. The surface used by agriculture is about 148 km<sup>2</sup> and the surface covered by woods about 118 km<sup>2</sup>. Sealed or artificial land is now 285 km<sup>2</sup>, while an additional 1 ha of open landscape is sealed every single day. The land consumption for built areas has been almost linear from 1972 to 2019. Related to this serious obstruction of the landscape, forest health declined dramatically with only 13 % undamaged trees in forests. The figures demonstrate that the development in Luxembourg is by no means heading towards a sustainable future if the chosen path is continued. We are therefore at a crossroads today—let's take the situation seriously! Do we really want to aim at maintaining the growth path that alone keeps the comfortable social systems in place?

— 2050



— 2050: The smart growth scenario continues on the path of More is More—an increase in GDP growth, an increase in jobs, an increase in population growth, an increase in tax revenue, and an increase in daily commuters. Many hope that this business model will be compatible with environmental premises. Such model would entail that this growth is made greener and fueled by technological development, including e-mobility, smart cities and buildings that use resources and energy more efficiently and feed on renewable energy, with a transformation of the steel and concrete industry that makes these materials green and recyclable, with vertical gardening and aquaponics that seal less precious land while increasing local production of vegetables and fruits. Although we find many of these achievements positive, we can already foresee that, firstly, such smart-growth scenario will continue to seal land even with a higher building density and, secondly, that the social gaps will continue to widen as less privileged people will move further into the hinterland and, accordingly, commuting activities will intensify further. Therefore, we plea for a paradigmatic turn.

**RCP 2.6 / +0.9°C**  
**Budapest, Hungary**

**RCP4.5 / +1.7°C**  
**Vienna, Austria**

**RCP8.5 / +3.0°C**  
**Milano, Italy**

## Höllensbild: 2100

The 2018 Special Report on Global Warming, published by the UN's Intergovernmental Panel on Climate Change, states that global annual greenhouse gas (GHG) emissions must halve by 2030 and reach net zero by 2050, in order to limit global warming to 1.5 °C (RCP 2.6) and thus prevent disastrous impact of climate change on our planet. However today, global GHG emissions continue increasing, such that GHG concentrations are on track to follow the RCP8.5 scenario. Without a drastic reduction in GHG emissions, Luxembourg will experience warmer winters with more flooding and hotter, dryer summers with more frequent droughts. The negative effects on biodiversity and agricultural production will be severe. Recent research results by team member Jürgen Junk show that for Luxembourg the frequency, as well as the intensity, of future heat waves will increase significantly, with more extraordinary heat waves expected than for London or Rome. As buildings and sealed surfaces absorb more heat than their surroundings, urban areas become "islands" of higher temperatures with negative health effects. Thus, the ultimate goal of spatial planning, urban design and architecture is the reduction of GHG emissions as well as the reduction of the urban heat islands.



## — Less is More Postulates

**More than a century ago, Ludwig Mies van der Rohe coined the term “Less is More”—the slogan of modernism that understood less formal and material expenditure as more beneficial for the built environment. We elevate this claim to the basic principle of the socio-ecological transition: only a severe reduction in materials and commuting mobility—or in resources and energy—promises a substantial decrease in greenhouse gas emissions. This would result in more ecological and social resilience, in more biodiversity and spatial justice, and—most of all—in more time and space for the transition itself. Our report demonstrates that sufficiency, rather than reducing, increases the quality of life. But especially in terms of mobility, sufficiency becomes only possible if the separation of the most fundamental functions such as living, working, commerce and leisure is overcome. The functional consolidation requires a fundamental turn in the realm of spatial planning, urban design, and architecture. This rationale is the essential thread of our prospect, which is sketched upon nine claims of “Less is more.”**

## Less Emissions More Resilience

First and foremost, our project leads step by step to a substantial reduction of greenhouse gases. However, parallel to decarbonisation, our project aims at more ecological and social resilience: better air and water quality, more time, health and safety, more functional and social diversity, more healthy and rich nutrition, more proximity to nature, more space for creativity. And it prepares the territory better for the impacts of climate change.

As we demonstrate in our proposal, this kind of reduction is possible by 2050, if we start now. And it comes with many co-benefits. Shifting away from fossil fuels reduces particulate matter and nitrogen dioxide emissions, which together contribute to more than 400,000 premature deaths in the EU. The reduction in emissions will be accomplished through a shift away from fossil fuels but also a reduction in energy demand. The best energy is the one not used. In addition, this reduction in emissions is accompanied by an ambitious strategy for carbon uptake through soils and re-naturalisation and afforestation of agricultural and built areas. Combined, the decarbonisation and carbon sequestration strategies significantly improve biodiversity in the functional area. Hedges along fields and riparian buffers along streams produce a network of biodiversity corridors that connects forests and protected areas. In cities, green roofs will be deployed to combat the urban heat island effect and increase resilience to the expected impacts of climate change that are already occurring. The improvements in air and water quality and large increase in green areas and options for recreation increase life satisfaction, and the required lifestyle changes come with opportunities for innovation and jobs in local economies. Less emissions thus does not mean less of everything.

## Less Sealed Soil More Biodiversity

Although our project is capable of accommodating the population growth projected by Statec, as of now we are not sealing additional soil in the aggregate. The realization of new housing surface will only be achieved by transforming what is already there. Less than no net land take means improving soil health to store carbon and support micro-organisms, plants, trees, and animals. It also means preventing and reducing heat islands and keeping urban spaces viable.

While growing cities traditionally expand at the expense of agricultural land, contemporary urban planning focuses on inner densification, i.e. the development of currently undeveloped but buildable land within the urban perimeter. In Luxembourg, between 50,000 and 80,000 dwellings could be produced by developing land that is eligible for construction. However, because there are no effective instruments such as *Baugebote* or real land taxes to stimulate the mobilisation of these sites, small as well as larger cities are growing more and more on greenfields. In Luxembourg, one hectare of land is sealed every day. However, as the containment of heat islands is one of the most important tasks in terms of urban resilience, every single undeveloped patch of unsealed soil in the city is valuable. Our approach is to neither convert farmland around the city into building land, nor to develop buildable land in the city. The latter should be immediately converted into non-development land and turned into cultivation and green recreational areas. Land owners can be compensated with land on Brownfields to be developed. This will also enhance biodiversity in the city. Every hectare of arable land that is sealed removes the potential of that land to sequester 4 t CO<sub>2</sub>eq/year and all of the biodiversity that could be contained in it now or in the future.

## Less Monocentrism More Spatial Justice

Contrary to the current monocentric but diffuse development of the functional area, our project intends a more polycentric concentration of demographic growth to strengthen more evenly the urbanities across the national borders. By going hand-in-hand with a fair cross-border taxation policy, the emerging urban archipelago will ensure spatial justice in the functional area as a whole.

Due to the uneven economic growth of Luxembourg, whose capital concentrates most of the jobs in the region, a monocentric but highly diffuse development is occurring. Villages, suburbs, cities—all are currently growing more or less equally, turning villages into small towns and small towns into towns, without generating urbanity. This inevitably increases people's individual mobility, because housing on the one hand and work, retail, cultural offers and supply on the other, are becoming more and more spatially separated from each other. With the 2016 national planning guideline "Qualitative Wuesstum," the Luxembourg government aims to concentrate population growth in three agglomerations. But since the budget of Luxembourg's municipalities is linked to their growth and they have relative planning autonomy, uncontrolled growth will continue. To make matters worse, the border areas are growing particularly fast because of the high land prices in Luxembourg. Most residents of these areas commute daily from these municipalities to work in Luxembourg, where they pay their taxes, but at the same time benefit from many social services close to their homes, which the public authorities in the respective municipalities have to finance from other revenues. Our project now envisages distributing the growth firstly among existing towns with more than 10,000 inhabitants as well as commercial areas to be transformed. Through an even distribution within a polycentric structure, the public transport system can also be better organised. A fair tax policy will lead to equitable cities and citizens in the region.

## Less Mobility More Quality of Life

Despite this polycentric structure, our project foresees a significant reduction in mobility, which will not only succeed in decarbonisation, but will also deliver individuals a better quality of life. Mobility itself will become less necessary—and when it occurs, it will be perceived again as an expression of freedom rather than a forced commute to be endured by the masses.

Although our proposal is to build a network of light-rail trains on existing fossil infrastructures and thus weave the various city islands together into an urban archipelago, our main goal is to reduce all mobility next to this shift in transport mode away from fossil fuels. For the most part, mobility is no longer an expression of freedom in the functional space of Luxembourg, but a necessity for the population to organise their lives. On average, people here spend 90 minutes per day in their cars to go to work, go shopping or take their children to school. This not only has devastating effects on the environment—3 t CO<sub>2</sub>eq and 11 kg particulate matter emissions per capita and year—but also psychological effects both on those who struggle through the numerous traffic jams and for those who live near the fossil infrastructures and have to live with the noise and poor air quality. A reduction in necessary mobility is therefore a gain in quality of life for everyone in terms of more time for family and leisure and a quieter, greener and more secure neighbourhood. Luxembourg has the highest share of teleworkable employment in the EU at 54%.<sup>1</sup> With co-working spaces, this share could be increased. However, there is still one fourth of workers who will still need to travel to work. They will now be able to use a multimodal network of soft and public transport, or commute using shared cars on uncongested infrastructures. Alongside this necessary mobility, hedonistic, local and regional mobility will become more intensive.

## Less Fragmentation More Proximity

Less mobility will be achieved in suburban and urban areas by radically mixing functions. People will less need to commute to work, shop, or take their children to school, because the most fundamental functions will be within walking distance from their homes. In rural areas, the provision of products and services itself, rather than the people, will become mobile.

The functionalist planning ideology in combination with Luxembourg's economic development policy has made Luxembourg the most fragmented country in Europe. On the one hand, instead of producing affordable housing in the cities, the focus has been on the construction of tertiary areas, and on the other, car-friendly commercial and industrial areas as well as shopping centres are still being built today, while people are increasingly pushed to live in suburban and rural areas. One of the main goals of our project is to bring together the essential functions—housing, working and providing for oneself within walking distance in the city. This requires, first of all, a massive production of affordable housing in the cities, which as a broad offer meets the needs of a rapidly changing society. This also requires the systematic integration of co-working spaces into existing and new residential complexes, as well as the conversion of the many office buildings that have lain derelict since the pandemic into hybrid buildings. And this requires the radical conversion of monofunctional commercial and industrial areas into mixed-use urban neighbourhoods, which will also benefit the ground-floor functions of existing cities. In rural areas, mobility to places of supply will give way to mobility of supply. Villages and small towns will also provide co-working spaces for the population and bundle supply as networks covering the basic needs of their inhabitants.

## Less Space for Cars More Space for Life

Less mobility will result in fewer cars. As a consequence, relicts of the fossil age such as highways, roads, parking lots, gas stations, and parking garages will be reused for the densification and diversification of cities, for new co-working spaces, new housing typologies, alternative commerce, transition hubs. Post-Fossil spaces will become counterspaces for the transition.

Many different surfaces and spaces were built for the automobile in the 20th century. Many of these spaces, such as parking lots or garages, are located in cities whose public space is still dominated by the automobile—a situation that is currently changing in many cities such as Paris, Berlin and Barcelona. Other such spaces, such as motorways or fast roads, are cutting up landscapes with all the consequences for biodiversity. This is a gigantic reservoir available for the transformation of our cities and landscapes when the automobile no longer exists in its present form. In Differdange alone, there are garages covering a total area of 15 hectares. Our prospectus now envisages using these fossil spaces in cities as well as in mono-functional zones as a substructure for their densification and intermixing. Garages are converted into workshops, offices and shops; high-rise garages are converted into co-working spaces, daycare centres and for other uses. Garage parks, which are usually single-storey, can also be overbuilt; petrol station roofs can cover markets. The possibilities for using the spaces for life instead for cars are endless. Every major social change needs (counter)spaces to unfold. Our decarbonisation strategies make it possible to open up these spaces for development.

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## Less Feed More Food

The primary goal of the agro-ecological turn is to reduce meat consumption and by that, disproportional use of arable land for feed production. In our project, this land will be used for organic production of a more diversified range of food rather than feed crops. This increases carbon uptake and biodiversity and simultaneously the well-being and health of people.

Agriculture is a direct source of GHG emissions. Even if we decarbonise electricity and cease using fossil fuels, agriculture would still emit GHGs in the form of methane, nitrous oxide and CO<sub>2</sub> from enteric fermentation, manure management, and soil management (tillage). Fertilizer application in agriculture is also the main source of nitrogen and phosphorous emissions in rivers, which leads to eutrophication or harmful algal blooms referred to as dead zones. Pesticides can have harmful effects on off-target organisms. Multiple, far-reaching changes in agricultural production are needed to reduce these environmental impacts. In particular, reduced tillage, cover crops, and diverse crop rotations reduce nutrient runoff and associated eutrophication and also improve soil health and carbon uptake. Together with a reduction in the use of synthetic pesticides, these changes constitute a shift towards 100% organic or rather more accurately “agro-ecological” or “regenerative” production. Agricultural land will be mainly used for the production of food, including by participative cooperatives to ensure shorter, regional supply chains despite the increasing population. These changes create a more (bio)diverse landscape, connect habitats, increase carbon uptake, all while increasing food sovereignty through raising awareness of people for locally produced food with verifiable added value in terms of social well-being, environmental integrity, economic resilience and fair governance.

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## Less Waste More Re-use

In the areas of food, building and consumption, our proposal is about substantially reducing waste: No longer throwing away food but using or composting it, no longer letting water go to waste, no longer demolishing buildings but only transforming them. Sufficiency means fewer consumer goods and fewer materials that remain in cycles through more repairing, up- and recycling.

Although many measures have been implemented in the last decades to generate less waste and an awareness of resource consumption has arisen in large parts of the population, we all remain gigantic wastemakers, as Vance Packard already called the people of the consumer society in 1960. With “Zero Offall Lëtzebuerg”, the government has presented an ambitious strategy to completely cut down on waste. We have already proven in the first report that avoiding waste in relation to food products has a huge impact on decarbonisation. Another important area is the building sector. In architectural discourse, an attitude has emerged with the New Realism to generate more uses with fewer materials in the Miesian sense. This year’s Pritzker Prize winners Anne Lacaton and Jean-Philippe Vassal, among others, show how this attitude leads to exciting architecture. Our approach of zero net land take and the transformation of the existing building stock means that, on the one hand, no more excavations are undertaken and, on the other hand, significantly less construction waste is created than through demolition. Firstly, new buildings should be designed in such a way that they can be reused and only built with upcyclable and recyclable materials. This fulfils two of the triple zero strategy in the building sector—zero grey energy, zero CO<sub>2</sub> emissions, zero waste. Finally, our project is about bringing the renaissance of repairing even more to fruition, so that it no longer necessitates the discarding of consumer goods.

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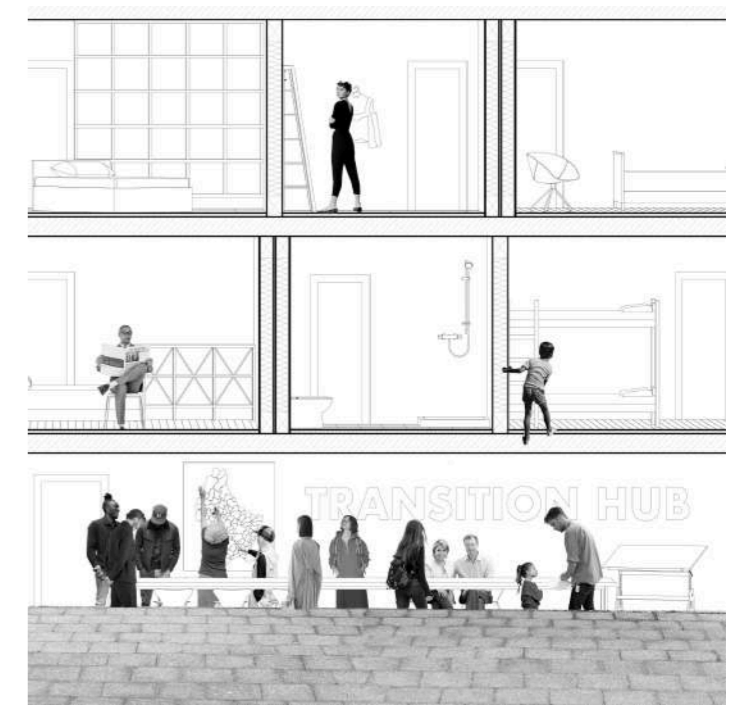
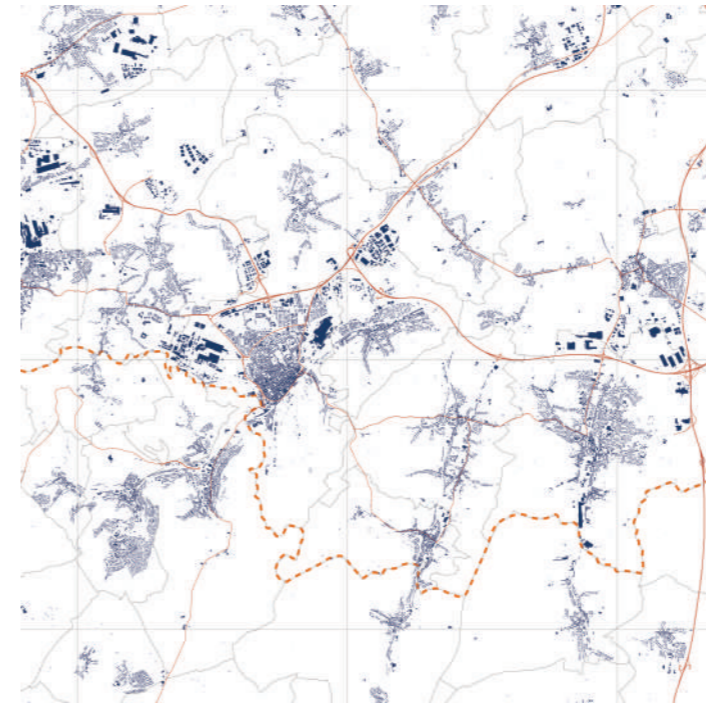
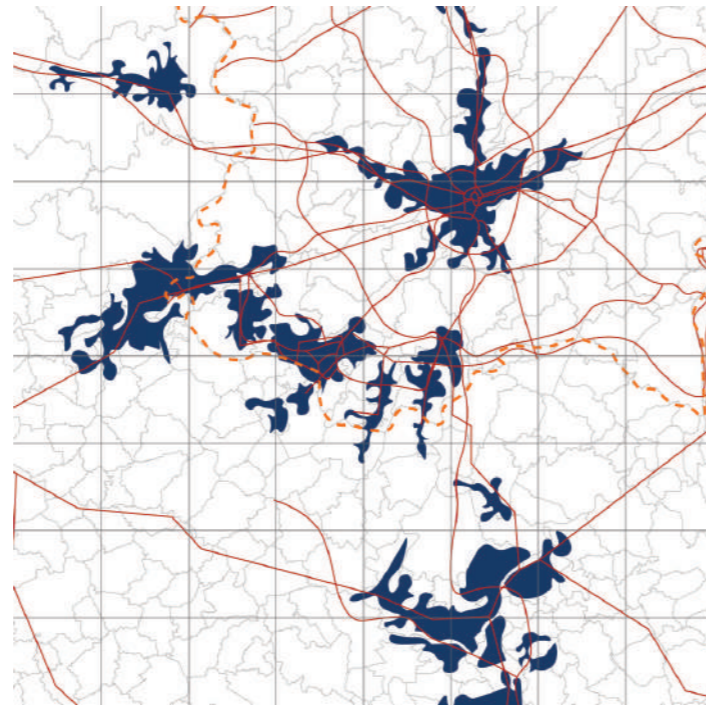
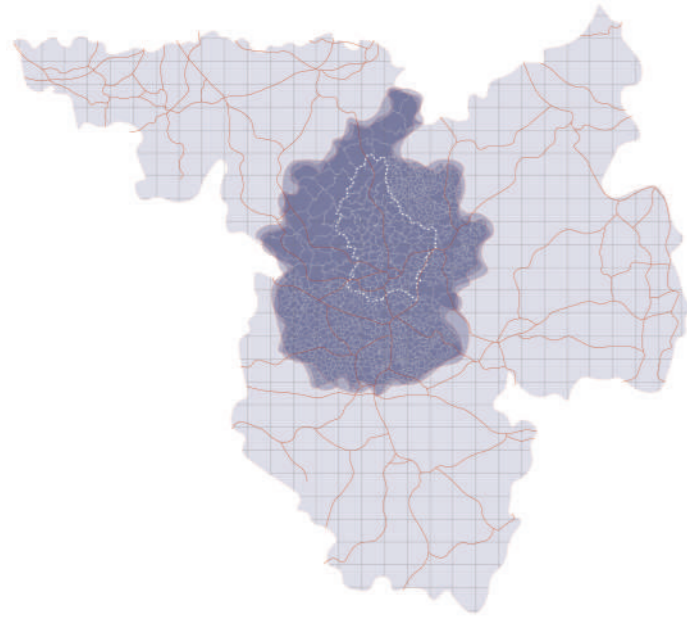
## Less Top-Down More Co-Creation

Last but not least, our entire project in particular and the transition in general can only be implemented in a democracy if the largest possible majority of the population participates. This will only be the case if many top-down practices are replaced by more co-creation. That is, if the population is given more responsibility, more self-determination and more processes of action.

Our democracies are grounded on a representative electoral system based on a delegation of power to the elected people who make laws and make them enter into force. The gap is growing between top-down decisions that follow a predetermined program and may appear disconnected from the priorities of the needs, vision, wishes of the citizen. New governance systems need to be developed in order to share responsibility on the world we live in through different decision-making processes while using co-creative methods to design our future. In the light of complex challenges such as decarbonisation and resilience, reforming our institutions (from the municipal level, through national and regional assemblies up to the Greater Region’s processes) is necessary in order to bring in more agility of system to cope with change. Moreover, strategic steps should be undertaken in Luxembourg in terms of governmentality: A public land and housing policy more common good oriented; the introduction of concept allocation or *Konzeptvergabe* in the development process; better equipping the municipalities in terms of personnel and finances, but also the introduction of independent expertise at the top of the city management—Luxembourg needs professionally arguing politically independent urbanists. Finally, the legal instruments and regulations have to be substantially simplified.

## — Multiple Scales

**As anthropologist Anna Tsing noted, “scale is not just a neutral frame for viewing the world” and that, instead, as “the spatial dimensionality necessary for a particular kind of view,” scale “must be brought into being: proposed, practiced, and evaded, as well as taken for granted.”<sup>2</sup> Starting from here, we might ask—what is the scale of Luxembourg’s ecological transition? As a process that goes beyond mere ‘greening’ of the existing infrastructures, ecological transition must involve thinking and acting across different scales. Rethinking the relationships between humans, non-humans and the world of material objects, thus, calls for bridging (and, at times, challenging) the spatial scales of the body, house, neighbourhood, city, country, region and the world, social scales of the individual, community and society, and temporal scales of a day, week, month, year, decade and a century. This process also calls for the multiplicity of tools and spheres of knowledge used to access such complex socio-spatial issues, and that include planning and design, science and metrics, principles of transition governance and visions for future social practices.**



## Planning and Design

Our project is built on the principle of ‘scalar fluidity,’ or on what a regional politician once called ‘géométrie variable de la Grande Région.’ That is, depending on the field, purpose and granularity of an intervention, different scales will be chosen. Most frequently, we will refer to the functional area (meso-scale) Luxembourg and the surrounding border-region. In specific cases where a wider spatial context seems helpful (e.g. biodiversity and ecosystems), the scale of the entire Greater Region will be considered. At the scale of cities and local (cross-border) agglomerations (micro-scale), a zooming in will allow us to represent and analyse the respective spatialities in appropriate detail. For relational aspects going beyond the regional context (macro-scale), two different types of visualisations will be used. Flow maps will be used where appropriate and where data availability permits (e.g. CO2 export/imports). In other cases, more stylized maps or schemes will indicate transregional dependencies and flows without precisely quantifying or localising them (e.g. international train connections). This principle will apply both to the prospective metrics as well as to governance aspects of interventions and related policy recommendations.

## Metrics

The question of scale is also at the heart of our approach to metrics. Depending on the subject, we measure indicators at different scales. For example, protected areas in Luxembourg gain new meaning when placed into the context of the Greater Region, as they form or have the potential to form regional biodiversity corridors. In some cases, measurement at multiple scales uncovers several possible levels of intervention. We measure GHG emissions produced in Luxembourg, in the functional area, as well as globally when considering GHG emissions embodied in the goods and services we consume in Luxembourg. In other cases, a single scale of measurement is appropriate—when examining the transportation network available to daily commuters, we measure indicators at the level of the functional area. Occasionally, data availability or quality impedes our desire to measure indicators at a certain scale. Detailed models developed for Luxembourg might deliver less reliable results outside the territory, such as for example our model of cold-air corridors in cities or our model of rooftop photovoltaics (PV) potential or energy savings from building renovations. This report combines data from different sources to provide a decarbonisation pathway for the functional area as a whole.

## Transition Governance

‘Scalar fluidity’ is also key for playing out the potential of the participatory transition governance that needs to be developed for a sufficiently fast and broad zero carbon transition to occur. In the existing traditional governance structures, scales, together with their own set of actors and scope of actions, are administratively fixed—municipality, country, Greater Region, EU. The suggested participatory transition governance, operated through local Transition Hubs and cross-border networks of expertise, complements the traditional governance of representative democracy. As such, it enables citizens or community initiatives to explore and determine the most suitable and powerful leverage point, and hence scale, for a specific transition project they are jointly developing and implementing. This allows working with hyper-local scales (building, block, street) and scales cutting across administrative borders (e.g. neighboring municipalities across cantons or national borders, bio-regions, but also the functional area defined according to project-specific criteria rather than defined generally or statistically).

## Practices

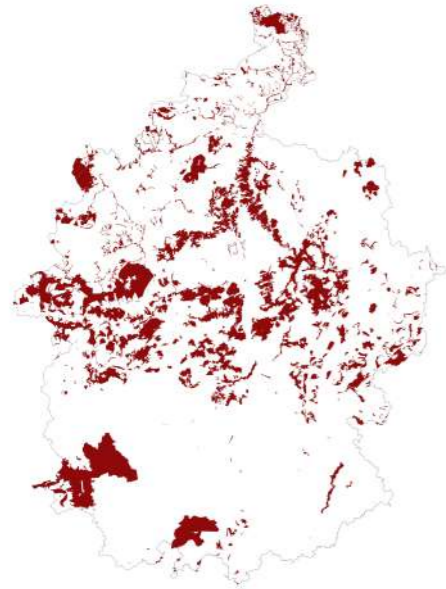
Next to participation, sustainable governance also requires re-imagining of existing practices of living, working, and leisure. Our project is anchored in a belief that ecological transition should not be imposed from above, but rather practiced across different social scales, such as those of an individual, community, and society as a whole. Going beyond mere change in the patterns of behavior and consumption, practices of ecological transition should also position values and imperatives of co-habitation, sharing, commons, care, solidarity, maintenance and repair to the forefront of the society. Such process also requires ‘scalar fluidity,’ thinking, on one side, different social scales with their spatial manifestations (scale of a body with a house or an apartment; ‘material community’ with a neighborhood or a village; ‘scattered community’ with a town or a city; society with a region, territory or the world) and on the other, with their temporal patterns (individual daily routines, weekly or monthly collective actions or and long-term planning milestones).



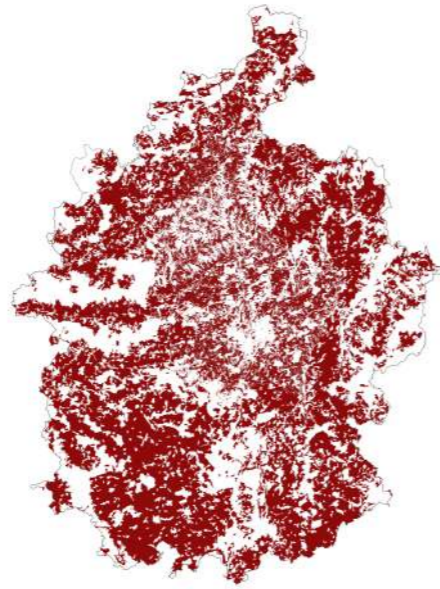
## — Multiple Potentials

**The spatialisation of our vision for Luxembourg in 2050 builds on a land suitability analysis developed to inform on the most appropriate areas for urban densification. The land suitability for a specific function or action is determined through spatial multi-factor analysis. In the case of Luxembourg and its functional area, the future population growth and where to allocate it meanwhile continuing a social resilient decarbonisation path is a major concern in our vision. In this sense, to identify the most appropriate areas where to increase urban population density according to traditional suitability factors for urban development (e.g., adequacy of the terrain slope) as well as factors representing the core principles of our vision (e.g., less than no net land take) becomes a key step to inform the spatialisation of our Regenerative City-Landscape strategy.**

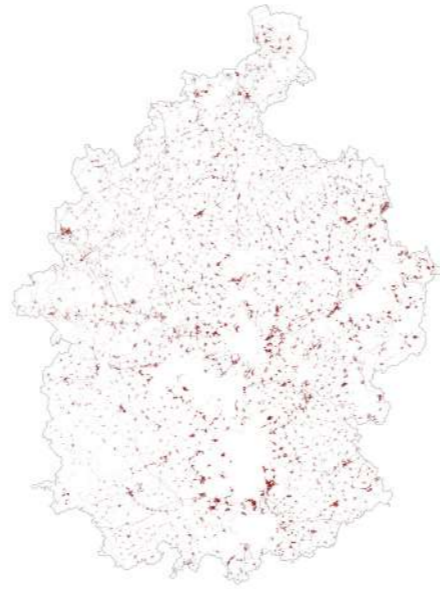
# Suitability of Land for Urban Densification



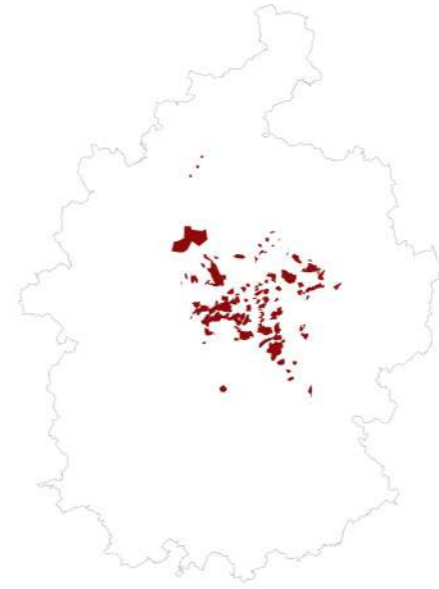
Protected Areas



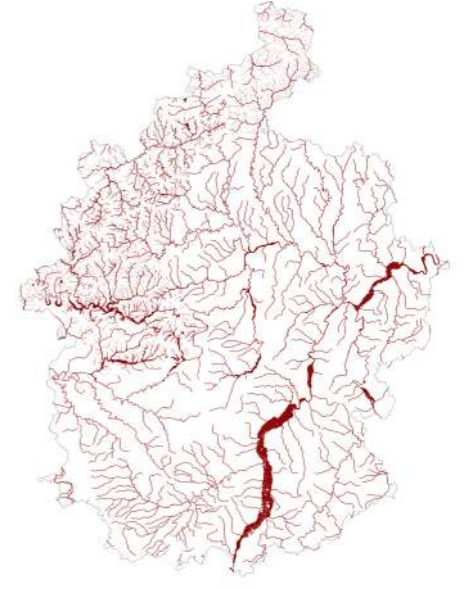
Agriculture



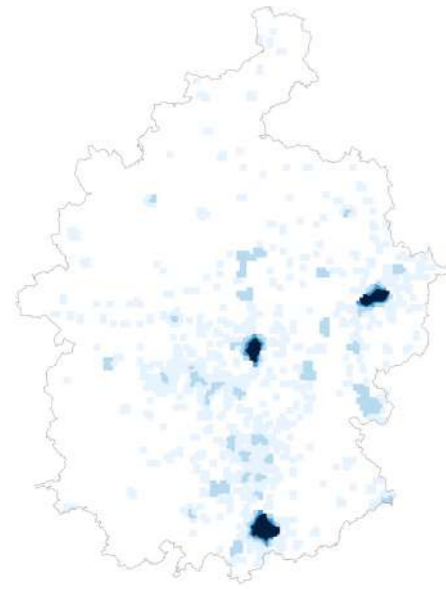
Villages



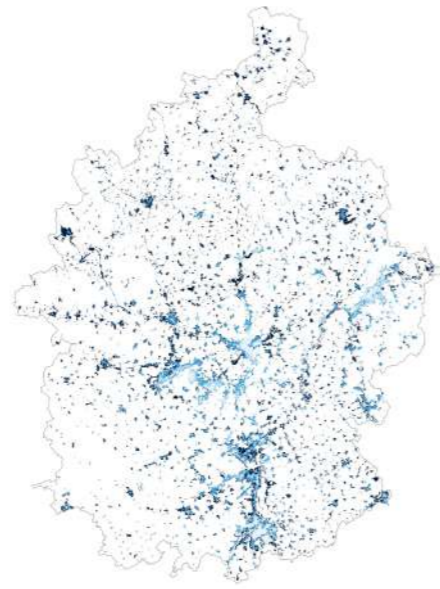
Water Safeguard Zones



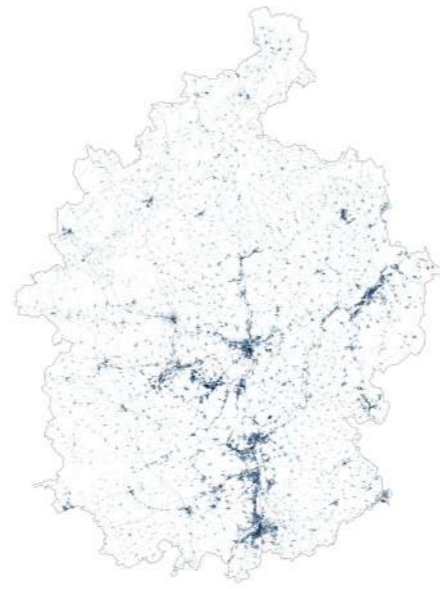
Extreme Flooding and Riparian Buffers



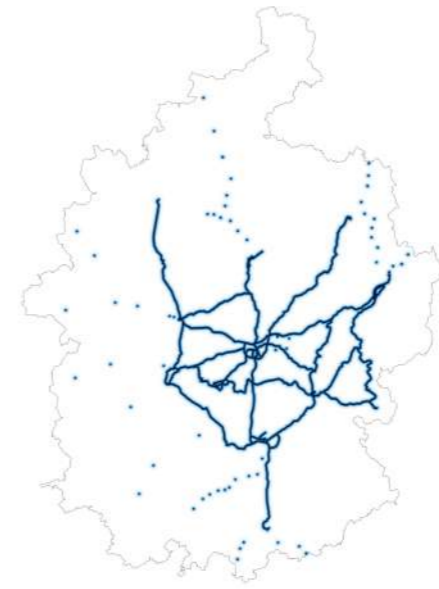
Size of Urban Areas



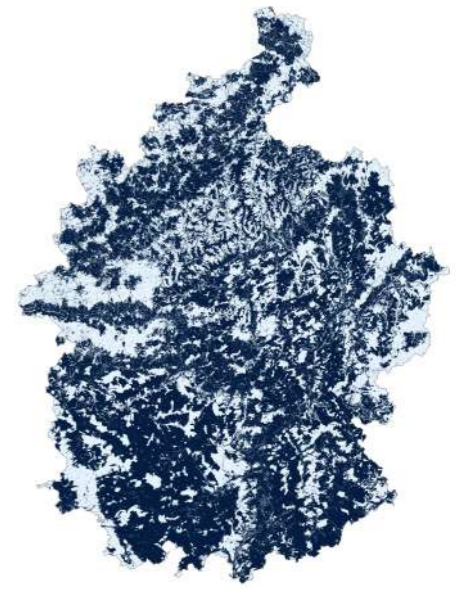
Population Density



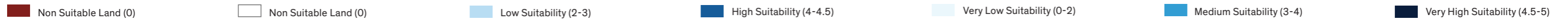
Percentage of Sealed Surface



Accessibility to Proposed Public Transport Hubs



Low Tree Cover Density



The first analysis identified the land non-suitable for urban densification due to their biophysical characteristics. Protected areas, agricultural land, villages, riparian strips along the stream network, water safeguard zones, and zones of extreme flooding risk were considered non-suitable due to their biodiversity value, relevance for clean groundwater, and to ensure zero environmental risk in regenerated urban areas.

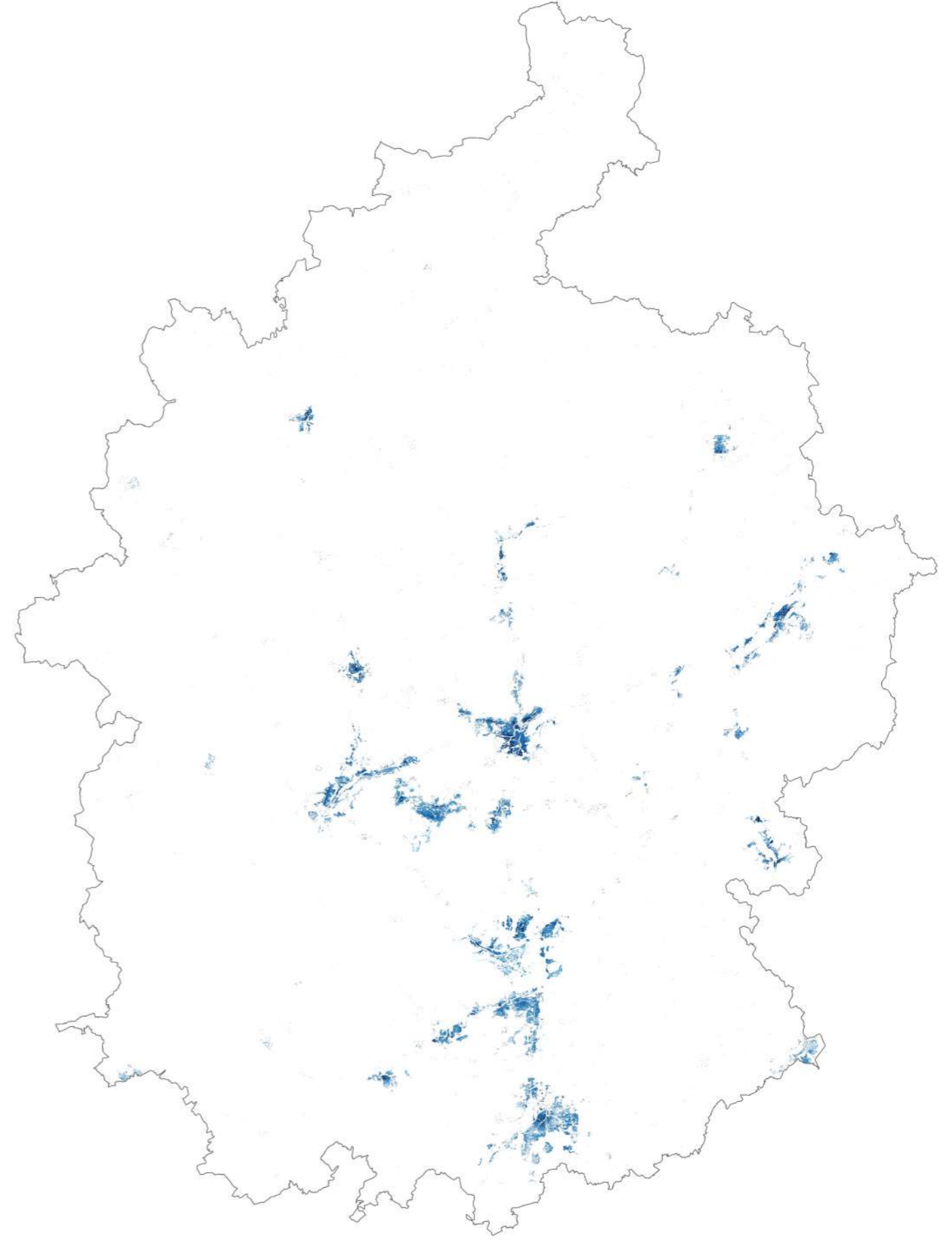
The second analysis identified suitable land according to factors representing core principles of our vision. The main factors considered were size of urban areas, population density, sealed surfaces, walking accessibility to public transport hubs (including proposed routes), and tree cover density. Large urban areas (more populated) and specific land above a minimum threshold of population density but not yet with a high population density were prioritised. Land with high percentages of sealing and already built surfaces were also prioritised. Zones close to

public transport hubs reachable by walking were prioritised to promote soft mobility and use of public transport among the population. Forested areas were assumed unsuitable due to their urban cooling value. As part of the suitability analysis, traditional suitability factors for urban development such as terrain slope, distance from protected areas and accumulative presence of protected species were also included.

The overlap of non-suitable land and the suitability for the different factors provides us with the overall suitability map for urban densification for the entire functional area of Luxembourg. The land suitability analysis is developed at a high spatial resolution, making it adequate to inform, together with specific local analysis, design actions at urban scale and not only at a large territorial scale.



Overall Non-Suitability



Overall Suitability

02 —

TRANSITION

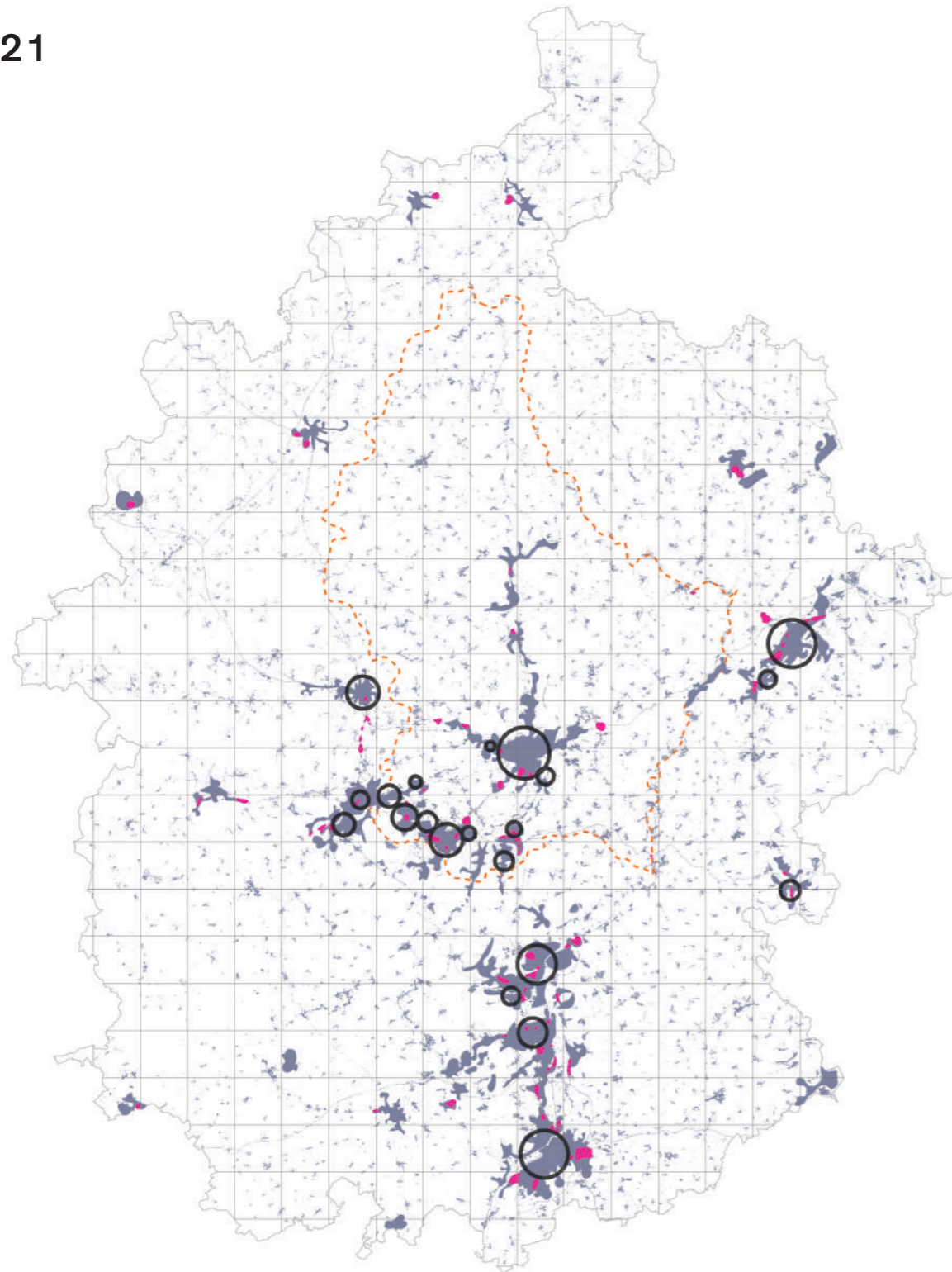
THEMES

## — Introduction

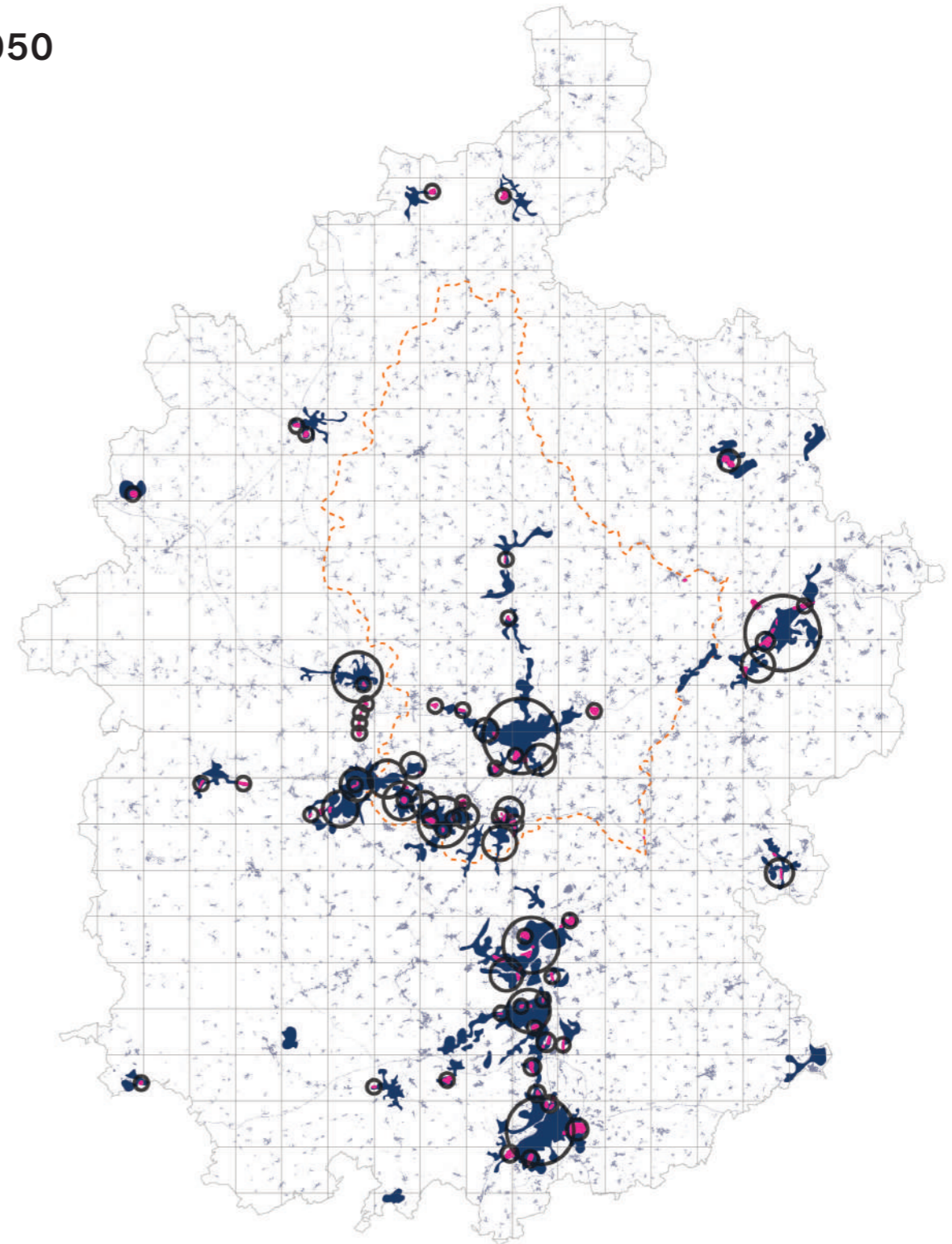
**The sectoral approach of the first stage—which focused on constructing a metric—must give way to a more integrative and contextual method in this second stage—where it is about translating this metric in space. Nevertheless, as an intermediate stage, it is necessary to unfold the strategies of the different sectors—from soil sealing to mobility, energy transition, agro-ecology, biodiversity and water—before synthesising and translating them into precise design strategies in the following chapter. In the transition to these case studies, we show a spectrum that is transversal and crucial for the socio-ecological turn: civic empowerment and the initiatives that arise from it. Planning alone, no matter how interdisciplinary, will not achieve the change without these bottom-up actions.**

# Urban Regeneration

— 2021



— 2050



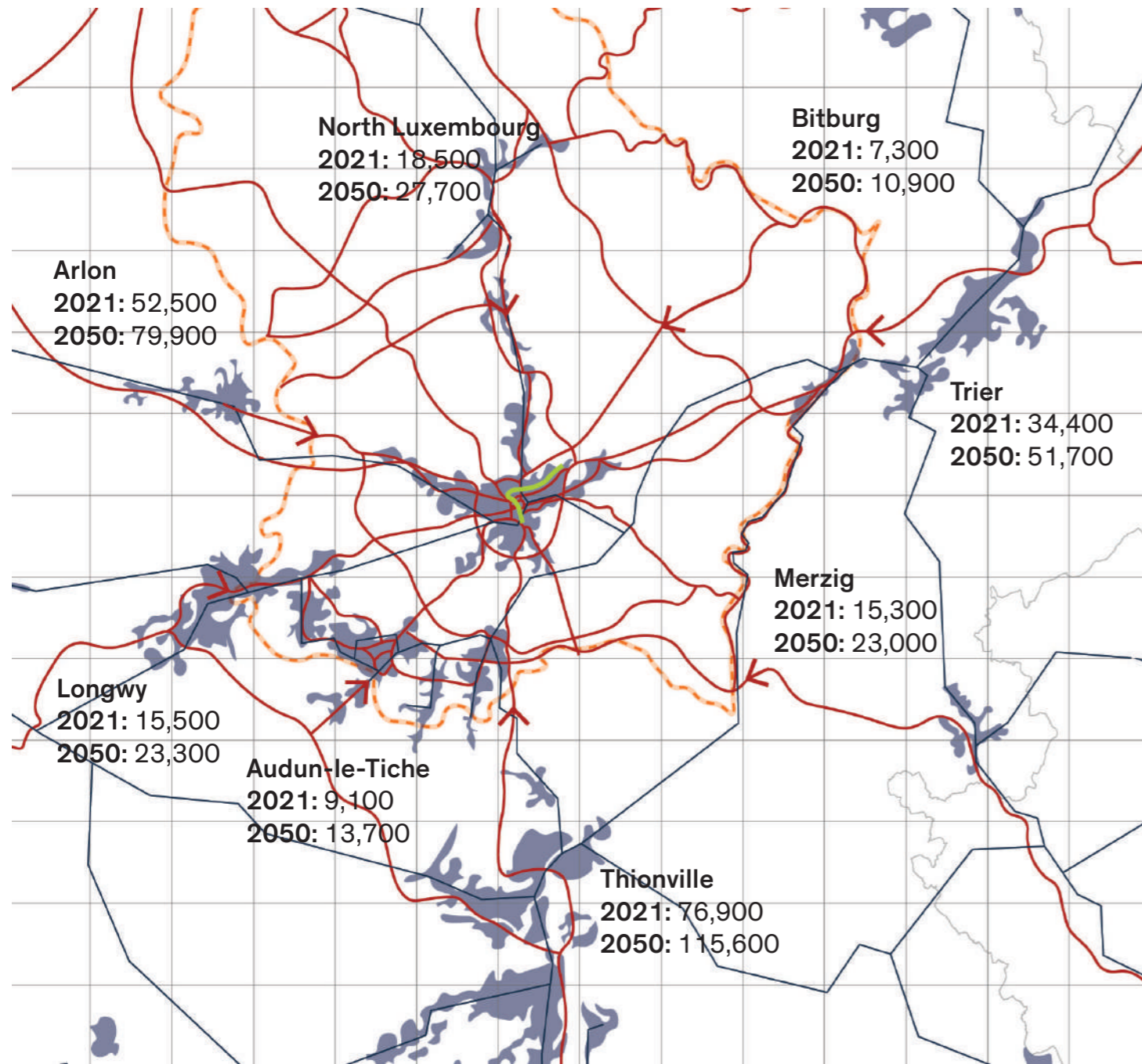
Population growth to the tune of about 10,000 new inhabitants each year has strained land and housing capacities, such that urban sprawl is progressing at a great pace: Every day, an area equivalent to a football pitch is sealed in order to prepare ground for new residential buildings and infrastructure. The map on the left illustrates (in blue) the current sealed area in relation to the population (represented in circles). In Luxembourg, there is a density of 245 inhabitants per km<sup>2</sup> compared to 65 inhabitants/km<sup>2</sup> for the functional area as a whole. Our perspective envisions starting today with the no net land take strategy proclaimed by the European Union for 2050—and not sealing any more land in total. New housing, including importantly social housing, and the complementary functions will be erected exclusively either on existing buildings or already sealed areas such as car parks or

brownfields. This “overbuilding” would be sufficient to accommodate the population growth predicted by Statec, even if this growth does not need to be targeted. According to our study, 10 % of all buildings could be overbuilt, thereby accommodating 100,000 new inhabitants in Luxembourg alone, while housing and adequate facilities for more than an additional 300,000 inhabitants could be realised on already sealed areas. Therefore, the map shown on the right is identical to the one on the left—only the circles representing the population growth increase according to the polycentric structure of our prospective. This redensification would considerably reduce the need for mobility while at the same time regenerating the cities.

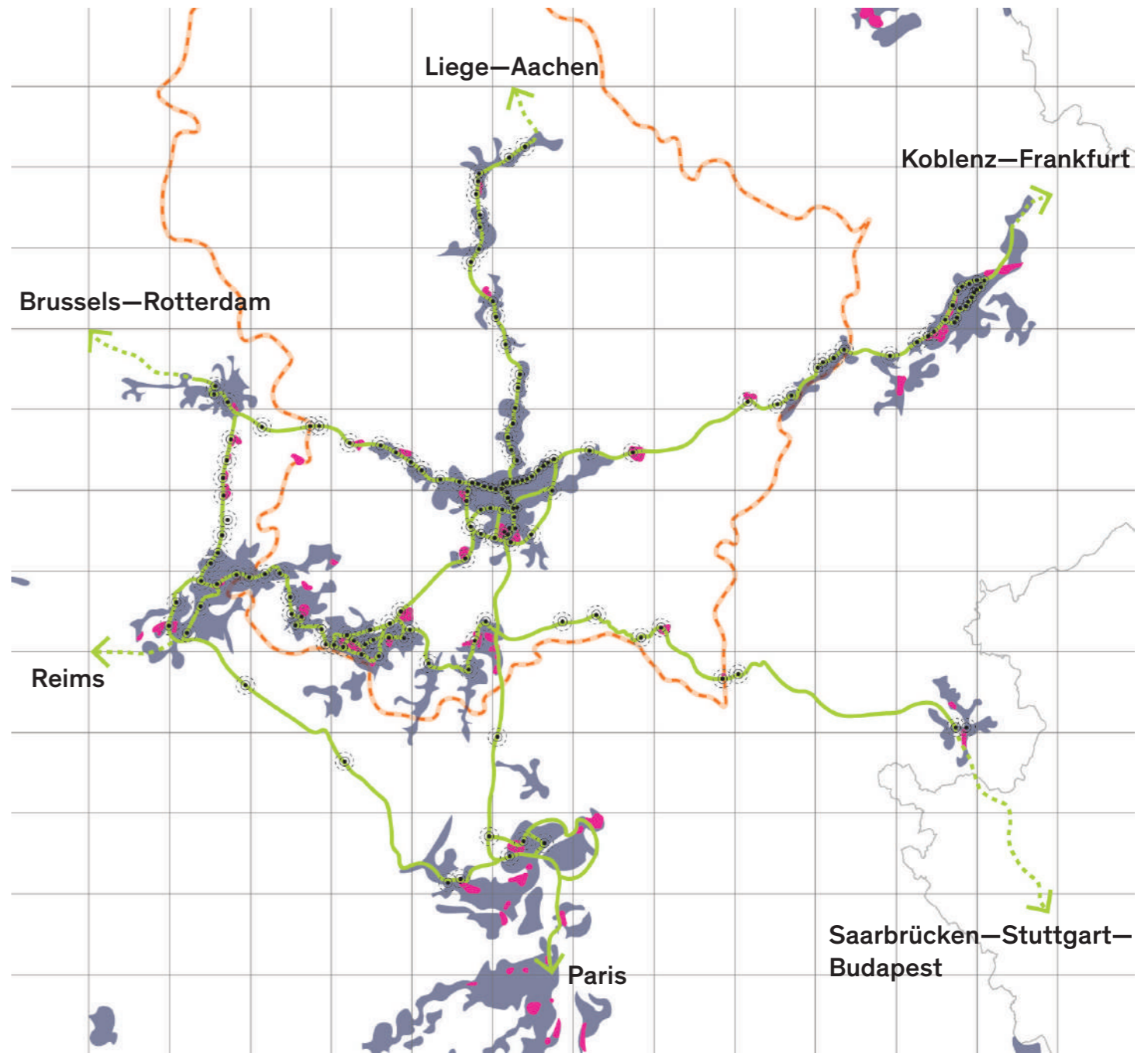


# Sustainable Mobility

— 2021



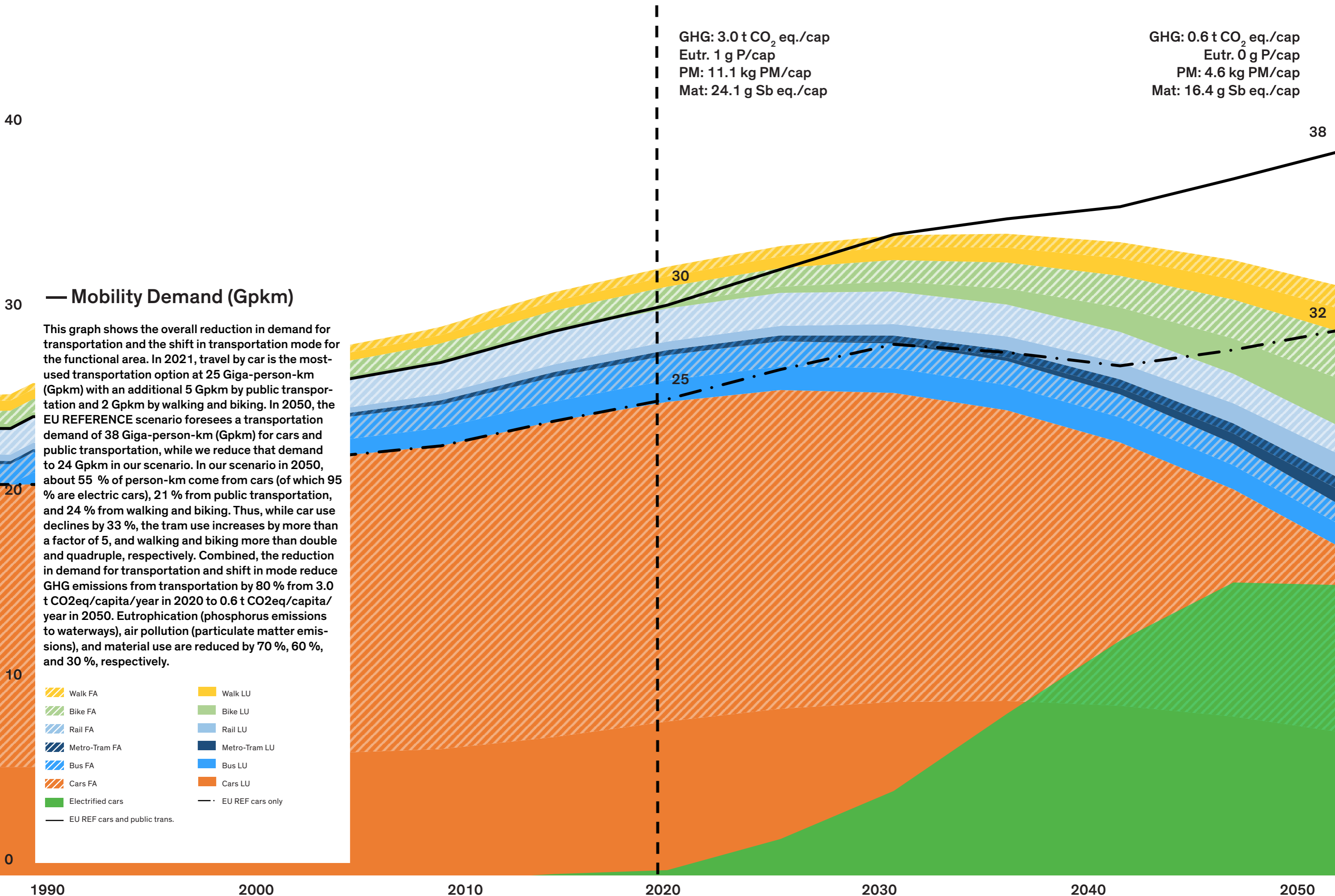
— 2050



The Luxembourg transportation system is marked by its car-centricity with 70 % of commuters opting for the car despite road congestion, since public transportation can still take longer and be overcrowded. Luxembourg residents spend on average 1h30m traveling each day, while the more than 200,000 cross-border workers spend 1h40m just on their commute. Alongside this demand for transportation by residents in Luxembourg and the Functional Area stands growing demand from the logistics sector, fuelled by the relatively lower fuel taxes and Findel Airport as a cargo hub. More than half of GHG emissions in Luxembourg come from fuel consumption for road transportation, while the shares in France and Germany are lower at 30% and 18%. Our mobility strategy consists of two main principles: reducing the demand for transportation and shifting the mode of transportation from cars to soft mobility, electric mobility (especially in a first transition phase), and public transportation. The reduction in

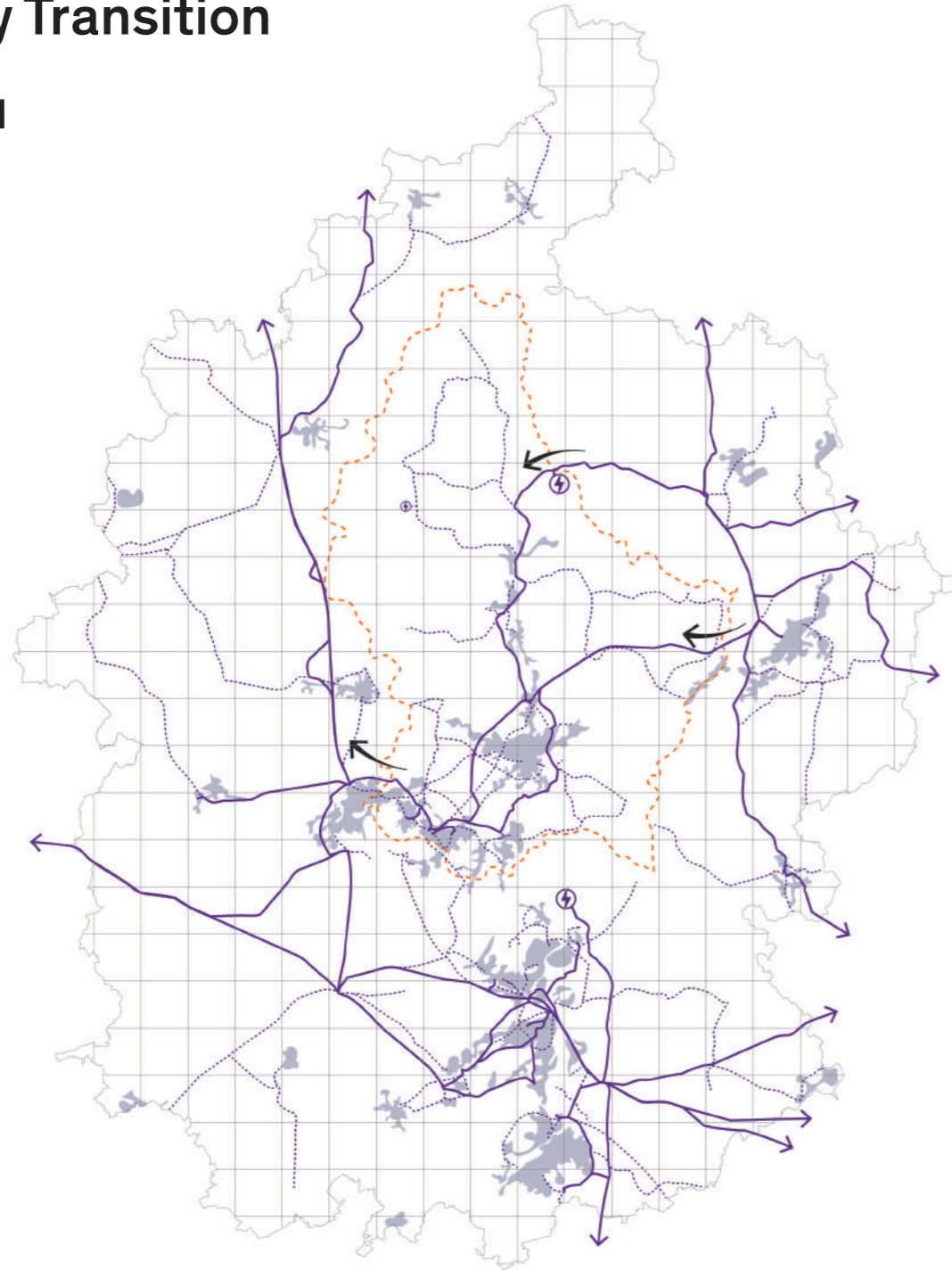
demand for transportation will be achieved through increased telework, densification, diversification and intensification of the amenities and activities in the cities. The shift in mode of transportation is supported through a variety of interventions, including improving the public transportation network, most notably the light-rail or tram network on existing heavy infrastructures and incentives for soft mobility. Combined, these measures reduce GHG emissions from transportation by 80 %. As a result, the transport system will be transformed from a monocentric figure to a web system following the polycentric development of the cities in the functional area and thus increasing—again—the spatial justice. Improving accessibility is another important tenet of our transformation of the transportation infrastructure. In redesigning the built environment, our plan includes barrier-free sidewalks and access to public transportation and streets to support social inclusion and mobility for all.





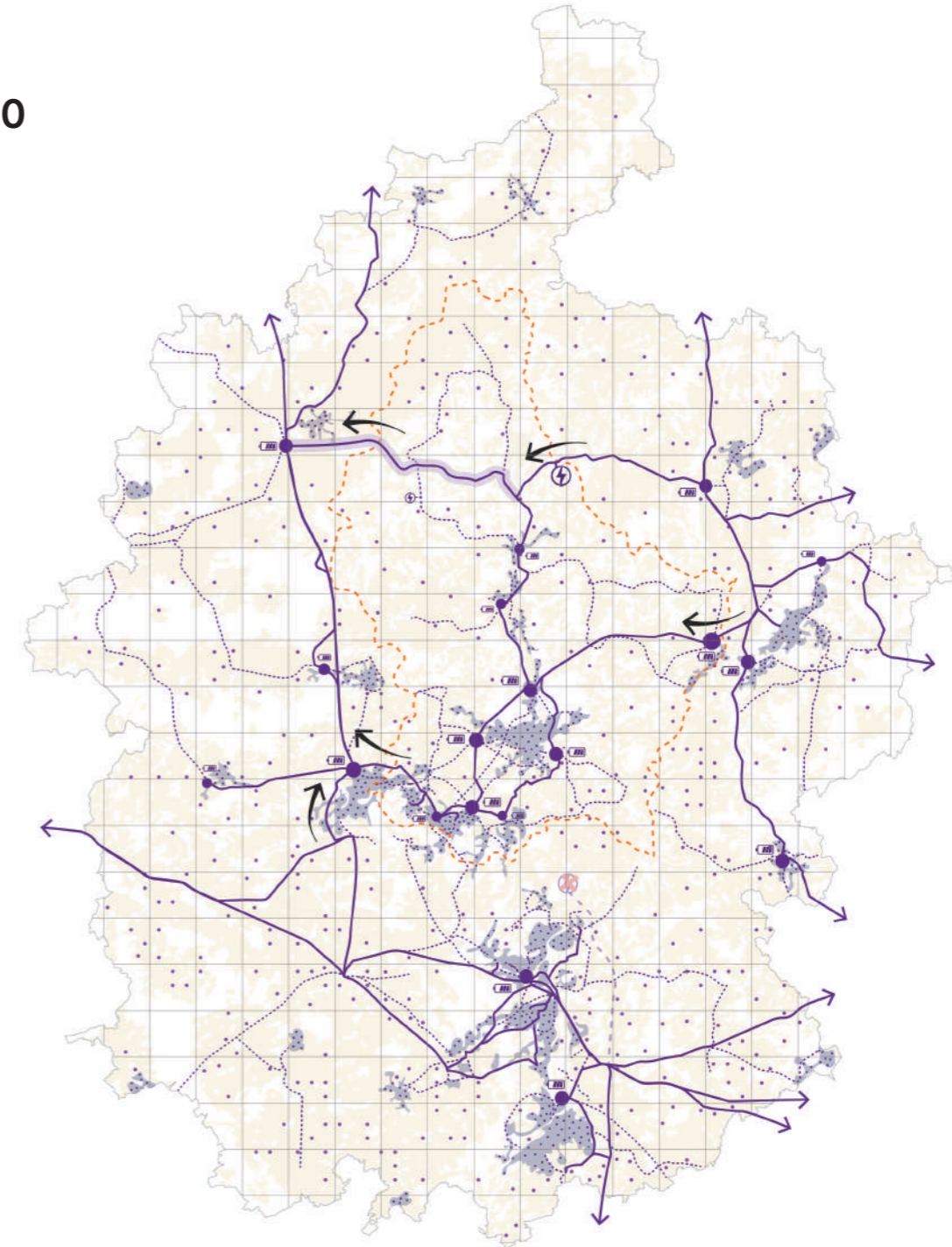
# Energy Transition

— 2021



- New Line of 380 kV
- New Line of 220 kV
- Lines above 220 kV
- Lines below 220 kV
- Agrivoltaics (5% of cropland)
- Urban Solar PV (20% of rooftops)

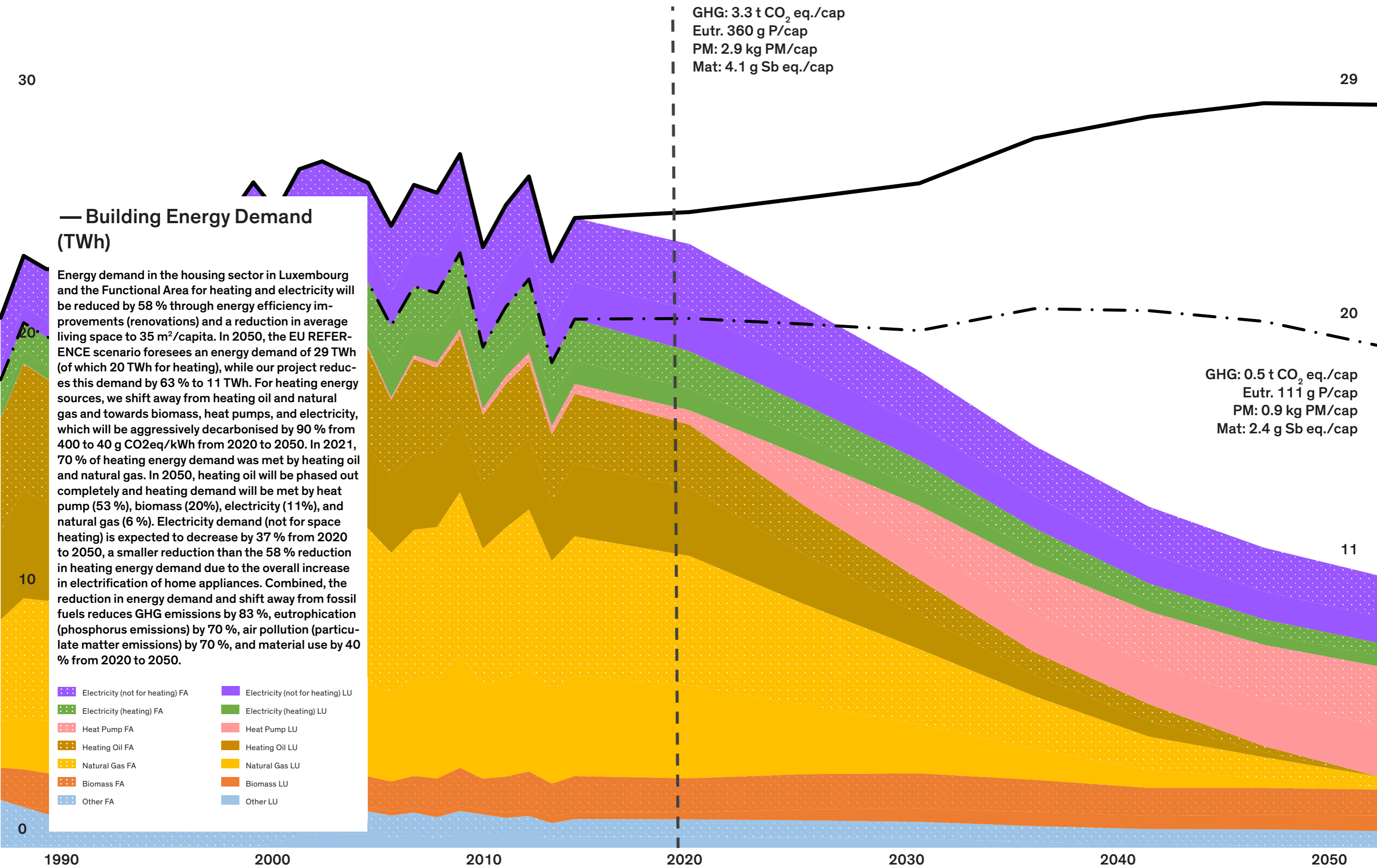
— 2050



- Additional Battery Capacity
- ⚡ Centralized Power Plants (>1GW)
- Shutdown of Nuclear Plant
- ← Net Annual Direction of Power Exchanges

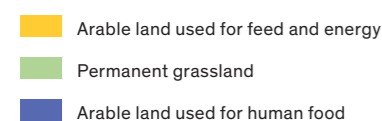
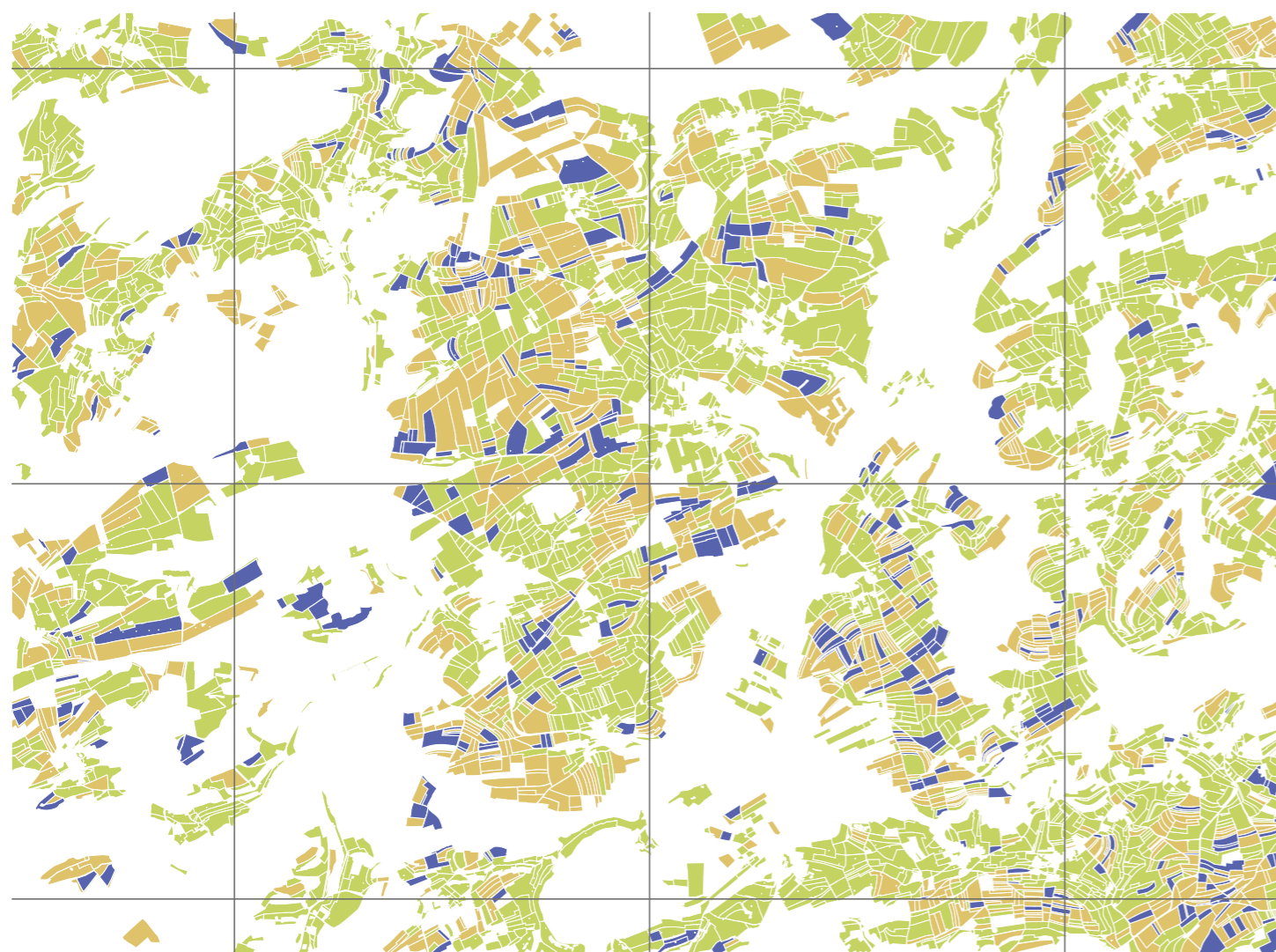
The national electricity consumption of 2020 relies heavily on imports (about 85%), mainly from Germany. As the share of intermittent, decentralized, renewable electricity will increase in all the functional area and neighbouring countries, grid reinforcement will be needed. Not only is a stronger grid necessary for Luxembourg's own consumption and supply reliability, but it also has a wider role to play, in order to facilitate electricity transfer from Germany to Belgium; the latter being the only country towards which Luxembourg exports power. Considering the various long-term energy policies of the neighbouring countries, namely the nuclear phase-out in Belgium, and aggressive renewable deployment of the German *Energiewende*, Luxembourg could contribute to (re-)exporting renewable power to its western neighbour to limit fossil gas consumption, which continues to be the medium-term

solution touted by the Belgian government to palliate the gap left by nuclear power plants' decommissioning. A new 220 kV power line will therefore be built in the North, following the existing natural gas connection, in anticipation of its conversion to hydrogen transportation and the building of electrolyzers along this route. The southernmost of the two interconnections with Germany will also be upgraded to 380 kV. By 2050 the Cattenom power plant will be decommissioned, after which higher exchanges with France may become conceivable, and can be done through Belgium. Finally, storage will be required all over the grid to accommodate the increase in distributed renewable generation and ensure flexibility—which will be achieved by deploying battery units at strategic points in the network.



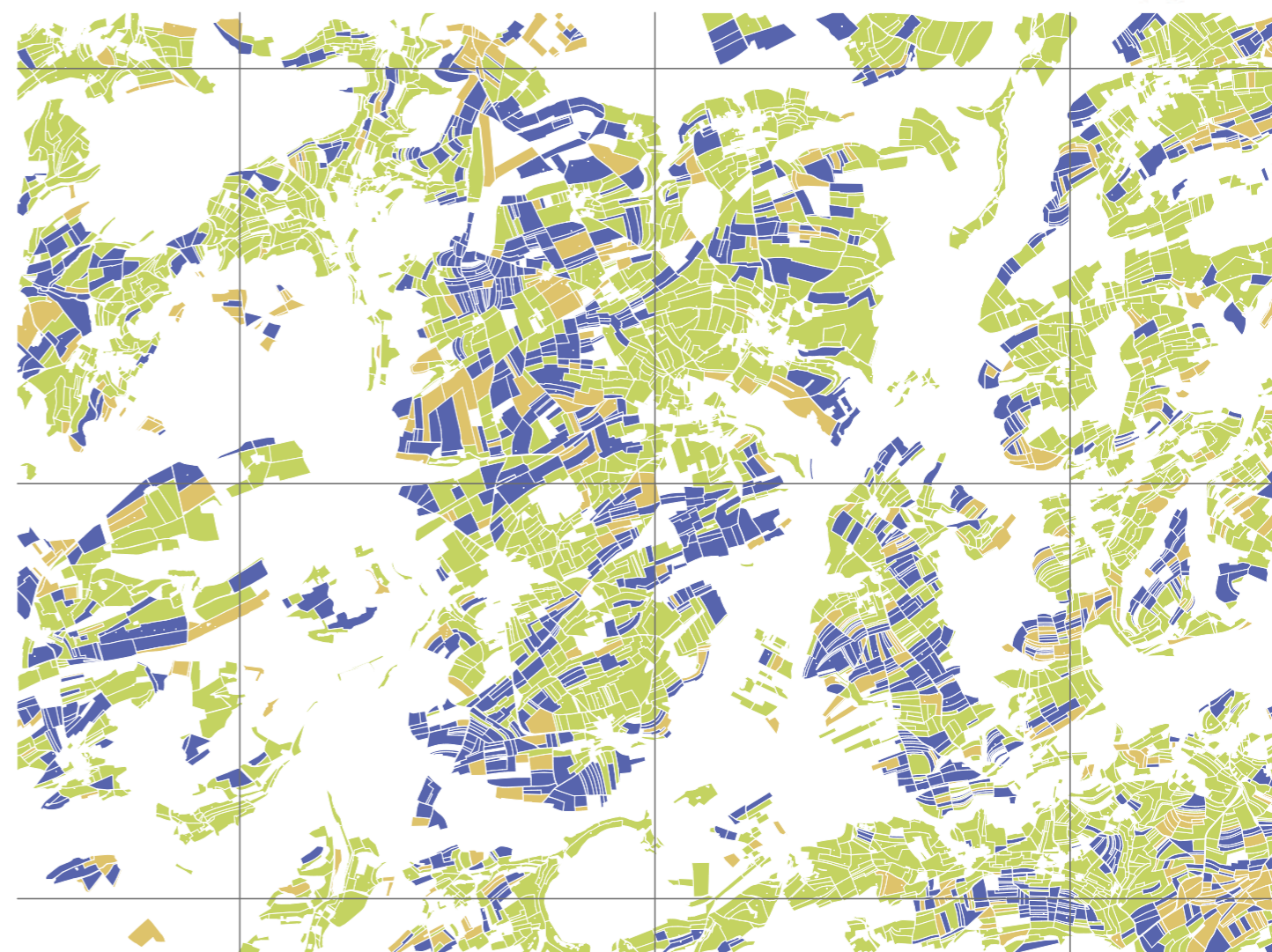
# Agro-Ecology

— 2021



The agricultural landscape is half composed of permanent grassland and half arable land. The latter has so far mainly been used for feed and energy production and only 25 % of the arable land grows crops for human consumption. In order to be able to produce a large share of food for the population and to become more independent of imports, agricultural land in our proposal is not reduced and the proportion of permanent grassland and arable land is retained. By replacing conventional agriculture with organic and agro-ecological farming, a more diverse landscape is developed by implementing wider crop rotations, smaller fields, hedgerows along field edges and agro-forestry. This is associated with a number of environmental co-benefits, such as an increase of carbon uptake, improvement of soil fertility and decrease of nitrogen and phosphorous emissions to waterways. The reduction in GHG emissions is mainly achieved by adapting livestock to area-bound animal husbandry, leading to a decrease of the number of cattle in 2050 by two thirds.

— 2050



The spatial changes of the agricultural structures and reduced import of consumption goods require a social transformation in food consumption and eating habits. The agricultural strategy therefore involves changing the diet mainly by reducing the consumption of meat, dairy and eggs, by focusing on local production, processing and consumption and by reducing food waste. Introducing regional networks and a shared system of governance (such as the establishment of food policy councils) among the stakeholders along the supply chain, promoting food education and solidarity systems as well as creating food belts around residential areas should substantially support the transition.

Field  
fodder

Other  
cultures

Potatoes

Fruit

Beets

Vegetables

Fodder  
legumes

Rapeseed

Maize

Fodder  
cereals

Grassland

— 2021

Cereals

Fodder  
cereals

RRM

Fodder  
Legumes

Hedges  
rows

Oleaginous  
crops

Other  
cultures

Potatoes

Grain  
legumes

Field fodder

Fruits

Vegetables

Grassland

— 2050

# Biodiversity and Water

— 2021



- High or Good
- Moderate
- Poor or Bad
- Unknown
- High or Good with a Buffer of Riparian Forest
- Cropland

In the functional area of Luxembourg, landscape fragmentation and the associated loss of ecological connectivity are a major pressure for biodiversity in terrestrial ecosystems, putting at risk the long-term viability of metapopulations. Specifically, forested areas could benefit from an enhancement of their ecological connectivity, reinforcing the system of protected areas crossing the functional area. In order to enhance ecological connectivity two strategic actions are proposed. First, renaturalisation and afforestation of riparian buffers creates a network of corridors for animal movement. Second, development of a system of agricultural hedges that provides habitat for farmland birds, small mammals and reptiles, acts also as a secondary network of corridors between forest patches.

— 2050



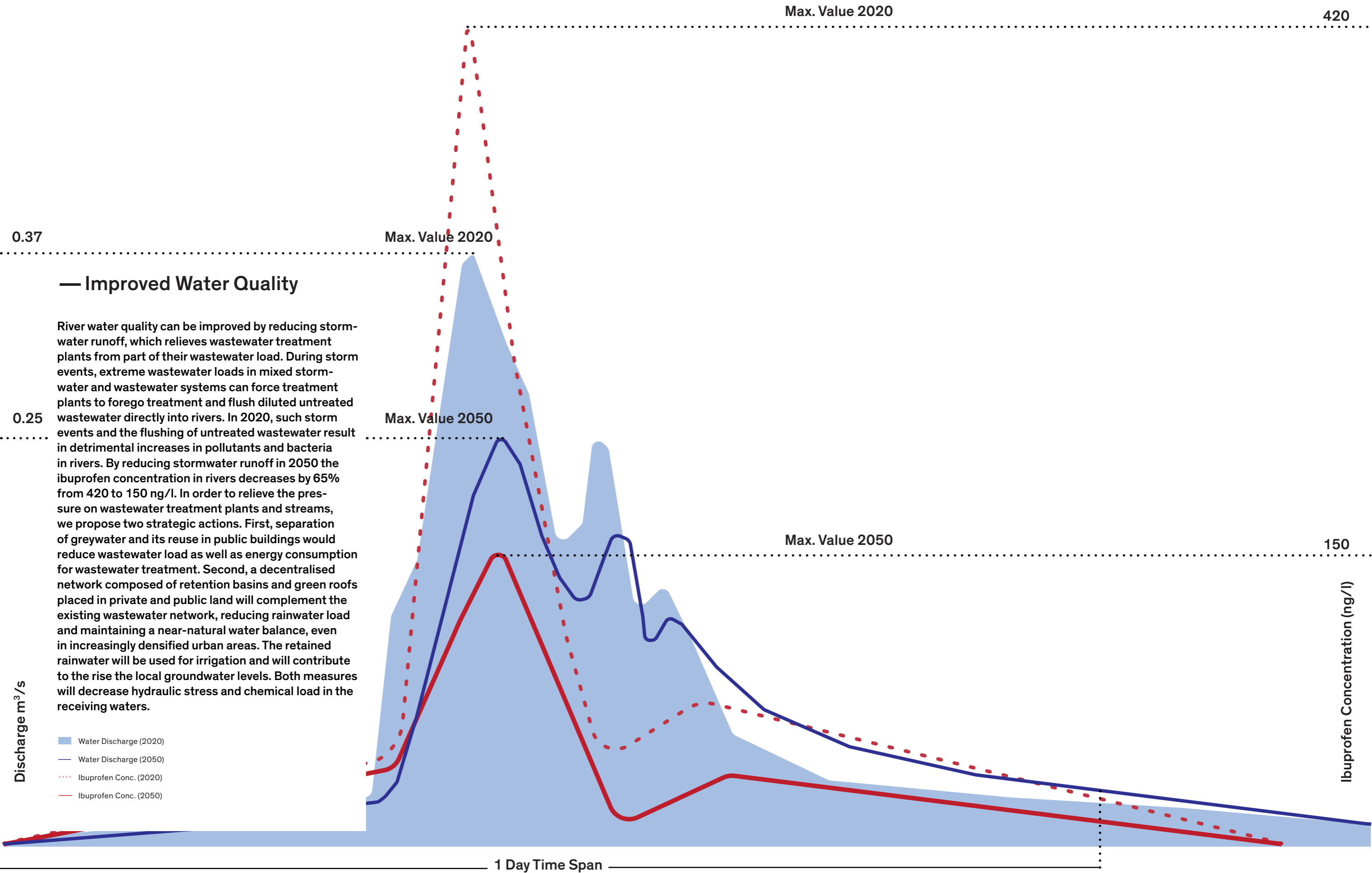
- Grassland
- Tree Covered Area (Tree Cover > 50%)
- Urban network of Green Roofs & Water Retention Basins
- Network of Agricultural Hedges
- Protected Areas surrounding Functional Area
- ↔ Enhancement of Species Movement among Protected Areas

In terms of aquatic ecosystems, the stream network of the functional area possesses low water quality. Most of the river stretches have poor to bad ecological status and only few have good or high ecological status. Renaturalisation of riparian strips of the stream network will improve water quality by enhancing the physical connection of streams to adjacent land and improve filtration of diffuse water discharge into streams. In addition, reducing stormwater runoff through a decentralised network of green roofs and retention basins means that wastewater treatment plants will no longer be forced to forego treatment during storm events, which resulted in the flushing of diluted untreated water into streams. Together, these measures improve water quality in the functional area.

### — Improved Water Quality

River water quality can be improved by reducing stormwater runoff, which relieves wastewater treatment plants from part of their wastewater load. During storm events, extreme wastewater loads in mixed stormwater and wastewater systems can force treatment plants to forego treatment and flush diluted untreated wastewater directly into rivers. In 2020, such storm events and the flushing of untreated wastewater result in detrimental increases in pollutants and bacteria in rivers. By reducing stormwater runoff in 2050 the ibuprofen concentration in rivers decreases by 65% from 420 to 150 ng/l. In order to relieve the pressure on wastewater treatment plants and streams, we propose two strategic actions. First, separation of greywater and its reuse in public buildings would reduce wastewater load as well as energy consumption for wastewater treatment. Second, a decentralised network composed of retention basins and green roofs placed in private and public land will complement the existing wastewater network, reducing rainwater load and maintaining a near-natural water balance, even in increasingly densified urban areas. The retained rainwater will be used for irrigation and will contribute to the rise the local groundwater levels. Both measures will decrease hydraulic stress and chemical load in the receiving waters.

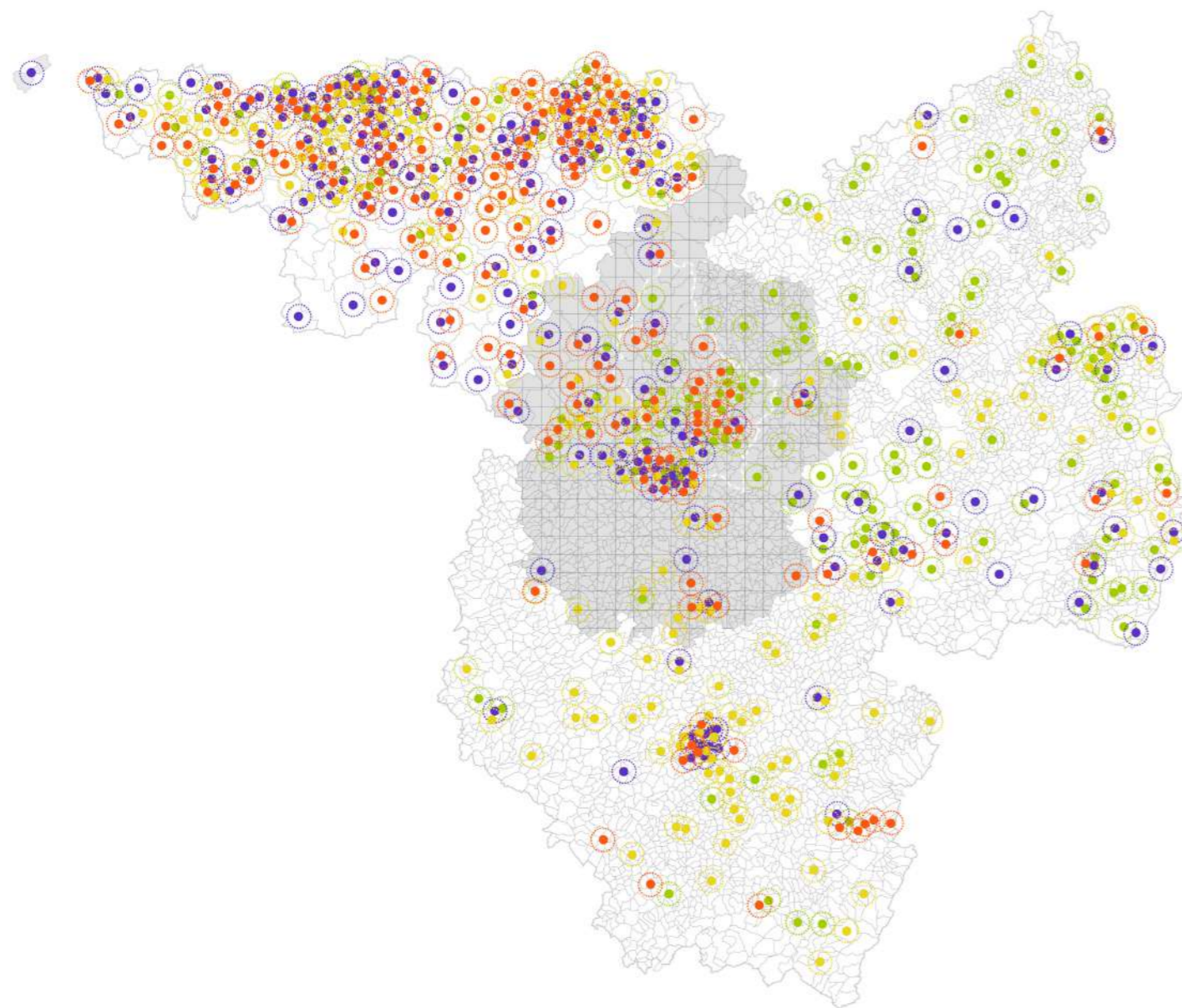
- Water Discharge (2020)
- Water Discharge (2050)
- ⋯ Ibuprofen Conc. (2020)
- Ibuprofen Conc. (2050)



1 Day Time Span

# Civic Empowerment

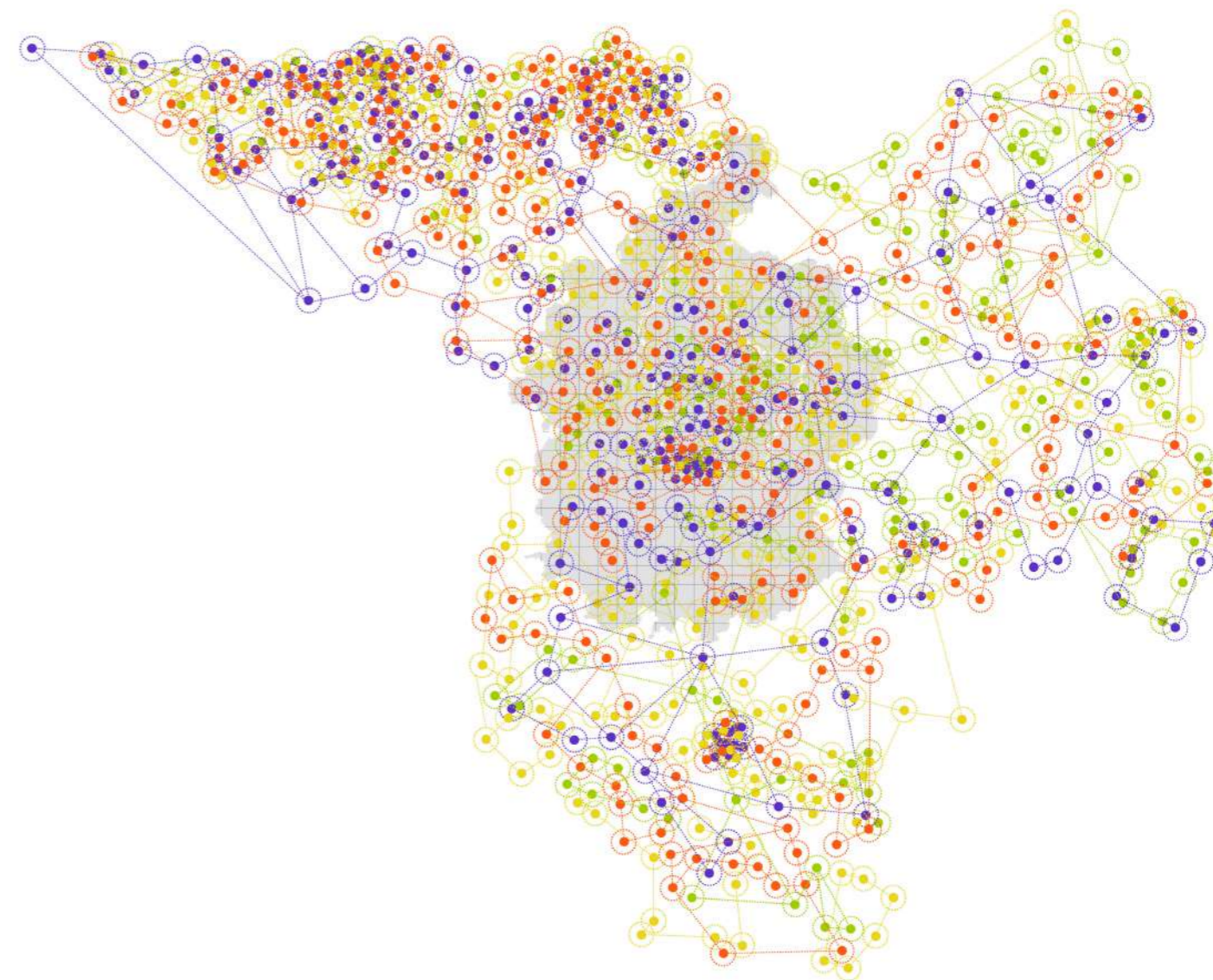
— 2021



- Energy Cooperatives
- Community-Supported Agriculture
- Community Gardens
- Repair Cafés

This map shows the potential of more than thousand projects spread all over the Greater Region. They are the incarnation of the “prosumer” model that has been addressed in Luxembourg’s “Third industrial revolution” (also known as the Rifkin study), but putting it into place from a bottom-up perspective. Unlike “uberisation” tendencies, thousands of citizens in Wallonia, Saarland, Lorraine, Rhineland-Palatinate and Luxembourg are investing their time, money and talent to develop localized, sustainable and resilient practices around food, energy, and resources in a broader sense. The four community-based dynamics illustrated here embody huge transition potential towards a low carbon and resilient economy: energy cooperatives, community supported agriculture, community

— 2050



gardens and repair cafés. They are citizen-run space invaders: locally rooted while empowering the communities behind these initiatives. We find that these schemes are important enablers of the energy transition, but they need public support (to be legally and financially viable) and cross-border cooperation (to enhance capacity in the regions). The transition narrative of this report is based on these community dynamics: if the conditions are right in terms of legal and financial support, network and capacity building as well as better public visibility, we may go from the 1.147 initiatives identified in 2021 to 10, 20, or 50 times more in 2030, 2040 and 2050.



# Civic Empowerment

## — Energy Cooperatives

are community-funded, democratic companies creating sustainable forms of renewable energy while generating prosperity for both the local area and the region. They provide broad energy services, ranging from electricity provision to district heating, IT solutions, and energy efficiency consulting. We have targeted our analysis on cooperatives that produce renewable energy (solar, wind, hydro, and biomass) as well as those with strong citizen involvement. We have identified 263 projects in the Greater Region.

## — Community-Supported Agriculture

is a system that connects producers and consumers within the food system by allowing the consumer to subscribe to the harvest of a certain farm or group of farms. The German model of the Solidarische Landwirtschaft (SoLaWi), which is also the most prominent in Luxembourg, is mostly hosted by a farm that associates consumers as a support community. SoLaWis promote food sovereignty, so the consumer can control what she or he gets, while the farmer can control what she or he plants, thus receiving a fair price for the resulting product. We have identified 299 projects in the Greater Region.

## — Community Gardens

are shared spaces giving access to meaningful nutrition, improving the ecological systems of the city/village, encouraging active and healthy living, and providing spaces for community building, food production and beauty in our daily lives. Community gardens can be initiated by a group of inhabitants or a municipality, but in any case, it implies that decision-making as to how the garden is being developed is taken collectively, by the community of gardeners. We have identified 342 projects in the Greater Region.

## — Repair Cafés

are temporary meeting points for people to work on repairing objects of everyday life, such as computers, bicycles or clothing. Beyond the “repair” aspect, the community aspect is central. We counted 243 repair cafes and DIY initiatives, including citizen based FabLabs and hacker- and maker-spaces. Although these initiatives might look symbolic in their impact, they are very popular with citizens and decision-makers. The data collected by the network of repair cafes has the potential to make the current model of “planned obsolescence” obsolete.

### Food

Community Supported Agriculture



Transition Gardens



### Energy

Alternative Housing



Energy Coops



DIY and Repair



Citizen Participation



### System Change

Systemic Education



Economic Alternatives



Community Building



Citizen Science



“

Muss daat sin daat Lëtzebuerg esou wächst?

All Joer 13.000 nei Leit déi brengen vill Potential zur Verännerung mat.

Wenn heute noch die Natura 2000-Zone für den Bau einer Umgehungsstrasse zerstört wird, und wenn man noch sowas wie die Cloche d'Or baut, dann kann ich mir die Transition noch nicht so richtig vorstellen.

Ich bin nicht optimistisch, wenn ich sehe, wie der Raum um Luxemburg-Stadt in den letzten Jahren verbaut wurde. Die Cloche d'Or wurde hinter meinem Elternhaus gebaut, für mich das beste Beispiel einer absurden Stadtplanung. Allein der Auchan ist überdimensioniert und die ganze Nacht beleuchtet. Da ist gewaltiges Umdenken notwendig.

On pense que c'est impossible de déclencher le changement. Or, la pandémie nous a montré que beaucoup de choses qu'on imaginait impossibles sont très vite devenues possibles.

En parlant de sobriété, il est important de faire évoluer les consciences dans une logique de joie et du collectif. Depuis le début de cette crise sanitaire, il y a une prise de conscience que l'impossible devient possible.

“

La Justice spatiale n'existe absolument pas ici. La frontière existe toujours, même si 200.000 personnes la traverse tous les jours.

Le Grand-Duché est gagnant si les villes de l'autre côté de la frontière se développent correctement.

Il faut être honnête dans ce débat-là en disant qu'un des plus grands problèmes du Grand-Duché et ses territoires périphériques est lié notamment à la surconcentration des activités économiques.

Du point de vue du Luxembourg cela va être politiquement compliqué d'expliquer aux électeurs qu'une partie des activités seraient transférées de l'autre côté de la frontière. Parce que c'est ça que cela veut dire si on va jusqu'au bout.

Les citoyens sont très pro-actifs. Plus il y a d'exemples d'initiatives positives partagées, plus cela va se développer. On n'attend plus des gouvernements des Etats.

Selon les problématiques, il y a des échelles différentes. Il y a forcément des choses que l'on ne peut régler qu'au niveau local si elles ne sont pas prises en compte à un niveau supérieur.

“

Actuellement, on échange des voitures à essence contre des voitures électriques, et on pense ainsi pouvoir continuer notre modèle économique.

Ich würde mir eine Stadt mit viel weniger Autos und viel mehr Fahrrädern wünschen. Das würde bedingen, dass man in allen Gegenden der Stadt eine Möglichkeit zum Einkaufen hat und dass man sich dort mit dem Fahrrad sicher fortbewegt.

Aujourd’hui, pratiquement tout le monde va en voiture au supermarché et remplit des caddies qui débordent. Pourquoi ? Parce que les commerces de proximité disparaissent malheureusement de plus en plus dans les villes et les villages. Nous avons pu observer la disparition des boulangeries et des cafés dans les villages. Les gens sont forcés à se déplacer.

L’avenir de ce pays réside dans les villes. Il faudrait investir massivement pour rendre la ville à 15 minutes possible. Cependant l’électorat luxembourgeois ne vit guère dans les villes.

On travaille avec un maximum de récup mais on se heurte au manque d’espace. Même s’il y a beaucoup de halls et de hangars vides, en tant que petit collectif on n’arrive pas à les utiliser. Il faudrait d’abord exproprier avant de pouvoir les accéder.

“

Les résidents luxembourgeois ont un pouvoir d’achat qui leur permet de mieux s’adapter, mais il y a une partie de la population plus vulnérable qui est amenée à déménager au-delà de la frontière.

On urbanise en excès certains villages ce qui pose la question de leur devenir.

La crise actuelle est aussi une opportunité à réinventer le travail et son espace géographique. Le télétravail ne peut pas être adopté quand on est isolé, mais on devrait développer des espaces de co-working décentralisés qui favoriseraient une réduction du besoin de mobilité.

Als Hauptproblem sehe ich, dass 90 bis 95 Prozent der Menschen zum Teil alleine mit dem Auto zur Arbeit fahren. Vielleicht haben wir ja in der Corona-Krise was aus der Erfahrung mit dem Home office gelernt.

Mir hun och vill saachen wou mir ofhängeg sin.

Aujourd’hui, les processus d’importation d’aliments vont bien au-delà de notre région. Ce serait bien de développer des coopérations transfrontalières pour établir des circuits courts en termes d’alimentation.

03 —

TRANSITION

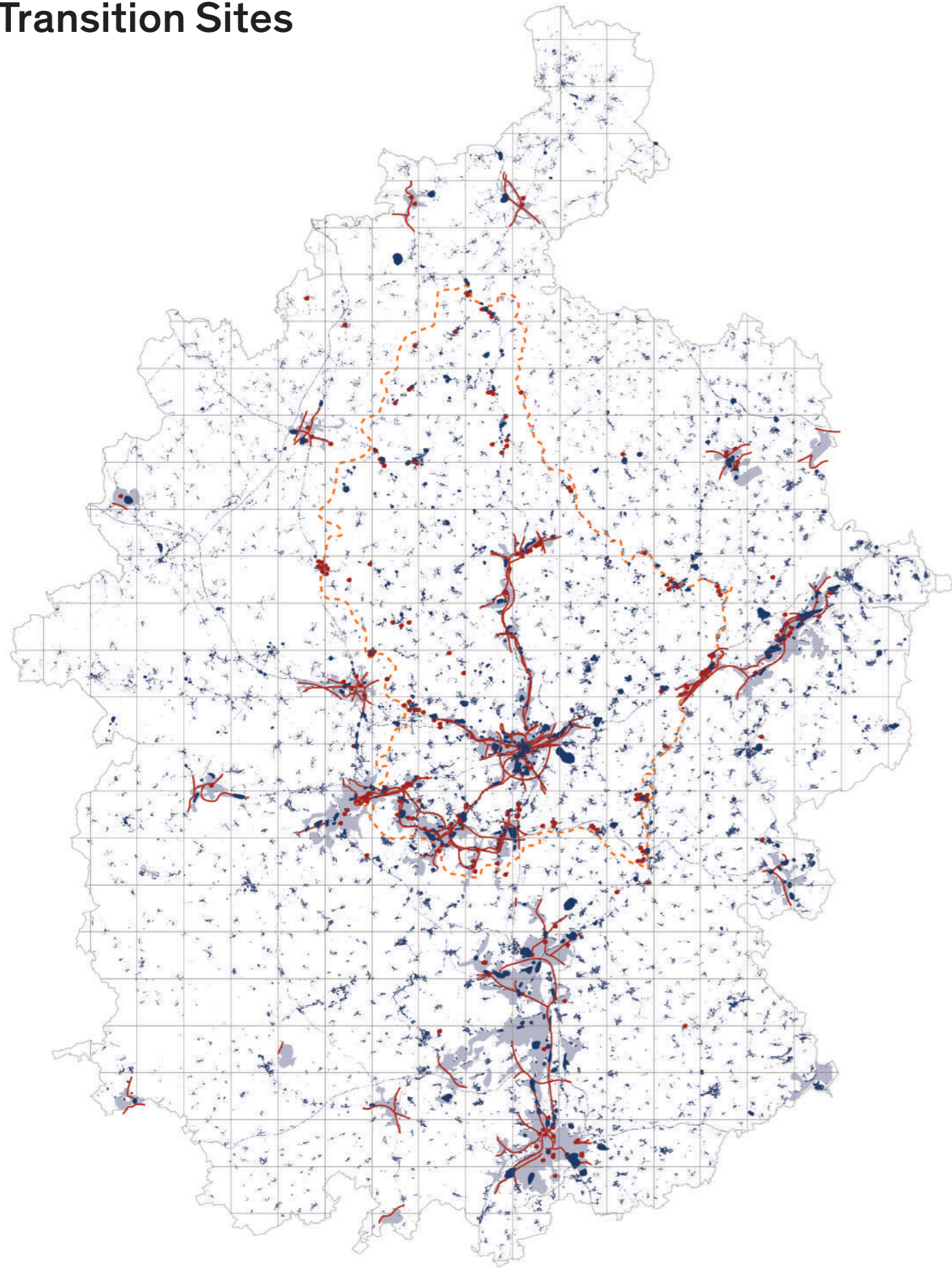
SITES

## — Transition Sites

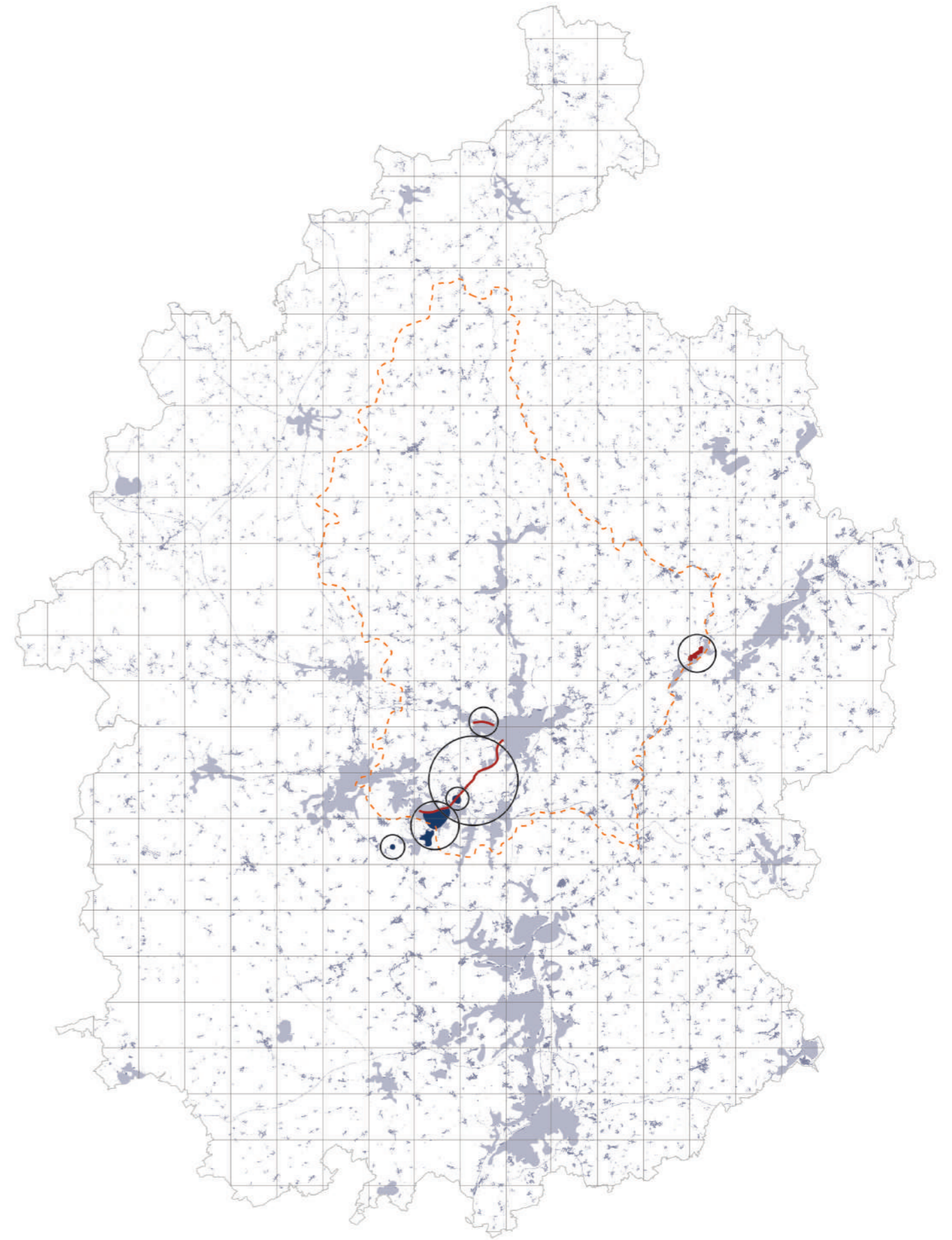
**This main chapter presents a series of case studies at different scales that are prototypical for urban, suburban, rural, and infrastructural typologies of the functional space of Luxembourg: cities, villages, commercial zones, farmlands, motorways, petrol stations, among others. Combined, these generic yet specific typologies present a “psychogram” of a transnational territory characterised by a high degree of functional as well as physical fragmentation and, consequently, by a high mobility effort. Overcoming this effort by means of an urban development of proximity is the common thread connecting these case studies. At the same time, this chapter is also about turning the car-related infrastructures towards new productive uses: for alternative forms of housing as well as for activities such as co-working, co-living or co-gardening. Consequently, in addition to possible design strategies and their corresponding metrics, we always represent a multiplicity of transition practices. After all, it is not only about quantitative results, but how the challenges of decarbonisation and resilience are qualitatively translated, culturally and politically integrated, and how they are being performed by the general public.**

- 01 Cities » Case study Transborder City Esch-sur-Alzette-Audun-le-Tiche**
- 02 Towns and Villages » Case study Tiercelet Network Village**
- 03 Farms and Fields » Agro-Forestry Productive Landscape**
- 04 Commercial Zones » Case study Foetz Circular Economy District**
- 05 Arterial Roads » Case study Route d'Arlon Agri-Urban Strip**
- 06 Urban Motorways » Case study A4 Park Avenue**
- 07 Gas station strips » Case study Wasserbillig Co-Working Strip**
- 08 Garage Parks » Case study Differdange Mixed-Use Neighborhood**
- 09 Business Districts » Case study Kirchberg–Kreuzberg**
- 10 Logistics Centers » Case study Cargolux Regional Supply Hub**
- 11 Brownfields » Case study Terre Rouge Urban Village**
- 12 Leisure Areas » Case study Via Mosel' Transborder Wine Valley**

# Transition Sites



All typologies



Selected case studies

# — 01 Cities

Case study: Transborder City Esch-sur-Alzette-Audun-le-Tiche





# Cities

First and foremost, the transformation of the functional space of Luxembourg into a regenerative city-landscape will focus on strengthening the cities: slowing down the growth of those villages and communes that have no prospect of urbanity. This is due to the fact that in this region cities increasingly lose their urbanity, while villages increasingly suffer from disappearing rurality. The representation of cities with more than 10,000 inhabitants allows for a clear polycentric figure to emerge, which will enable us to build a coherent public transport network and increase the urbanity of cities, resulting in a network of interconnected cities of short distances. Strengthening cities and increasing their urbanity does not mean allowing them to continue to expand, but instead to densify them qualitatively and to diversify them socially and functionally. Our first strategy is to create a landscape belt around each city, a porous tie that clearly marks its boundaries. This belt will consist of different typologies of nature: solidary agriculture, community and individual gardens, parks, sports-fields and playgrounds, forests, and lakes. This will offer every citizen proximity to productive and regenerative nature.

## Density and Porosity

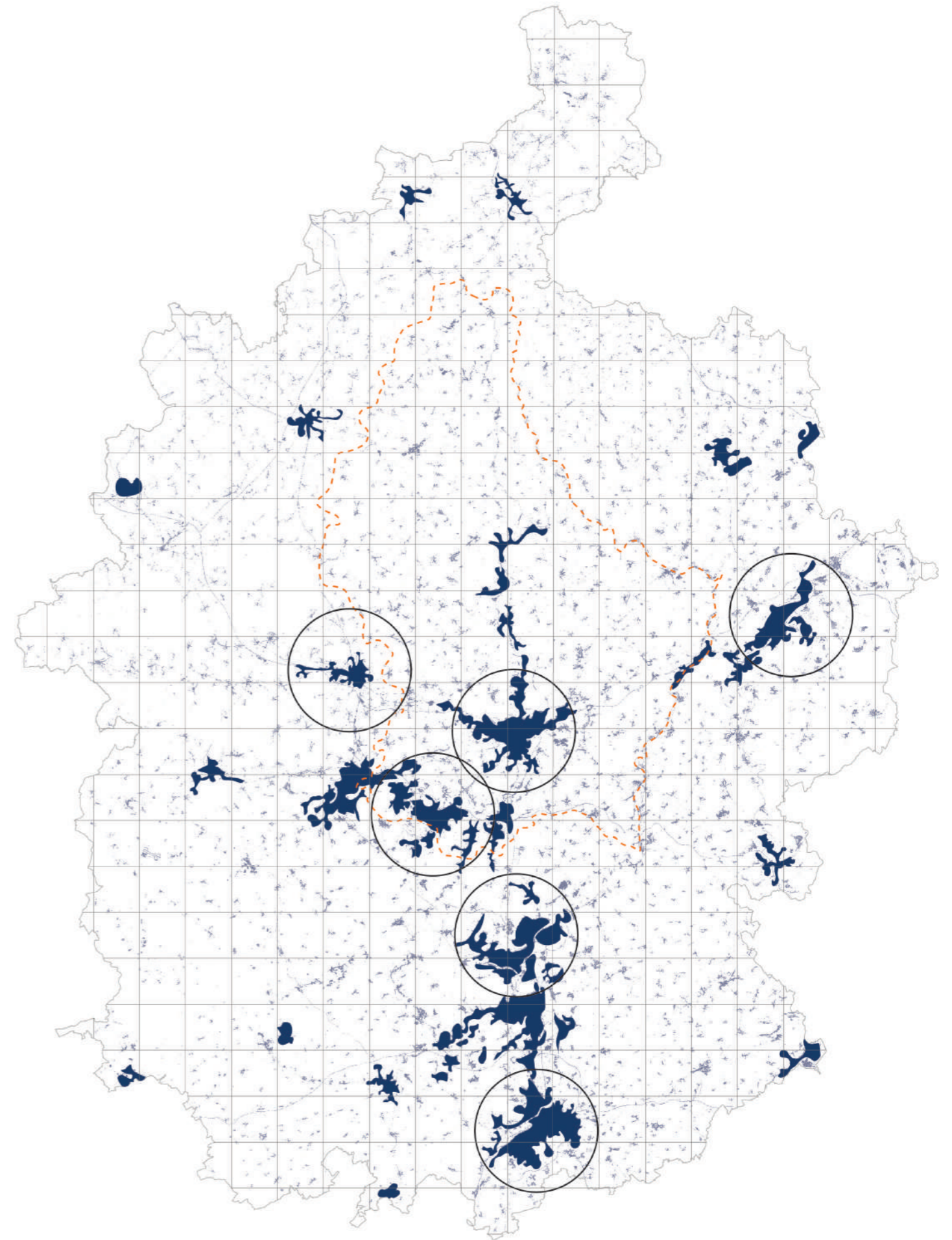
By densifying and diversifying cities, we do not mean to address the classic inner development—i.e. primarily the development of buildable plots in the building perimeter—but to develop, overbuild, and transform exclusively the sealed areas within the city: car parks, garages, brownfields, existing buildings. Simultaneously, the wastelands in the city will, from now on, be converted into unbuildable land and—like a denser and more closely knit version of the landscape belt—be transformed into different landscape typologies. This will increase the supply of nature in the city and counteract urban heat islands, as green urban areas cool down much faster at night and act as cold air formation areas. In this respect, the creation and protection of cold air corridors is also elementary for the ventilation and cooling of the cities. Local wind systems, either induced by topography or by thermal conditions, are of great importance for urban planning in general, and more specifically in order to reduce thermal stress levels in densely populated urban areas,<sup>3</sup> something that Joseph Stübgen—the urban designer of Esch-sur-Alzette and other sites in Luxembourg—already took into account in the beginning of the 20th century. Beside the cooling effect, green spaces in the city increase biodiversity, deliver synergy effects for precipitation management (infiltration)

and air pollution control (filtration and deposition of air pollutants), and last but not least improve life satisfaction and represent important free spaces especially in times of pandemics.

## Diversification and Walkability

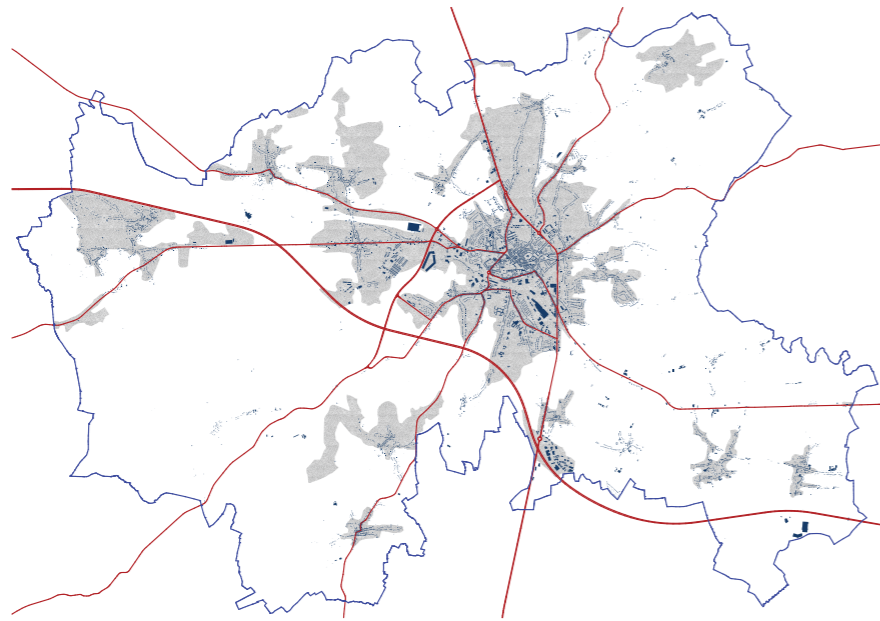
By adding common and shared functions, affordable housing and the reduction of existing living space lies at the heart of this densification. According to our study, with a consistent overbuilding of existing buildings, 100,000 inhabitants could be accommodated in the cities of the State of Luxembourg alone. A more concentrated densification would also benefit the currently weakened or dead ground floor zones, where small-scale retail outlets, repair shops, or kindergarten will nestle. Throughout the process of overbuilding, existing buildings will also be renovated in order to improve energy efficiency and to systematically equip them with green roofs and photovoltaic panels. Overbuilding existing structures will also increase the shadows, which reduce the thermal stress caused by direct sunlight during the day. Shaded roads, footpaths, bicycle paths or parking lots store less heat than the sealed open spaces exposed to sunlight. With large-scale shading, the nocturnal heat island effect can be substantially reduced.

The conversion and the increase of urbanity are further ensured by our fourth measure for cities: the gradual reduction of the automobile in the city up to completely car-free cities in 2040. This will free up many spaces and areas for densification and diversification. Cities will become more diversified and more vibrant, cleaner and safer.



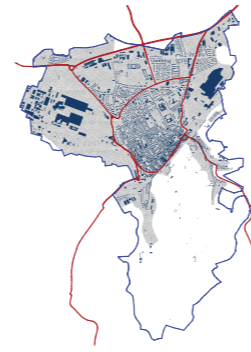
Cities with more than 10,000 inhabitants

# Atlas



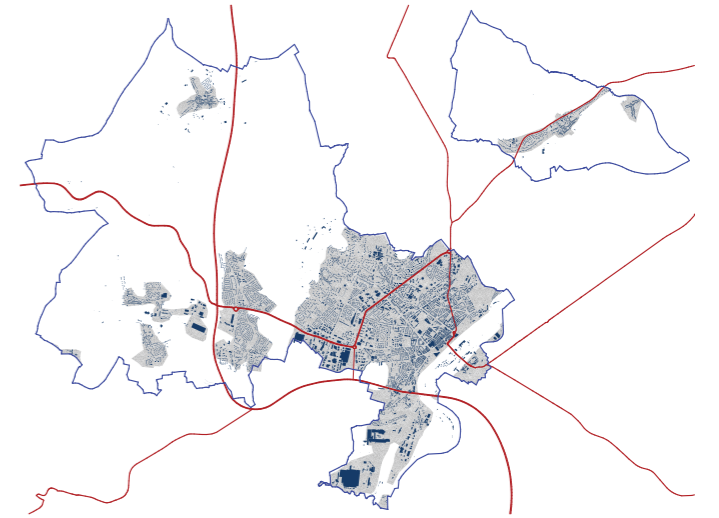
**ARLON**  
*(29.858 inhabitants)*  
Belgium

site area: 11.906,2 ha



**ESCH-SUR-ALZETTE**  
*(36.228 inhabitants)*  
Luxembourg

site area: 1.439,1 ha



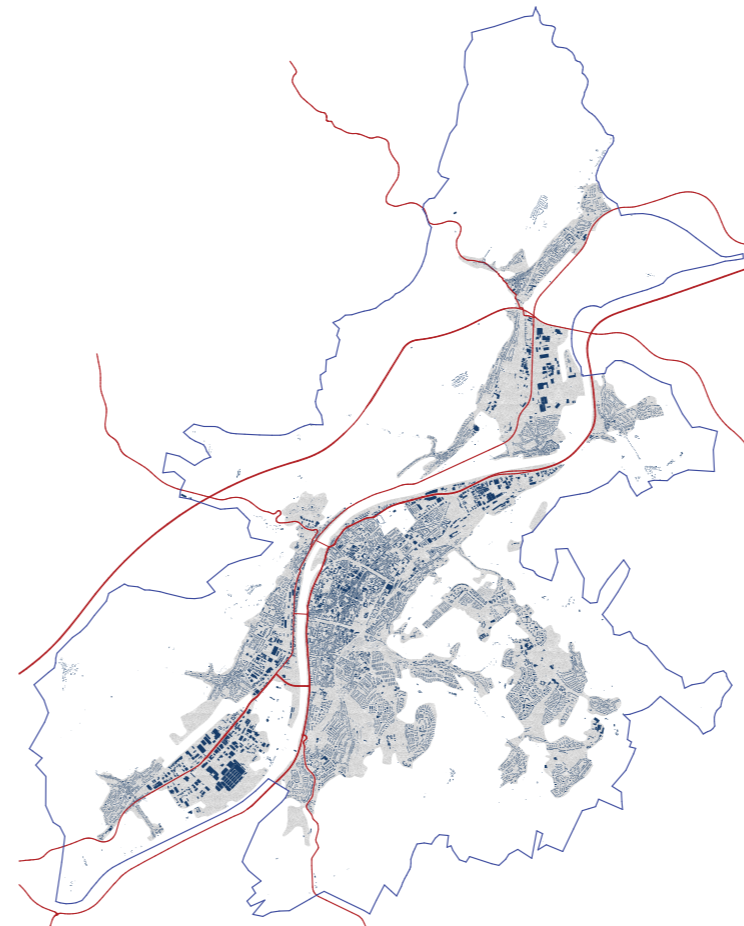
**THIONVILLE**  
*(40.477 inhabitants)*  
France

site area: 4.984,1 ha



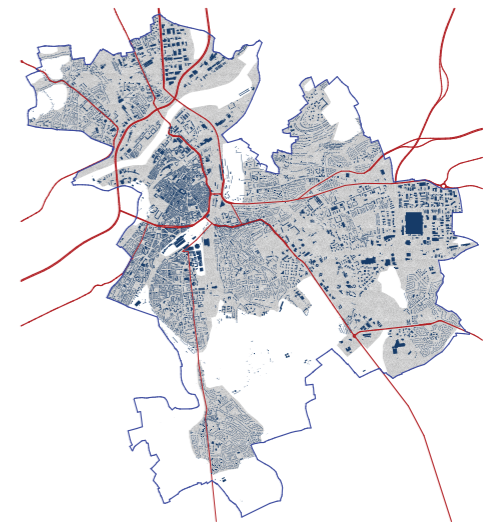
**LUXEMBOURG CITY**  
*(124.509 inhabitants)*  
Luxembourg

site area: 5.171,8 ha



**TRIER**  
*(111.528 inhabitants)*  
Germany

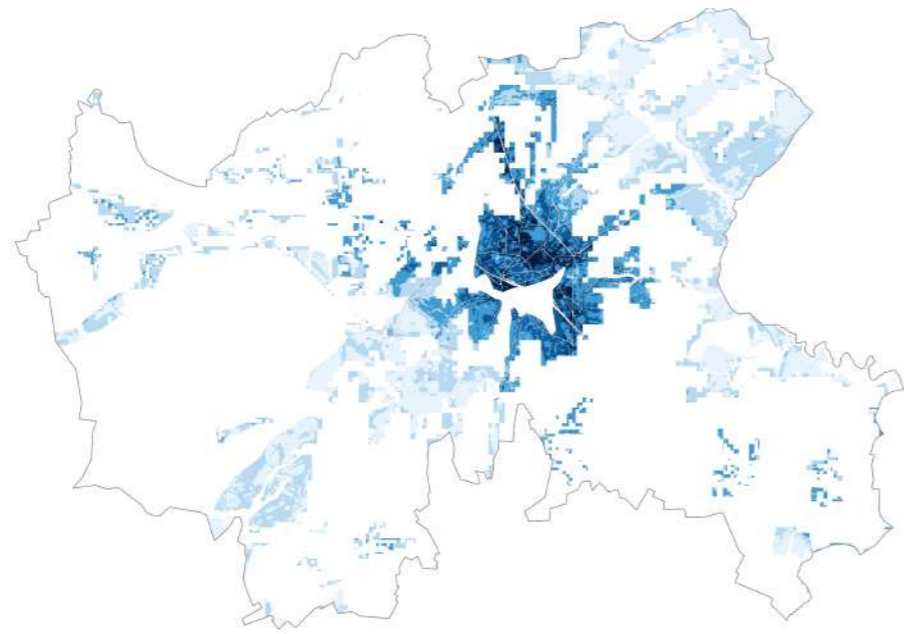
site area: 11.556,5 ha



**METZ**  
*(116.581 inhabitants)*  
France

site area: 4.175,6 ha

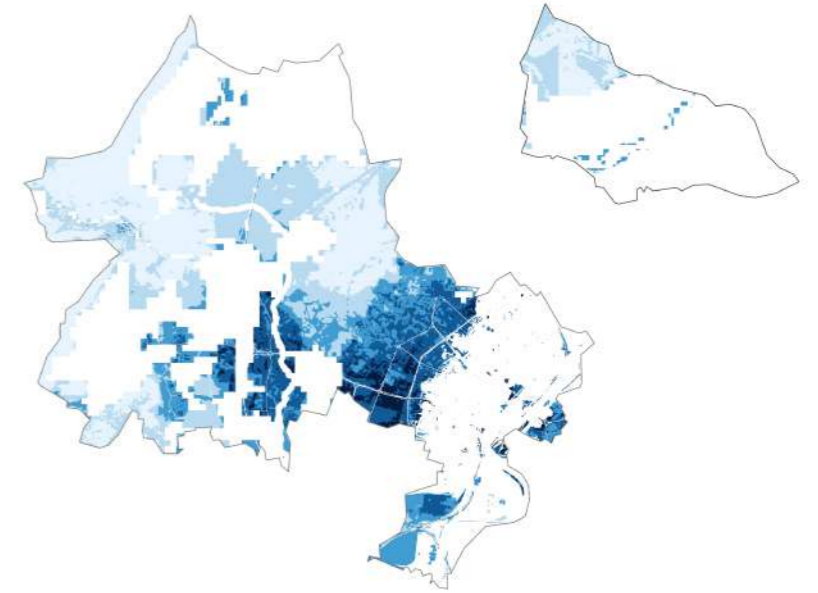
# Potentials



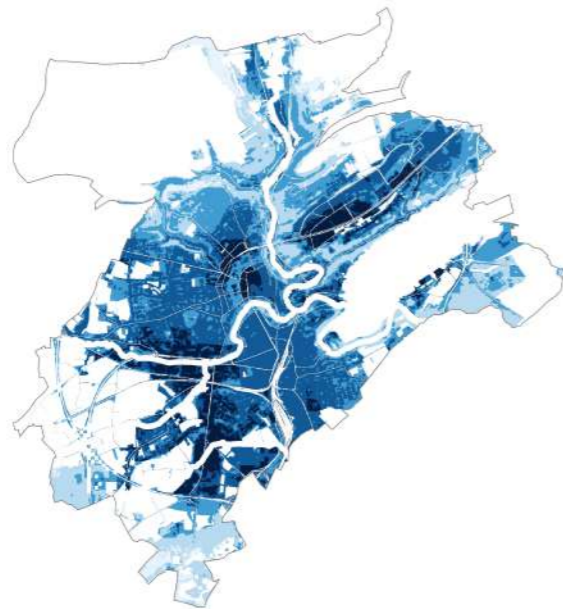
ARLON



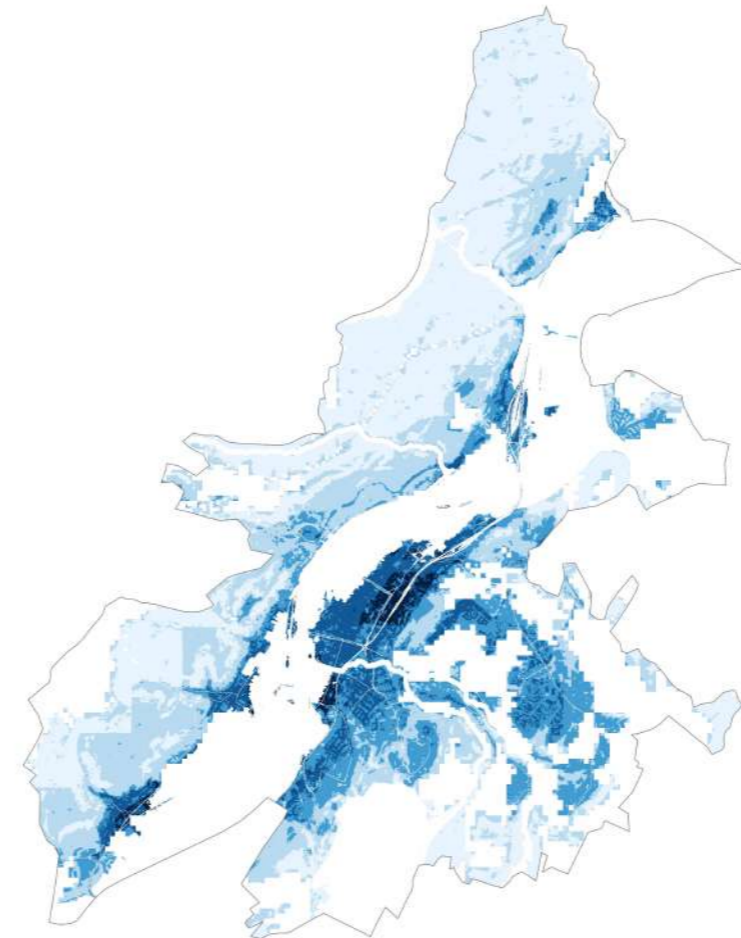
ESCH-SUR-ALZETTE



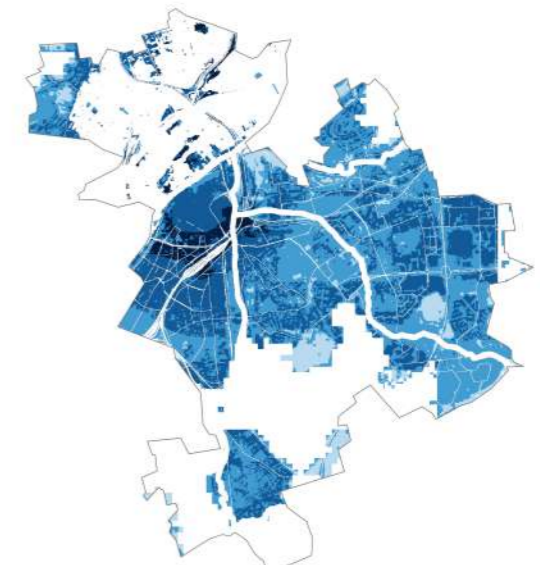
THIONVILLE



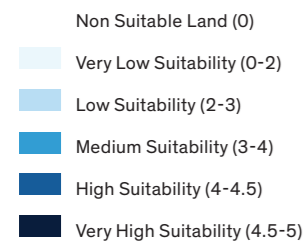
LUXEMBOURG CITY



TRIER



METZ



# Potentials

Currently, Esch-sur-Alzette is the centre of an urban area (referred in this vision as Esch-Audun) that expands beyond its municipality boundary as well as Luxembourg national boundaries. The transborder urban area of Esch-Audun has the potential to become a *mittlere Großstadt*, with an active population enjoying a high quality of life. It is surrounded by accessible protected areas, forests, unimproved grassland, wetlands and streams, which provide a reserve for biodiversity and nature-based recreation services to citizens. Its size and the topography of its urbanised area makes it ideal to become a soft mobility city supported on a well-designed public transport network. However, Esch-Audun is disconnected from its landscape by the primary roads, highways, and railway of the current transport infrastructure surrounding it. Concurrently, its multiple urban zones are fragmented and not easy reachable by foot or bike because a hierarchised soft mobility network is not empowered yet. Under current urbanisation trends, Esch-Audun would be vulnerable to the effects of climate change, with strong urban heat islands occurring in its urban core and the risk that spots of air cold production and cold air corridors would disappear due to inappropriate placement of future new housing. Our vision for Esch-Audun regenerates this City-Landscape building on the local potentialities and removing the current threats and risks. The case study of Esch-Audun showcases how our vision address the regeneration of urban areas, as well as our transborder approach at urban scale for a stronger functional area.



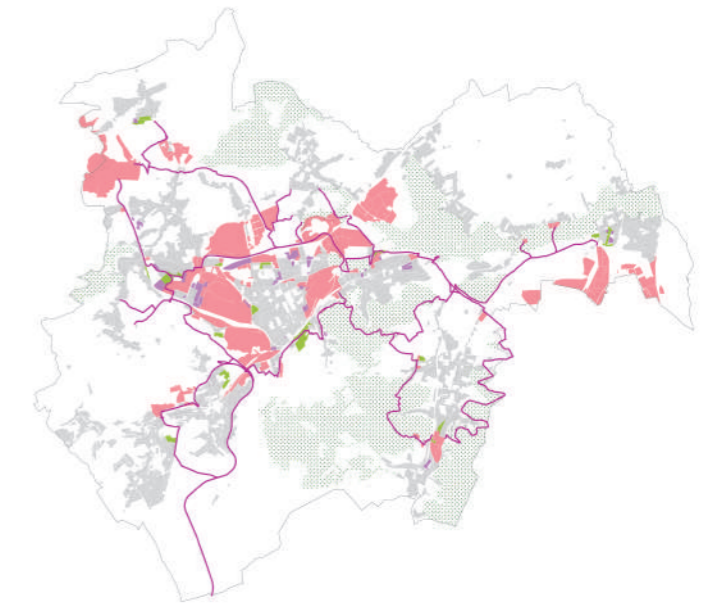
Administrative Boundaries

- Luxembourg
- France



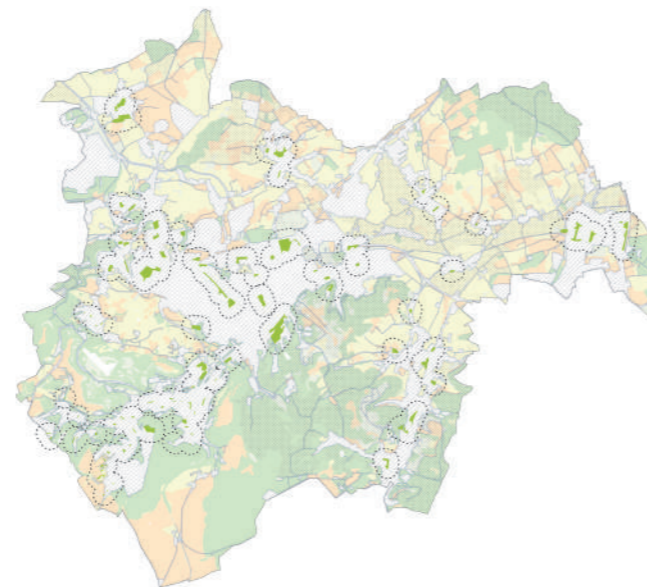
Transport Infrastructure

- Cycle & pedestrian paths
- Railway
- Highway & arterial road
- Tunnel arterial road
- Future liaison arterial road
- Road network



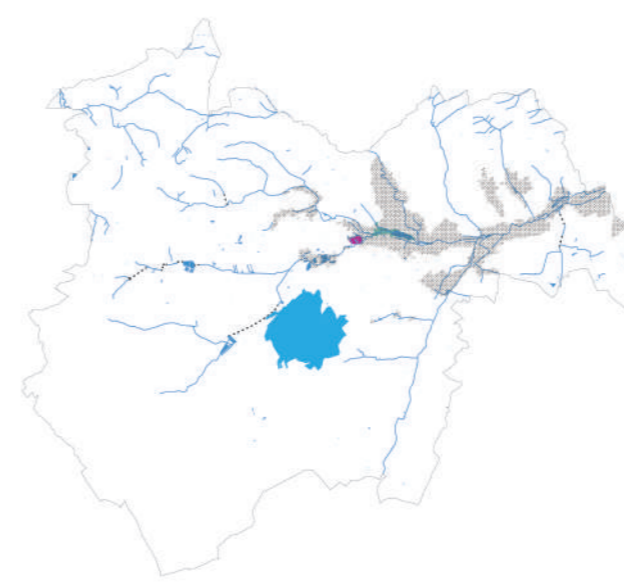
Ring Strategy with Potential Site of Intervention

- Soft mobility belts
- Urban green spaces embedded in the belts
- Sealed areas to be regenerated in the belts
- Social services adjacent to the belts
- Urban fabric
- Protected areas crossing the belts



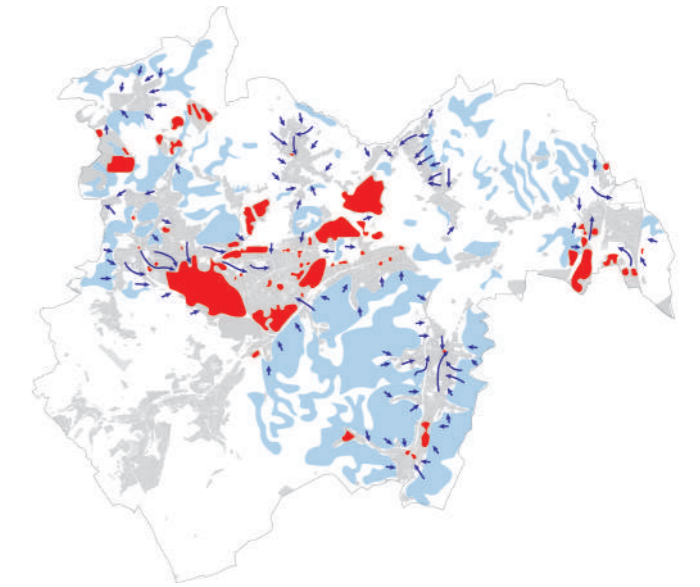
Urban Nature and Terrestrial Ecosystems

- Protected areas
- Forest
- Shrubs & herbaceous
- Pasture
- Other agricultural land
- Urban green areas
- Ecological barriers
- Urban green spaces
- 5' Walking buffer



Water

- Water safeguard zones (groundwater caption)
- Sewage treatment works
- Protected areas related to water or wetness
- Stream network
- Culverts
- Wetland
- Temporary wet
- Zones of extreme flooding



Cold Air Corridors and Heat Islands

- High to extreme urban heat island
- Cold air generation
- Cold air flows
- Urban areas

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## Strategies

- 01 **Densifying and diversifying cities without sealing more land**
- 02 **Transforming cities into car-free areas**
- 03 **Alternative forms of affordable housing**
- 04 **Reduce the overall housing surface to 35 m<sup>2</sup> per capita by offering generous shared spaces**
- 05 **Stop the demolition of existing buildings**
- 06 **Energetic renovation with PV and greenery on roofs**
- 07 **Activating dead ground floor zones like garages**
- 08 **Protecting unbuilt land and making it productive**
- 09 **Decontaminating soil on polluted urban sites**
- 10 **Creating landscape belts with food production**
- 11 **Creating cold air corridors**

### No More Air Pollution

Exposure to the air pollutants NO<sub>2</sub> and PM<sub>2.5</sub> leads to 54,000 and 379,000 premature deaths in the EU28 each year. During the lockdown month of April 2020, NO<sub>2</sub> concentrations in Luxembourg declined by 30 %, while PM<sub>2.5</sub> concentrations in Germany and France were down 15 and 20 %. Car-free cities do not just reduce GHG emissions but come with measurable improvements in local air quality and noise reduction.

### No More Energy Waste

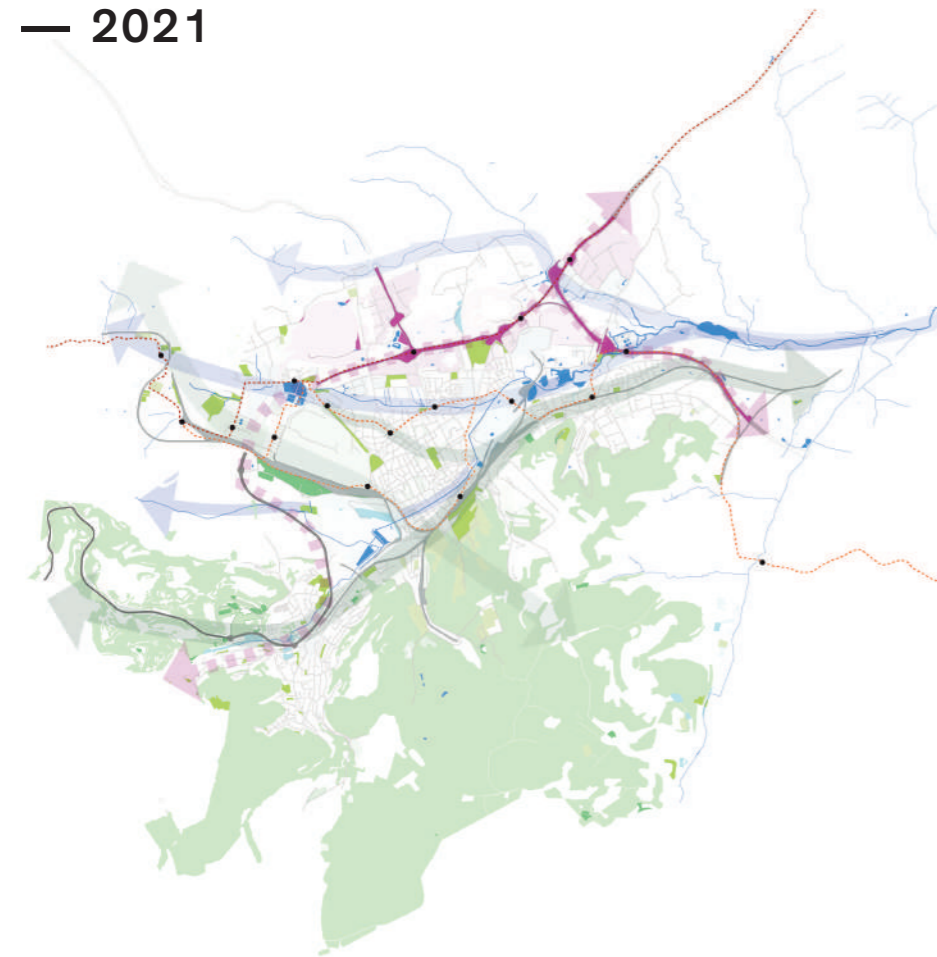
Luxembourg single-family homes have an average energy class rating of F, consuming 220 kWh/m<sup>2</sup> per year compared to 101 kWh/m<sup>2</sup> for single-family homes in France. The difference in avoided GHG emissions is large, amounting to 4.8 t CO<sub>2</sub>eq/year for a 100 m<sup>2</sup> house or about 30 % of the carbon footprint for the average resident of the functional area.

### Cooler Cities

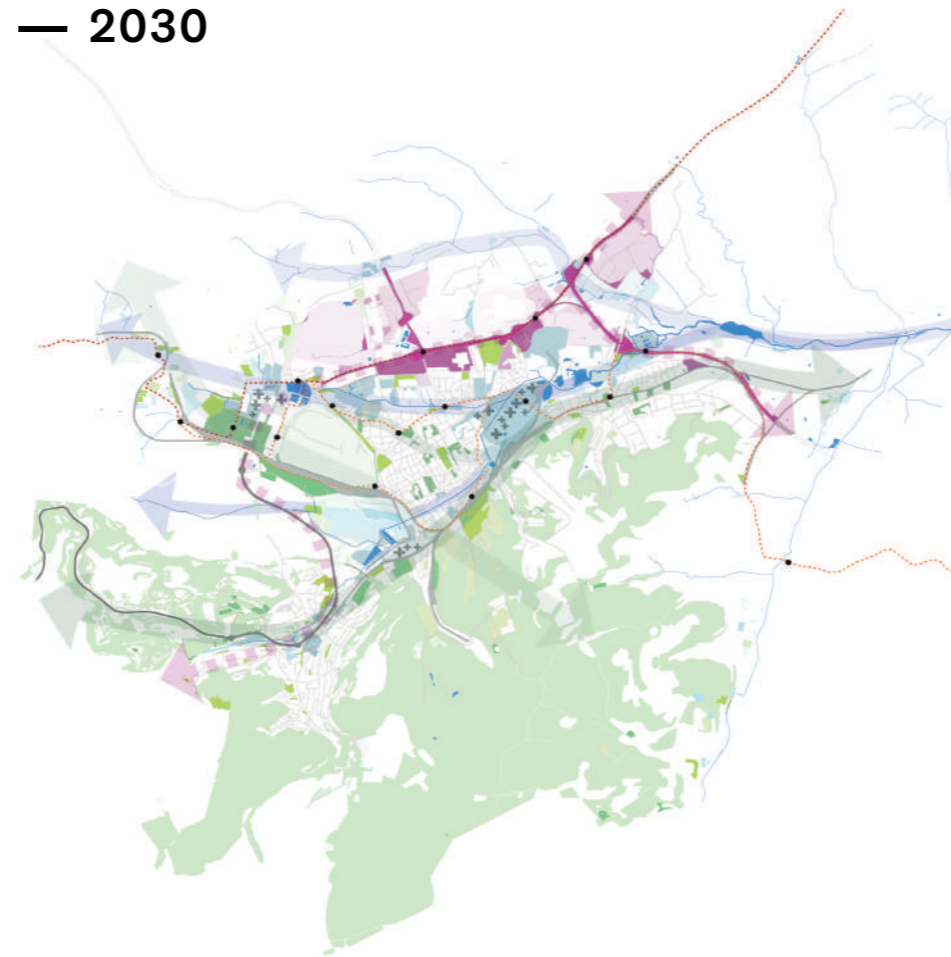
Built-up areas trap heat and increase the ambient air temperature compared to the surrounding area. Green roofs counter this effect through increased evapotranspiration and come with the added benefit of reducing stormwater runoff. Cities with 50 % green roof coverage reduce the heat island effect by 1.3°C.

# Strategies

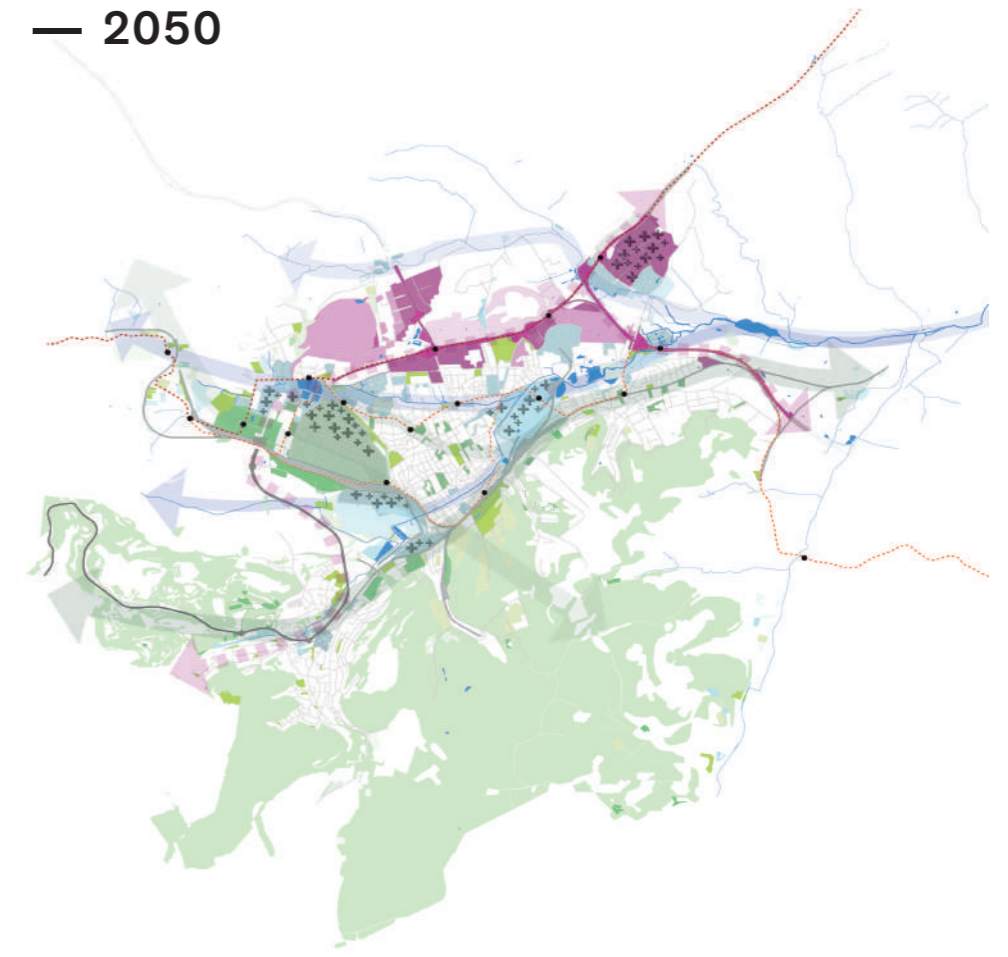
— 2021



— 2030



— 2050



-  New multifunctional district
-  Urbanization
-  Urban green
-  Forest – Green belt
-  Water network – Blue belt
-  Ex highway – New centre of attraction

Esch-sur-Alzette and Audun-le-Tiche are two neighbouring cities that are separated from each other today in terms of urban planning and administration, but will merge in the future in order to form a twin city. Currently, the so-called “Red Lens” is being developed at the territorial interface of the two cities. Additionally, the reconversion of the former steel production site in Schiffflange is in the planning process. A third major project presents itself in the current wasteland of Terre Rouge and the south-eastern section of Belval, which is still being used by Arcelor Mittal, and which separates the Belval neighbourhood from the campus of the University. These will be the major development areas in Esch-Audun in the very near future. All in all, there is tremendous potential here to produce housing for at least 20,000 to 35,000 new inhabitants without sealing any more land.

## Landscape Belts

Our first strategy for urban regeneration is to create a landscape belt. In Esch, this belt gives us the opportunity to think the different new development areas as a system while linking them through a sequence of

different natural events and by means of a sustainable transport system: the new tram as well as cycle and pedestrian paths. The different development areas should therefore not be designed independently from each other, but as part of this new urban-landscape-soft-mobility belt.

## Soil Decontamination

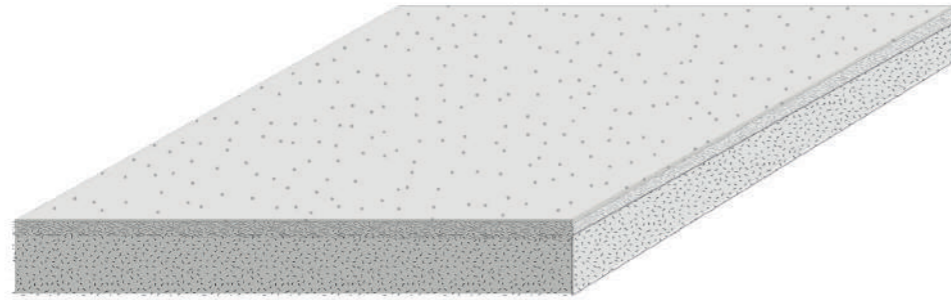
However, many of the soils located in this belt are contaminated today—and the development of this belt, which is planned to take place in successive stages, must take into account the decontamination of the soils, which may extend beyond the year 2050.<sup>4</sup> Thus, non-agricultural functions of the belt could then evolve into a food production function, giving the local population the benefit of an intermediate situation with recreational, depolluting and biodiversity-enhancing functions. The assessment will be carried out for most of the area (driven and pushed by the new soil legislation) in order to identify the non-polluted areas and start the de-contamination process of specifically polluted areas through timber production (for example) to be used in Foetz before reaching a sufficient quality for food production. A soil observatory will be introduced and developed for exploring solutions and monitoring the territory.

## Urban Boulevard

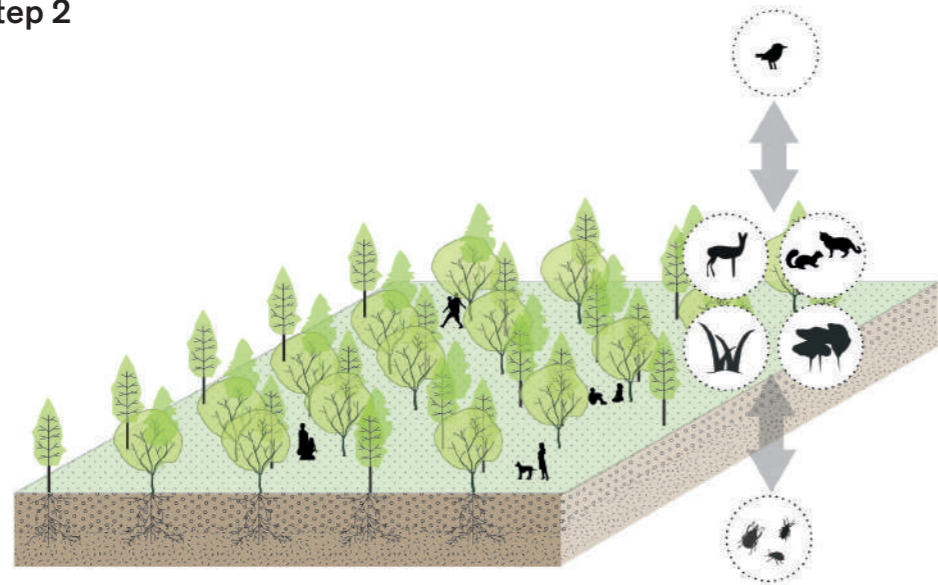
Complementary to the other large industrial sites, a new development area will emerge with the transformation of the motorway into an urban boulevard. This applies here, for example, to the northern area between the Raemerich roundabout and the commercial zone of Foetz. This boulevard will integrate and transform the existing commercial, tertiary, and sports structures and will be densified with small-scale developments on the numerous sealed areas, including many parking spaces currently blocked by cars. In the East, the belt will link Esch with Schiffflange. In the West, it will create the longed-for connection with Belval. At the same time, the open spaces will have to be designed in such porous way so that cold air corridors will reach the city from the West. An important aspect in the planning of this landscape belt will be the connection of Esch-sur-Alzette and Audun-le-Tiche, whereas Terre Rouge will act as a hinge between the two cities.

# Strategies

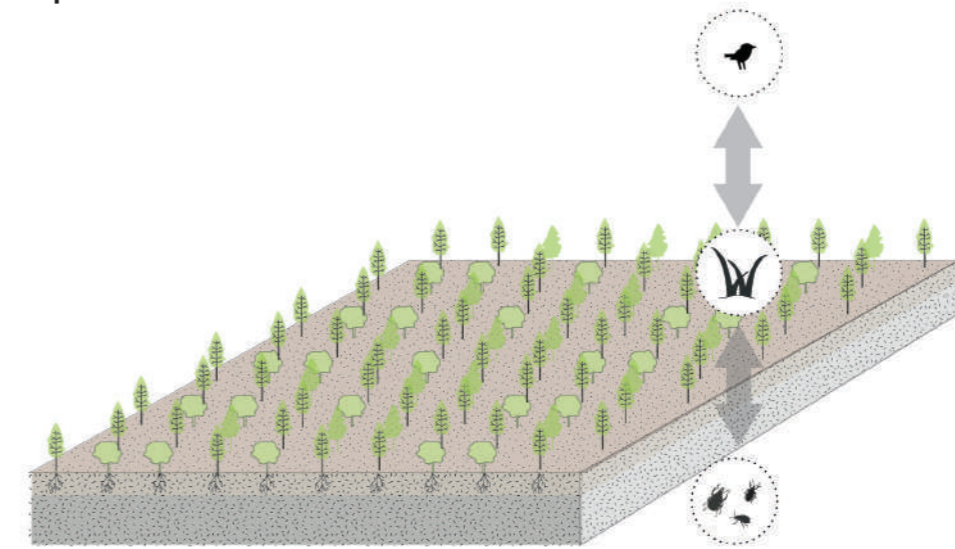
Current Situation



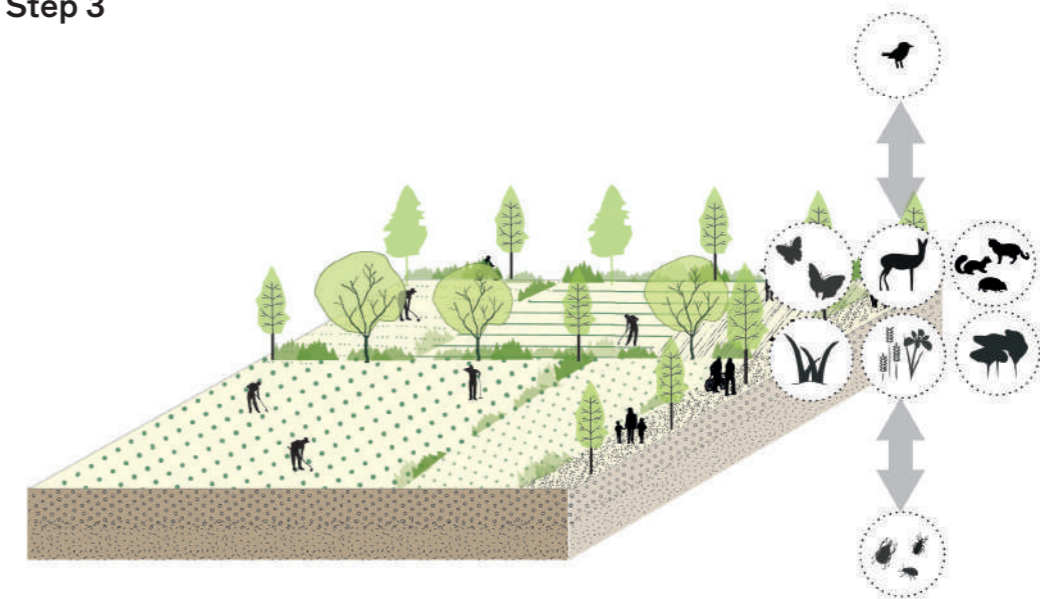
Step 2



Step 1



Step 3

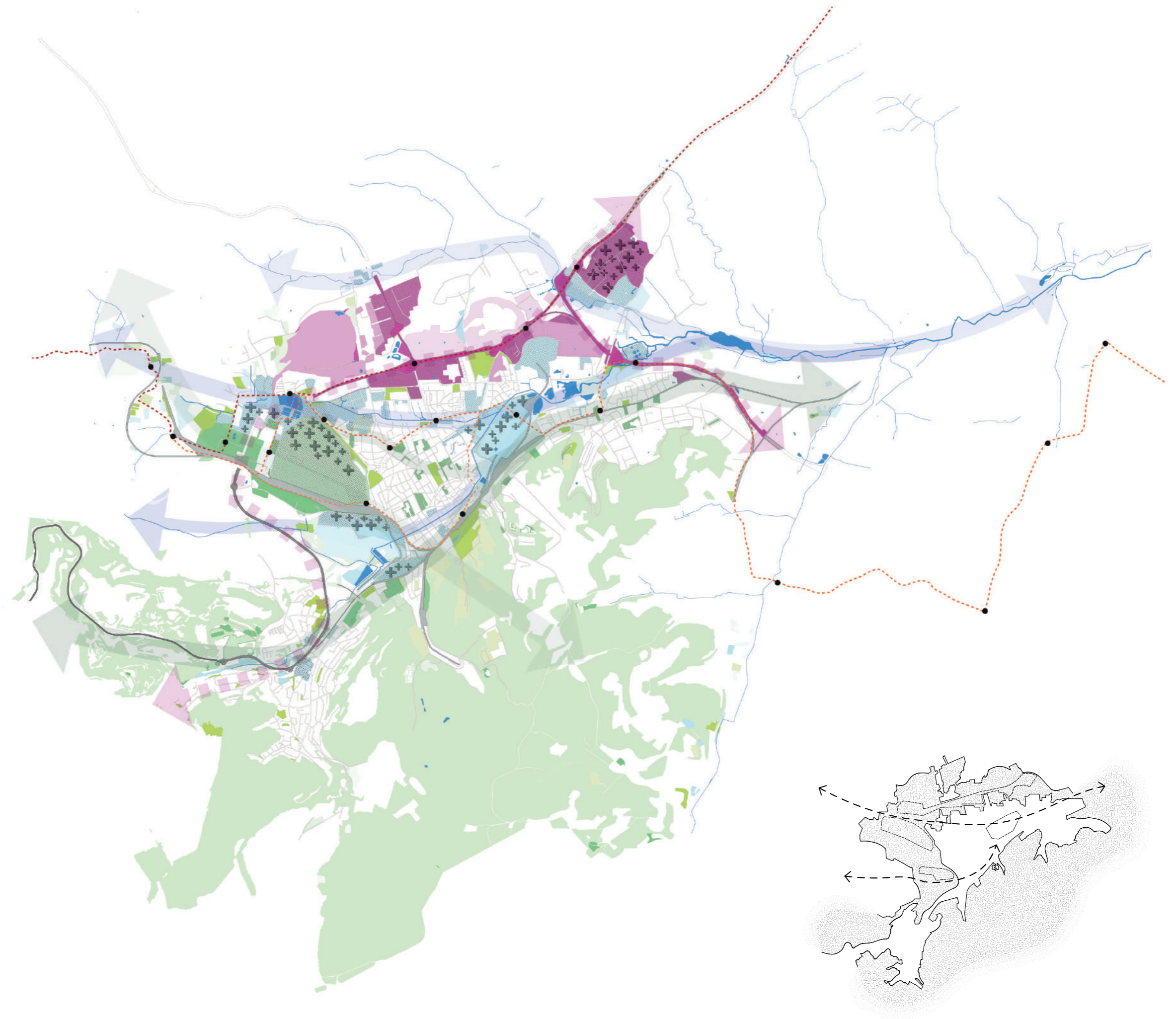


## From Unproductive Polluted Land to Productive Landscape Belts

The conception of these belts at the territorial scale around all towns will, over time, replace and transform the existing unsustainable and unresilient food chain supply into a new food system operating in a short circuit: the respective local population gradually achieves food sovereignty (including decision-making processes). It is a multisectoral strategy that concerns the entire food system integrating production, processing, distribution, catering (restaurants, canteens et al.) and its related marketing. Urban spaces not only host community gardens or private allotments, but also function in a closed loop (production of food products, seeds and recycling of organic matter, water collection, plant nurseries, collective orchards et al.). Roof extensions or undeveloped areas are partly used for food production (off-ground if necessary and low-tech). Following the zoning of permaculture design—the production that requires the most care and the most frequent uses is found closest to the people—peri-urban spaces

will see an adaptive type of production and form of farms developed according to distance to urban areas, quality of soil, size of the plots, and specific needs of the respective population (agroforestry, micro-farms, livestock, and mixed farming). Food shops and processors are moving closer to the spaces of inhabitation. Food distribution is multifaceted: it is partly provided by producers at the production sites, markets, or retail shops, and partly handled by groups of citizens self-organized into food cooperatives ensuring links between the various actors in the sector. The distribution of products is interconnected and interregional (importance of scale: from local to greater-regional) and is ensured by the rail network and the tramway.

# Strategies



- ✦ New multifunctional district
- ▨ Urbanization
- Urban green
- Forest – Green belt
- Water network – Blue belt
- Ex highway – New centre of attraction



## — Roof Potentials and Building Up

By combining high-resolution surface models of the city area with long-term meteorological data and building data, we optimised the selection of buildings suitable for extension and roofs suitable for solar photovoltaics (PV) or green roofs. For rooftop PV, we used roof morphology to identify suitable patches which are uniform in slope and orientation as well as non-obstructed by obstacles such as dormers or chimneys. We found that about 40 % of roof area is suitable for PV. Very well-suited roof patches are reserved for PV installation where a solar irradiation of more than  $900\text{kWh}/\text{m}^2/\text{year}$  is received, producing 600 MWh per year and avoiding emissions of 216 t CO<sub>2</sub>eq per year. All roof patches below this level of irradiation and with a slope of less than 12 degrees are suitable for installation with green roofs, which is about 25 % of the roof area. Additionally, roof spaces with flat roof tops and a footprint larger  $100\text{ m}^2$  are reserved for horticulture activities. Buildings suitable for extension are residential, multi-family buildings constructed after 1950, which account for 10 % of buildings, yielding more than 100,000 m<sup>2</sup> in additional living space in Luxembourg as a whole (14,000 m<sup>2</sup> in Esch), assuming these buildings are extended by two floors. Buildings that are extended are also simultaneously renovated, reducing energy consumption by 20 %.

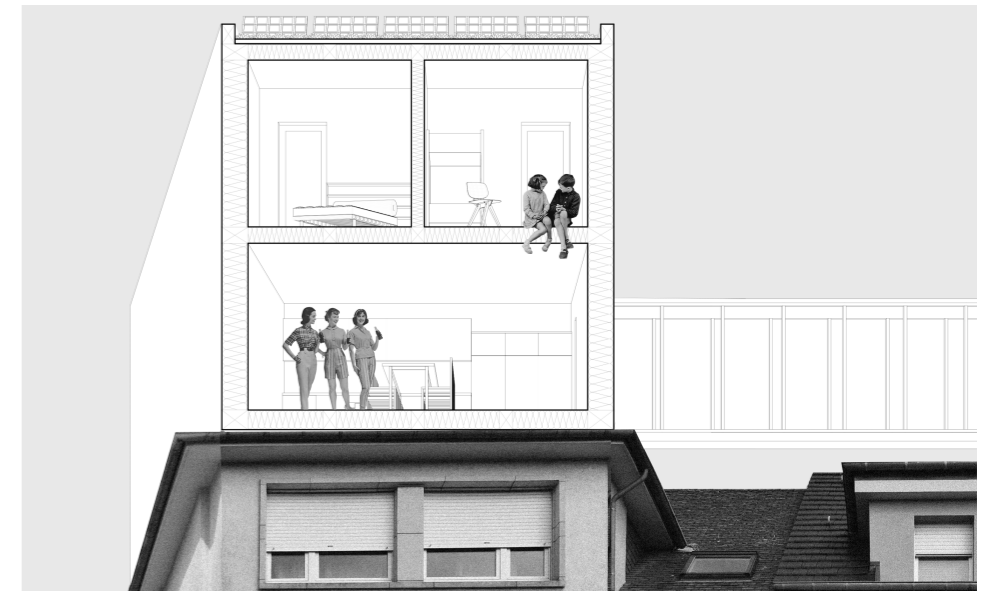
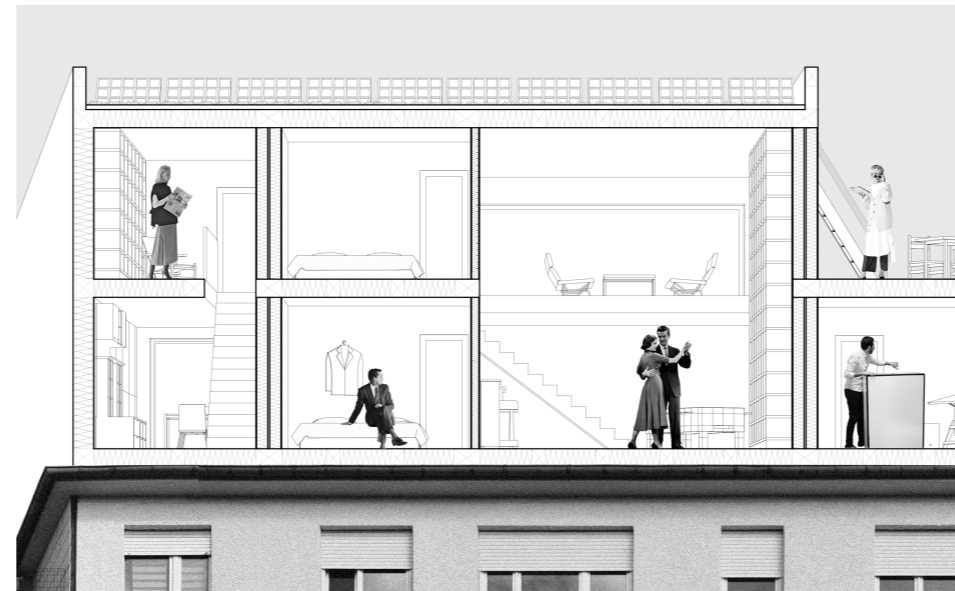
- Overall PV Potential
- Horticulture
- Green Roof
- Suitable Building Extension
- < 0.11 €
- 0.11 – 0.125 €
- > 0.125 €



# Strategies



# Strategies



## Mutualisation

From an urban development point of view, not only the energy renovation and equipping of the roofs with PV and green roofs presents a significant added value, but—above all—the generation of new housing units and of additional public and community uses, which will allow a sort of “inner” densification. The creation of shared functions on existing buildings, in which most of the apartments are extremely large, makes it possible to reduce their surface area and to make the structure of the existing apartments more compact. As a target in the metric of the first report, we had set an average per capita housing space of 31 m<sup>2</sup> plus 4 m<sup>2</sup> of shared space for the whole housing stock. The creation of shared spaces such as co-working, shared kitchens or common guest apartments built on top of existing residential buildings will make it possible to achieve this average smaller living space also in existing buildings. On the ground floors, where mainly garages exist today, more public, commercial, and tertiary functions will be located: small shops, repair shops and other workshops,

or small offices. This will diversify and revitalise streets, which are today largely mono-functional, especially in suburban areas.

## Empowerment

The mobilisation of engaged inhabitants for this transformation process is essential. Therefore, in this twin city, each neighbourhood will have its own local Transition Lab, which is both a physical meeting space and a co-creative process for incubating and realising local transition projects. All interested residents, civic associations, and local companies are invited to engage in their Transition Lab, where they will be supported by professional facilitators and action researchers. All Transition Labs of the twin city are connected through the Esch-Audun cross-border Transition Hub responsible for synergizing the transition projects across neighbourhoods and sectors, while assuring exchange of best-practice transition tools and practices across the cities of the functional region.

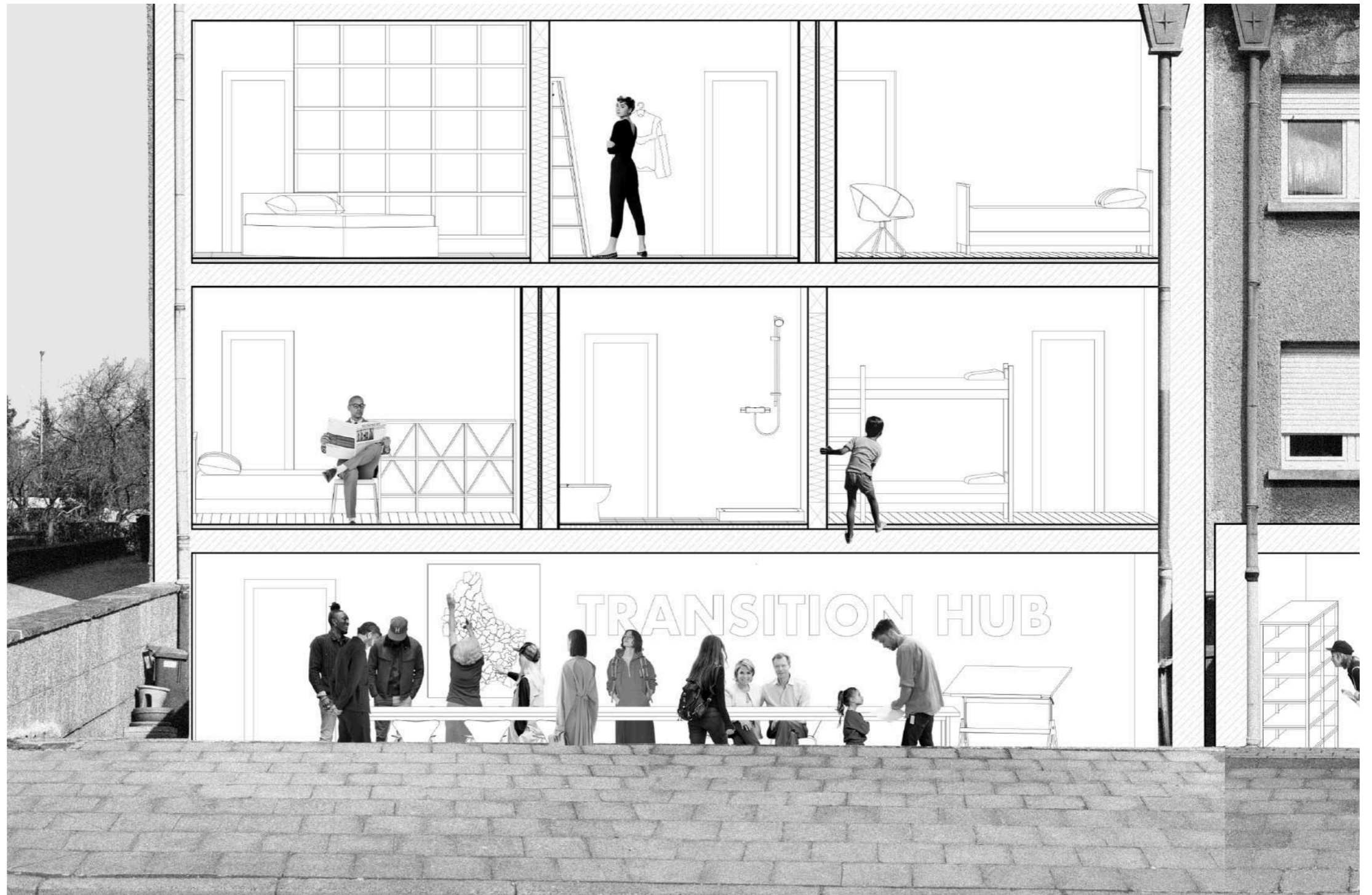
## City Without Cars

Finally, another—and no less central—strategy is the gradual removal of the automobile from the city. This will make the (re)use of these former fossil-era spaces possible. In a first stage, combustion engines will be replaced by electric or hydrogen driven cars, the car-sharing system in the city will be greatly expanded, safe cycle paths will be systematically installed on all major roads, and the two tram lines will be routed across and around the city by 2028. In a second step, between 2030 and 2040, privately owned cars will finally be banned from the city, the entire public space of the city will be transformed into a shared space (where shared cars are only allowed to drive in exceptional situations) and the conversion of the many fossil spaces will begin. Humans, in co-habitation with other living beings, have reclaimed the city, which is now densified and diversified—at the same time green and healthy.

## Practices

Ana is an architect from Esch. She is a member of the so-called ‘post-growth generation.’ A daughter of Portuguese immigrants and workers, Paolo and Beatriz, she grew up in Esch, but barely remembers what the city used to look like before the transition started. During the last thirty years, Esch grew significantly, mainly through the construction on top of the existing buildings and sealed surfaces. Already in the late 2020s, Ana’s parents applied for the popular municipality-sponsored roof extension and energy retrofitting scheme, that provided them with an additional (future Ana’s) room next to the newly built apartment on the second floor. Her friend Lara was a bit luckier—their building was extended for two floors that included a shared swimming pool and a cinema on the rooftop, both managed by the community of neighbours.

She is now sitting with her father Paolo, browsing through photos of the old Esch. One thing strikes her the most—almost all of the parking spaces are gone. The transformation of the surrounding Foetz returned centrality to Esch, radically diminishing the use of cars. The concrete islands turned into squares, cooperative housing and vertical gardens. As an architect, in fact, one of her first commissioned projects was precisely a re-adaptation of several connected and remaining parking spaces into a small dog park. Today, she is working on a much more complex task of re-development of Terre Rouge into a forest with residential neighbourhood. The displacement of the steel factory infrastructure in 2020s was a very emotional move for many in Esch. Steel industry, or as Paolo likes to joke today—carbon, as a metaphor of Luxembourg’s Fossil Era—was seen as part of national identity. The 2020s Master Plan proposed to detoxify the site with the planting of the dense forest, which should have been partially revisited today, in 2048, for the new housing construction. This sounded so easy back then, but a lot has changed. With the introduction of referendums and participatory planning, Ana’s job as an architect now involves regular meetings with the citizens. Needless to say, these can get pretty intense. Today is one such day—she will meet with a local community in one of the Transition Hubs, continuing for a collective walk through the Terre Rouge forest. Still, she sees this as a regular part of her work. Architects today learned to challenge the technocratic planning approach and embrace processes of repair, and above all, conversation, as core aspects of their profession. That sounds nice, but now she better brace herself for an explosion of all those (often contradictory) visions and ideas she needs to find her way through.



# — 02 Towns and Villages

Case study: Tiercelet Network Village



## Towns and Villages

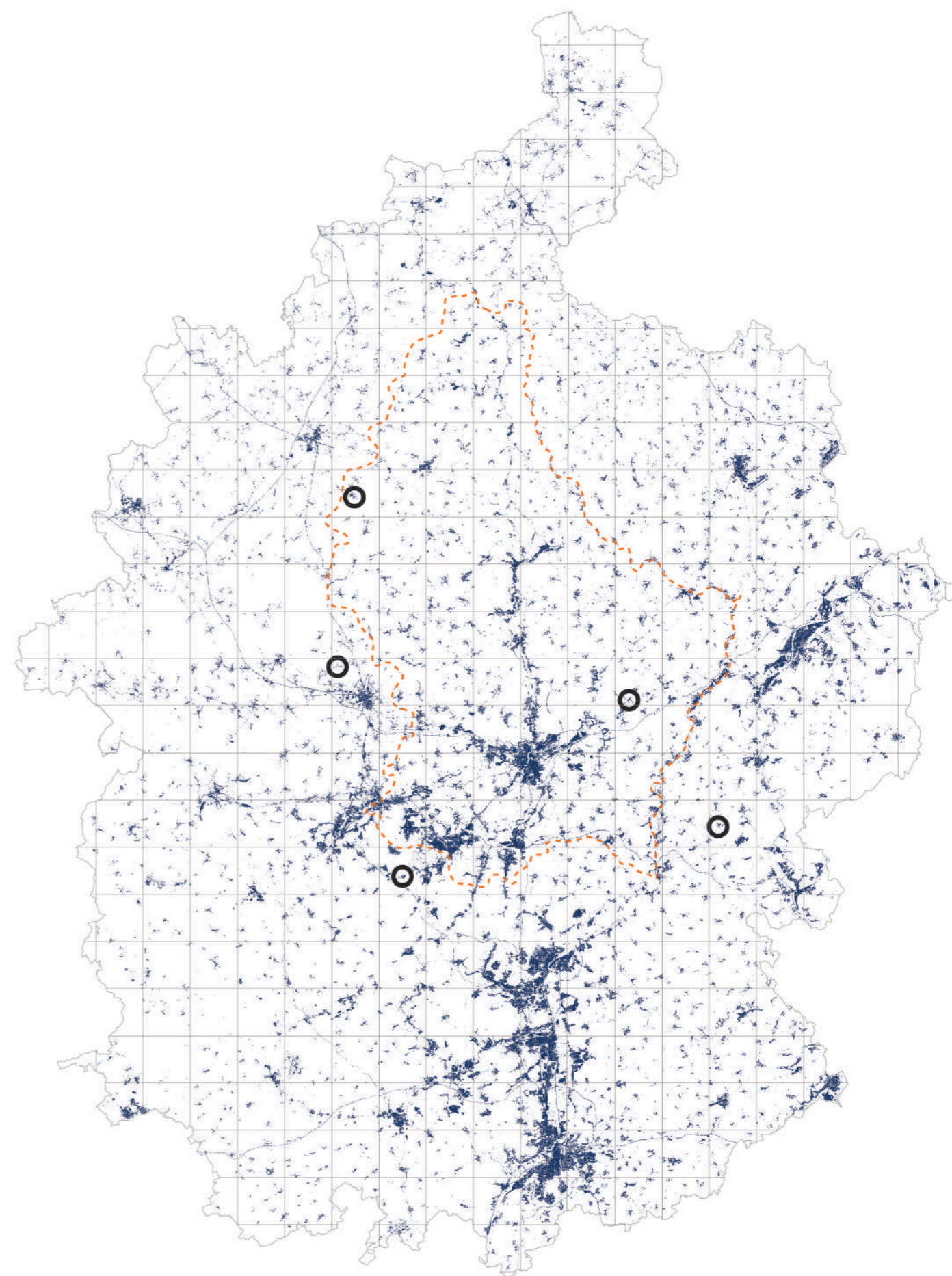
Villages and small towns of less than 10,000 inhabitants currently often come across as dormitories. They are home to people, who rely on cars for everything except some leisure activities: to go to work or to buy even the most basic products, to take their children to school or to meet friends. In this mobility effort, the daily commute to work is the most significant: on average, inhabitants of municipalities like Tiercelet travel 54 min to work one-way, spending 460 hours a year in their cars just on their commute, which are most often occupied by one person only. Public transport cannot cover the necessary mobility of these people, because these small towns and villages together form a proliferating carpet across the territory. In addition, the public transport system of the border areas does not dovetail with those of Luxembourg. Many of the inhabitants of these places—where new single-family homes are currently sprouting up like mushrooms everywhere—have their social contacts in other municipalities and towns rather than in the village itself. Moreover, they live in these “sleeping towns” because most of them cannot afford an apartment near their work. Across the border, housing prices drop relatively quickly. Now, our proposition for these small towns and villages is not to optimise and decarbonise individual transport with the help of electromobility or smart city concepts that increase the need for primary energy, but rather to enable the inhabitants to live better with less mobility.

### New Commons

The pandemic has pushed teleworking, which has been intensively discussed in urban planning discourses since the 1990s. Simultaneously, many home workers also suffer from the home office after a year of social isolation and less physical movement, and sometimes too much time in their own homes. Our project now envisages reinterpreting what used to be called the commons in the villages: each village, like Tiercelet, will receive a co-working space that is made available to the residents for free. Their employers alone pay for the upkeep of these spaces, but in turn undertake to initiate the transformation of the now redundant office spaces in the city into affordable housing and other uses essential to urbanity.

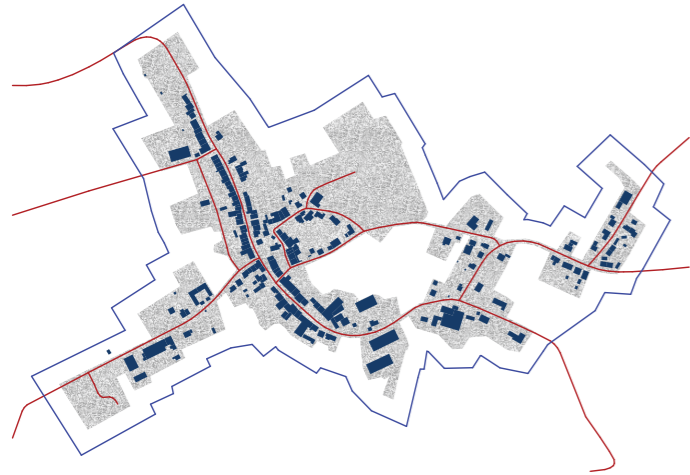
In Tiercelet, two buildings will be dedicated to co-working activities. Building 6 (the current automotive retailer, approx. 500 m<sup>2</sup>) will be transformed in an open workshop/makerspace, where craft and repair activities can take place. It will provide workstations, machines, and tools that can be flexibly rented and

used onsite by professional craftsmen/women, private individuals, associations and schools. Building 7 is designed for office work with both open spaces, individual rooms, and (video) meeting facilities. It hosts up to 80 people and offers flexible short- to long-term booking options. This co-working space is also used for co-creative Transition Hub meetings. Twelve neighbouring rural municipalities have established a joint Transition Hub in 2025. Ever since, citizens, civic associations, schools, local farmers, and enterprises as well as municipal councilors and staff imagine, develop, implement, and monitor transition projects together in and across the villages, based on participatory budgets.

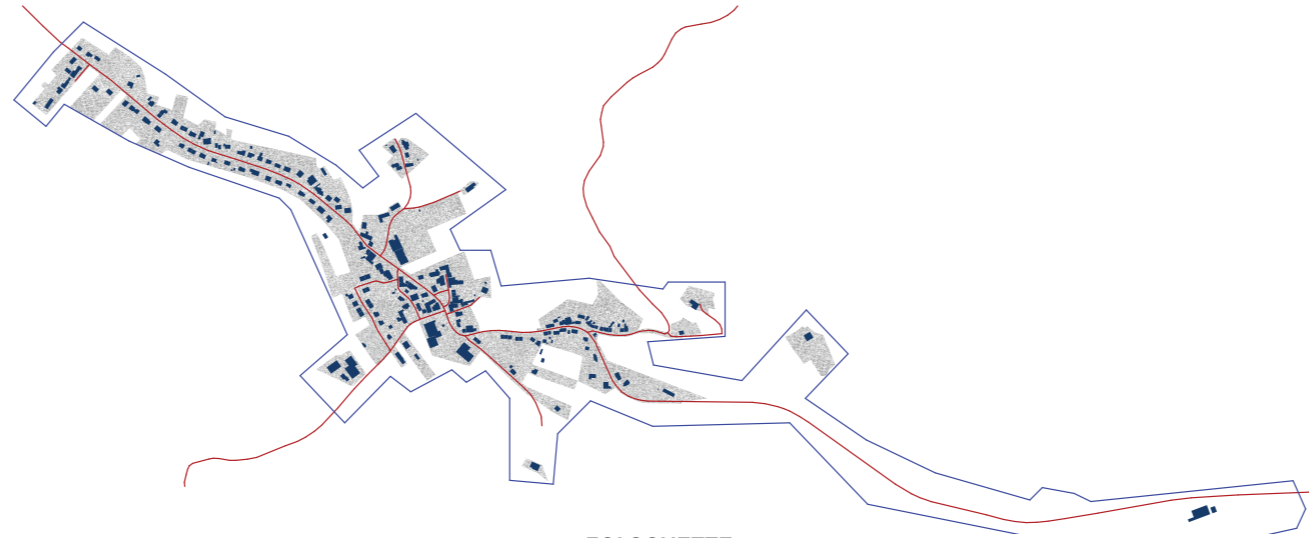


Towns and villages in the Functional Area

# Atlas



**FAHA**  
*Mettlach (DE)*  
site area: 57,0 ha



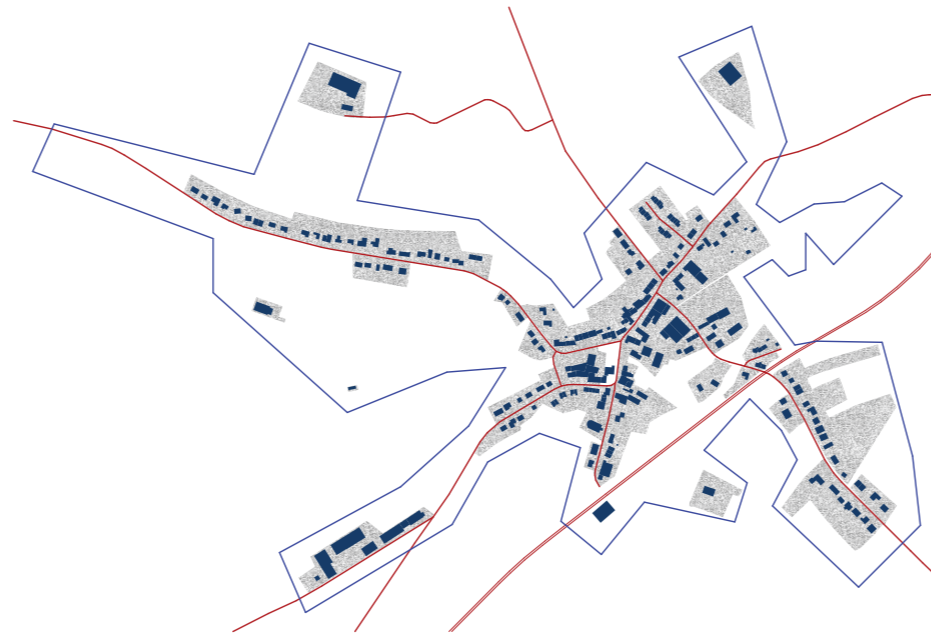
**FOLSCHETTE**  
*Rambruch (LU)*  
site area: 75,8 ha



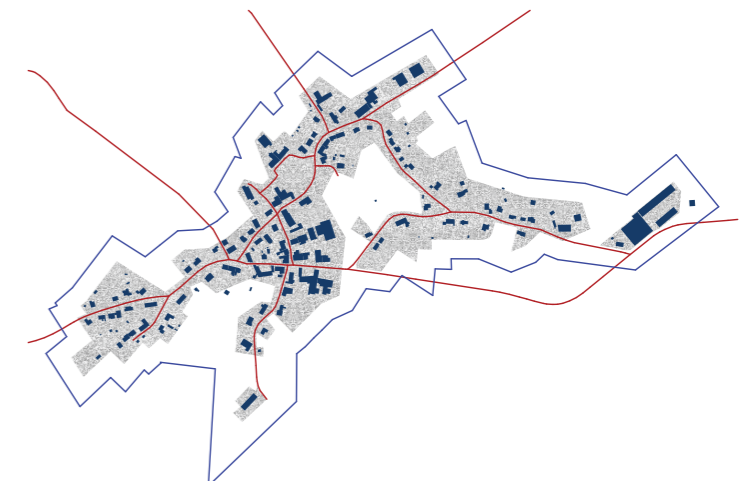
**TIERCELET**  
*Tiercelet (FR)*  
site area: 52,1 ha



**LUXEMBOURG CITY CENTER**  
area: 41,1 ha



**OLINGEN**  
*Betzdorf (LU)*  
site area: 89,2 ha



**LISCHERT**  
*Attert (BE)*  
site area: 46,9 ha

## Strategies

- 01 Making the budgets of small municipalities in Luxembourg independent from their growth
- 02 Establishing tax compensation for transborder communes
- 03 Enabling teleworking in co-working spaces
- 04 Ensuring basic supply by mobile networks
- 05 Promoting car-sharing in each village
- 06 Connecting villages through e-buses into the tram network
- 07 Energetic renovation with PV and greenery on roofs
- 08 Supporting barrier-free adaptation in order to promote inter-generational forms of living

### More Space, More Energy

Traditionally, families are seeking single family homes (SFHs), looking for space and privacy. However, such houses use more energy to heat, per person, when compared to multi-family homes (MFHs), let alone apartments in higher-rise buildings. Even with the same energy label, the useful floor area per person is higher in SFHs: of the 35 m<sup>2</sup> used per person in 2050, 10 m<sup>2</sup> will be in SFHs, and 25 m<sup>2</sup> in MFHs—but SFHs will still require about 30 % more energy to heat on the aggregate.

### Sharing is Caring

The vehicle ownership of Luxembourg and the functional area (around 60%) means that most adults have their own private vehicles. A favourable tax regime, especially towards company cars, instead of towards helping the active population to live next to where they work, means workers seek housing in towns and villages, entailing long commutes and high expenses for a house that is not used. Ending the company car culture and encouraging teleworking could reduce the use of private vehicles drastically – more “local” living also means that soft mobility can cover most mobility needs. In this vision, the mobility in 2050 will be split equally, with 16 billion passenger-kilometers (Gpkm) in private cars, and 16 Gpkm in buses, trains, trams, or bicycle and walking (from 24 and 10 Gpkm respectively in 2020). Along with electrifying the remaining automotive fleet by 2050, this means that mobility-related GHG emissions can be cut by a factor of 5, per person.



# Strategies

— 2021



Existing situation

In Tiercelet, building 5 will be restructured to accommodate various services for the local population, in particular retailing and health services. The size of the village does not allow operating a private grocery. A community shop, run by a local association with the help of partly remunerated volunteers, offers a certain range of food and non-food products provided by local producers, driving merchants or pre-ordered from more remote producers in the Greater Region. The time slots used by the driving merchants are coordinated and alternate with the neighbouring villages in order to optimise the merchants' circuits and timetables. Similar to the resident store concept, another part of the building will be at the temporary disposition of medical services, including a medical doctor/general practitioner offering her service one morning per week. This basic service is complemented by further health specialists offering physiotherapy, TCM, psychotherapy, and similar activities in those shared premises. A coordinator employed by the municipality takes care of the booking, promotion, and maintenance of the service building. This person will act as an intermediary and will be in close contact with local community initiatives, external service providers, and public authorities.

The transformation of single-family homes provides an answer to the ongoing change in household constellations. In the post-family phase, homeowners can convert the unoccupied living spaces into smaller apartments and, subsequently, rent them out. Barrier-free living spaces can be organised on the ground floor for the last residential phase. At the same time, the entire house can be renovated and better insulated, with an enclosing conservatory extension, to provide an example.

— 2040

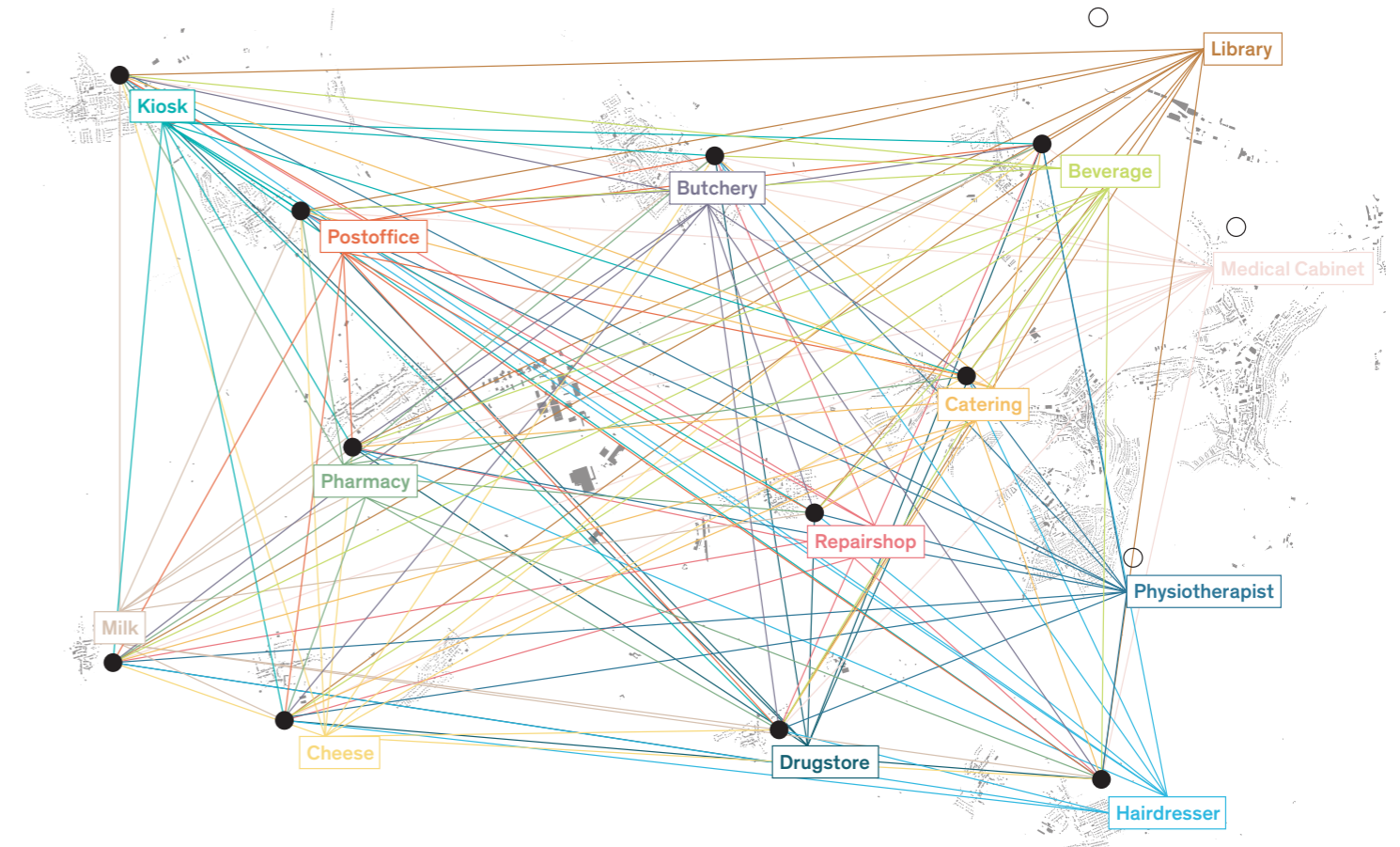


A new "T" for Tiercelet: Common uses on a shared space. Buildings: 1—Workshop Space, 2—Brasserie *Claudine*, 3—Town Hall, 4—Primary School, 5—Market Hall, 6—Repair Shop, 7—Co-Working Space

The surrounding landscape is an important recreational area for residents and families in which they spend their free time. The transformation towards a diverse agriculture and thus a landscape, especially in the winter half-year away from fallow land and towards permanent soil cover, significantly increases the recreational value of the landscape. People will be encouraged to grow their own fruit and vegetables in private and community gardens in the immediate vicinity of their homes. Initiatives such as community supported agriculture, but also forms of direct marketing on the farms, e.g. farm shops and restaurants, enable people to enjoy local agricultural products and appreciate the Luxembourgish natural landscape.

In 2035, the EU will have eventually passed a legislation for cross-border metropolitan regions (CBMR), eliminating tax and social security-related limits for cross-border commuters and hence generalising remote work from the place and country of residence as much as possible. As a model, CBMR committed to a polycentric transition, the Greater Region countries will set up a scheme through which 3,5% of (former) commuters' income tax will be transferred to their municipality of residence.<sup>5</sup> Municipalities with more than 50% of commuters in their active population will receive compensation to adapt their public infrastructures. As a result, those municipalities will receive a chance to contribute actively to the zero carbon transition. As residents will spend more time and money in the village, local life and local economy will become reinvigorated.

# Strategies

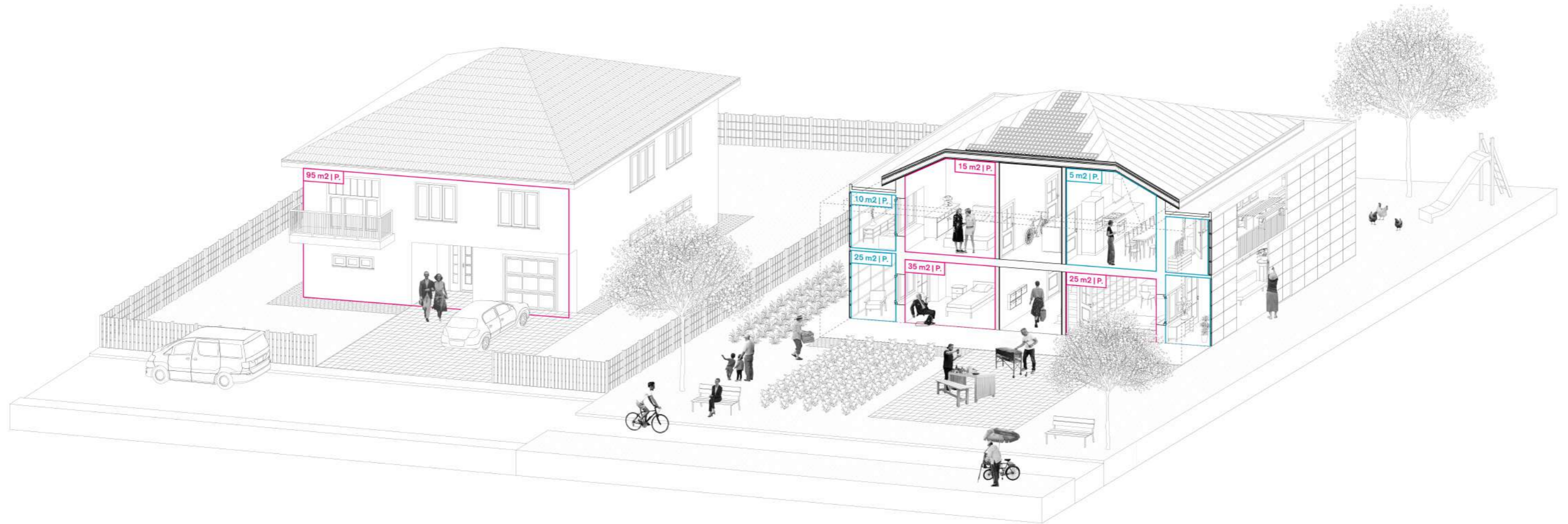


Another strategy for villages like Tiercelet is to replace mobility to utilities by mobility of the utilities themselves, which will be interconnected in the immediate region. People will have less need to travel to other places to get supplies; instead, providers will cover a manageable network of villages that they drive to every day, just like the ice cream truck used to do.

# Practices

— 2021

— 2050



It's Monday morning in Tiercelet, and Jacques and Mira are getting ready for work. The two met during the 2020s, when Mira moved from Bosnia and got a job as a nurse at the hospital in Esch, where Jacques already worked as a technician. Back then, she would wake up at 5:00, prepare and drive with her car for the start of her shift at 7:00. Jacques had those two additional precious hours of sleep before his shift at 9:00. He would take his car, drop the kids off at the kindergarten, and drive to work. 'So close, but so far away'—they used to describe Esch, referring both to its real estate prices that made them abandon the idea of moving there, but also to the lack of public transportation to the place that was just 14 kilometers away from their home.

When the transition started, the two of them, like many other citizens of the Greater Region, were sceptical about whether the implementation of policy and infrastructural strategies will actually cross the border. Living in a village like Tiercelet makes you get used to the social, cultural, economic and political 'in-betweenness' as a citizen, asking yourself—is it about where I live or where I work, and how, after all, to draw clear boundaries between the two? Jacques and Mira knew already back then that there is no real sustainable development without taking the cross-border region into consideration.

Today, more than twenty-five years later, life in Tiercelet looks very different. The introduction of an e-bus line and a bike line to Esch, made cars practically obsolete. With most of the hospital infrastructure run

remotely, Jacques is now working mainly from a co-working space. Operating as a new commons, the co-working space, developed and financed by the municipality, is connected to the kindergarten and a care center for the elderly, where Jacques occasionally helps the older folks fix their electronic devices. With many people now using the co-working space instead of commuting, Tiercelet feels alive again. The turn towards local food production reduced the individual shopping trips, also inspiring new business models. The case in point are Jacques's neighbours, Elena and Ada, whose bakery delivers fresh bread every morning to the surrounding villages. As a nurse, on the other hand, Mira still needs to be physically present in Esch. Instead of a car commute, she now takes her e-bike, or if she is in a hurry (even the most stoic early-birds sometimes do oversleep the alarm), she takes the e-bus, reaching Esch in less than 20 minutes.

The end of the fossil era brought new functions to the garages in a village, which now transformed largely into storage rooms for food and sometimes into small pop-up restaurants and cafes. The former car dealer at the corner of Rue Honore de Balzac and Rue Jean Racine turned into a repair shop for gardening tools. With the e-bus stopping only at the fringe of the village, the inner streets are now occupied mainly by bikes and occasionally shared cars. Walking still remains the main 'mode of transportation,' because Tiercelet is still that tiny place it used to be.

# — 03 Farms and Fields

Case study: Agro-Forestry Productive Landscape



## Farms and Fields

As part of the ecological transition, society places a wide variety of demands on agriculture and its practices, which all actors of the food system have to meet. The structure and location of agricultural holdings differs from farm to farm, with different field sizes and access routes. Farm consolidation is a trend: While the number of large farms with more than 150 ha has been increasing for years, the total number of farms has declined, and stood at 1900 farms in 2019, of which 105 were organic farms. The majority of farms are livestock farms: 1200 farms keep suckler cows, dairy cows or both, some of the farms also grow energy crops in addition to feed. In Luxembourg there are currently only a few farms producing vegetables or fruit, despite the importance of this sector to healthy, climate-friendly diets.

### Climate-Friendly Diet

Meat and dairy products account for more than half of food-related GHG emissions. Ruminant livestock, in particular, emit methane and nitrous oxide from enteric fermentation and manure management. In addition, all of the inputs and soil emissions from feed production must also be attributed to livestock production. While switching to completely vegetarian or vegan diets would yield the largest reductions in GHG emissions, we propose switching to a flexitarian diet, which consists of an omnivore diet 1 day per week and a vegetarian diet 6 days per week. The flexitarian diet meets the dietary guidelines and beef production would come from dairy herds rather than dedicated beef herds. Switching to the flexitarian diet would reduce GHG emissions by 40 % (see Annex for further details).

### Soil Health and Carbon Sequestration

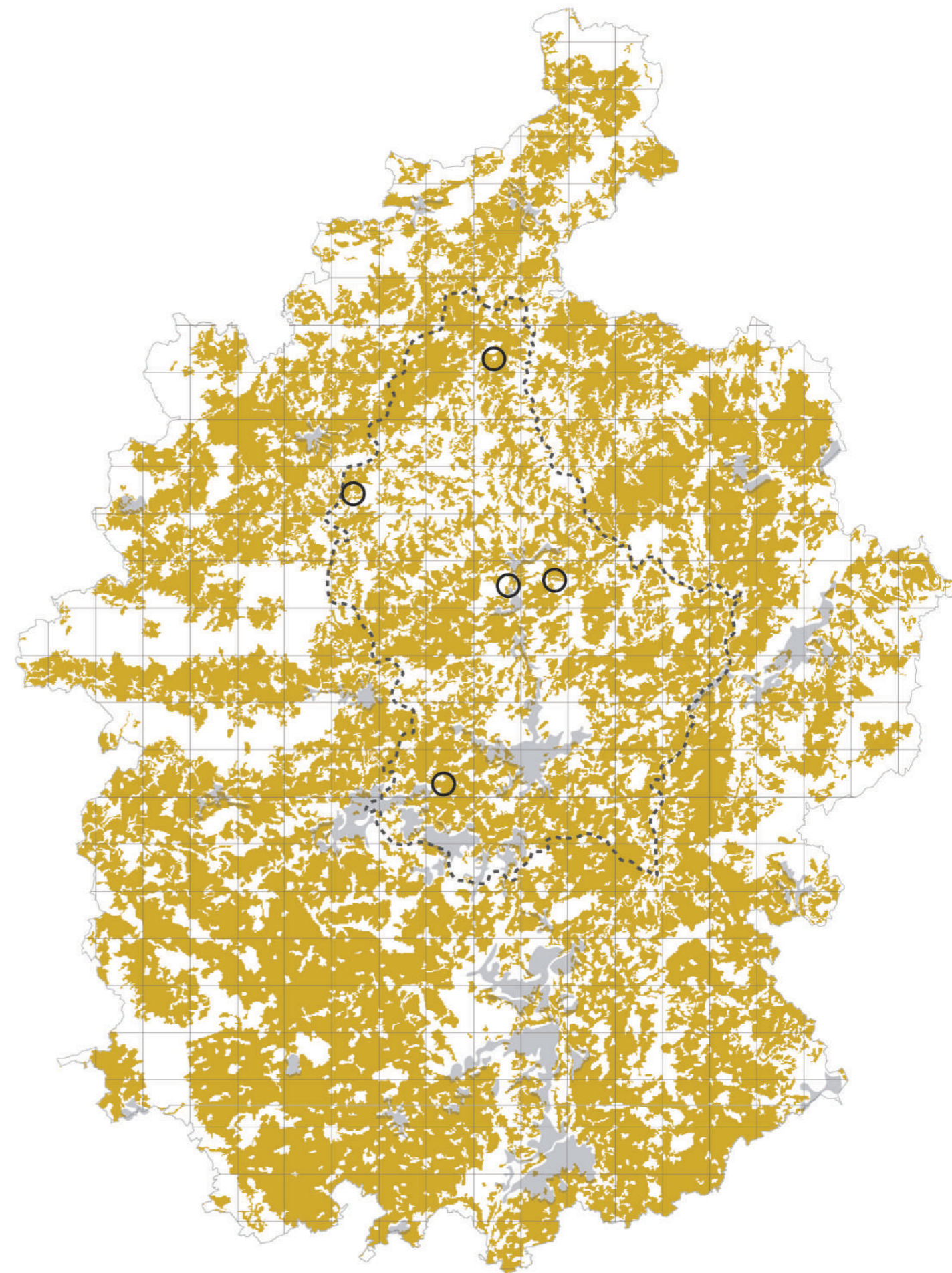
Luxembourg needs a diversified landscape to improve biodiversity and meet the needs of diversified diets. Currently, Luxembourg consists of 50 % permanent grassland and 50 % arable land. The aim is to maintain and diversify the existing agricultural land. Biodiversity on and in the soil is improved by increasing structural landscape elements, the stock of trees and bushland areas that interconnect habitats, as well as by widening the crop rotation from 3 to 7 crops and reducing tillage to support humus formation.

A particular focus is set on maximizing the carbon uptake through agri- and silvicultural areas as well as on the reduction of agricultural GHG emissions by a reduced livestock. Ruminants remain an important link

between the grassland and the arable land, as organic fertilisers from animal husbandry favor soil fertility, and as ruminants are the only way to transform grasslands into edible energy for humans. Their number will significantly be reduced to area-bound animal husbandry relying on grassland-based feeding favoring summer grazing. Along with the use of adequate agricultural practices, N and P emissions and the application of pesticides can be minimized. Moreover, the optimization of the cultivation techniques of arable land will help to decrease GHG emissions towards C sequestration and a balanced soil water content. Due to the reduction of farm manure and the cultivation of energy crops, other forms of energy generation are required on agricultural land. This demand is met by installing PV on the roofs of the farmhouses and barns as well as up to 5% agrivoltaics in the fields.

### Food Sovereignty

The number of animals will be drastically reduced in order to minimise emissions from animal husbandry and, in return, to maximise the areas for human plant-based nutrition, also with a view to population growth and public health, as well as planetary efficiency concerns. This is closely related to the population's food consumption and the associated food production and processing. Consumer based agriculture, direct marketing via farm shops and restaurants will reconnect people to the surrounding landscape and local agriculture. A key moment of the transition will be the appreciation of agricultural work and products by the society, which can be achieved in particular through the proximity of high-quality food production and prosumer commitment, and through the inclusion of a variety of food system actors.



Agricultural land in the Functional Area

# Atlas



**STEGEN  
(LU)**  
site area: 105,1 ha



**HARLANGE  
(LU)**  
site area: 70,4 ha



**COLMAR-BERG  
(LU)**  
site area: 71,7 ha



**SPRINKANGE  
(LU)**  
site area: 96,9 ha



**HUPPERDANGE  
(LU)**  
site area: 98,5 ha



**LUXEMBOURG  
CITY CENTER**  
area: 41,1 ha



## Strategies

- 01 Diversifying crop rotations
- 02 Reducing tillage and using cover crops
- 03 Hedgerows along field edges
- 04 Reducing use of synthetic fertiliser and pesticides
- 05 Grass-fed versus grain-fed cattle
- 06 Reducing the number of cattle and raising them on pasture
- 07 Combining crop and solar power production with agrivoltaics
- 08 Increasing carbon uptake with agro-forestry

### Soil Health is the Key to Climate Health

With regenerative agriculture, crops can develop longer roots that funnel carbon from the atmosphere into the soil, where it is stored for thousands of years instead of being released back into the atmosphere when a field is tilled. In central Europe, organically managed land has a 10 % higher soil organic carbon content than conventionally managed land.

### Huge Potential of Agrivoltaics

If agrivoltaics are installed on 6 % of arable land in the functional area, they could meet the region's entire electricity demand and reduce power-sector GHG emissions by 90 %.

### Cow Burps—Silent, but Potent

One cow burps out 2.5 t CO<sub>2</sub>eq of methane per year. This means the carbon footprint of 1 person living in the functional area is equivalent to the annual enteric fermentation emissions of only 6 cows.

### Eat Well and Save the Planet

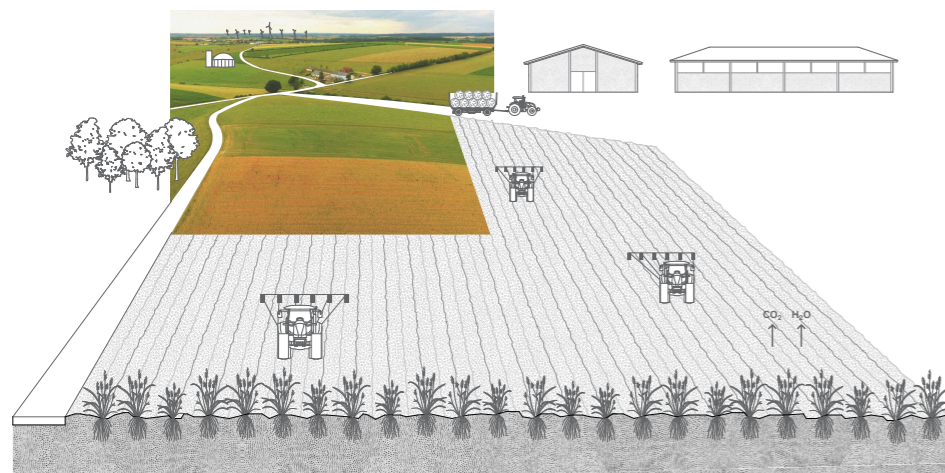
Following dietary guidelines and eating a healthy omnivore diet would reduce food-related GHG emissions in the functional area by 30 %. Reducing meat consumption would also free up the 75 % of arable land in Luxembourg that is used for livestock feed production and reduce our need for food imports.

### Save Money and the Climate

Smart food shopping, shared recipes for managing leftovers, and new markets for imperfect or soon-to-expire produce can reduce food waste, which constitutes 25 % of food-related GHG emissions.

# Strategies

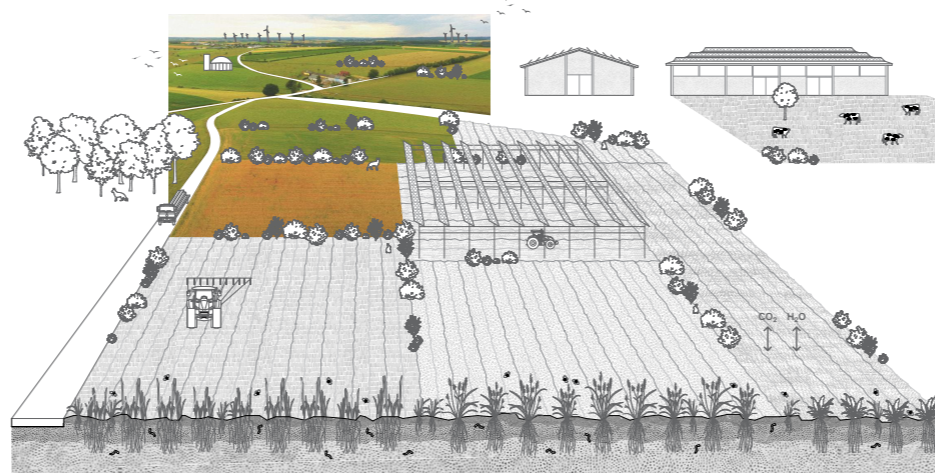
— 2021



Conventional cultivation

In 2021, agricultural production is characterised by a focus on livestock and feed production, with the latter occupying 75 % of arable land. Farmers manage their land through a three-crop rotation system, such as maize, winter wheat, and rapeseed. Synthetic pesticides are used to manage weeds, insect pests, and nematodes with adverse impacts on off-target organisms and ecosystems. Tillage is one way of managing weeds, but it reduces soil health, soil organic carbon sequestration, and soil water retention. The result is that soil health is poor due to tillage, pesticides, overapplication of fertilisers. Plants can grow only short roots into the compacted soil. Overall, biodiversity in this landscape is poor.

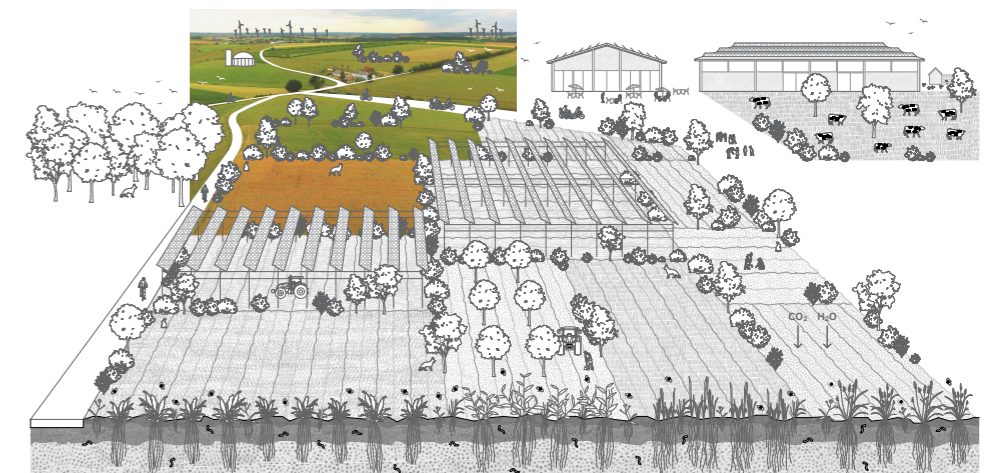
— 2030



Diversification process

In 2030, cover crops and reduced tillage translate into less required fertiliser and reduce nitrogen and phosphorus emissions to waterways. Water quality improves as a result, as well as through the planting of hedgerows around field edges. The hedgerows serve mainly as a habitat for beneficial insects and as a means to increase carbon uptake. Barns with their large surface area are equipped with rooftop solar photovoltaics to contribute to electricity decarbonisation. Solar photovoltaics are also installed on 5 % of cropland to meet 80 % of the functional area's electricity demand. These agrivoltaic systems can protect crops from intense sunlight and make efficient use of land to produce renewable energy.

— 2040

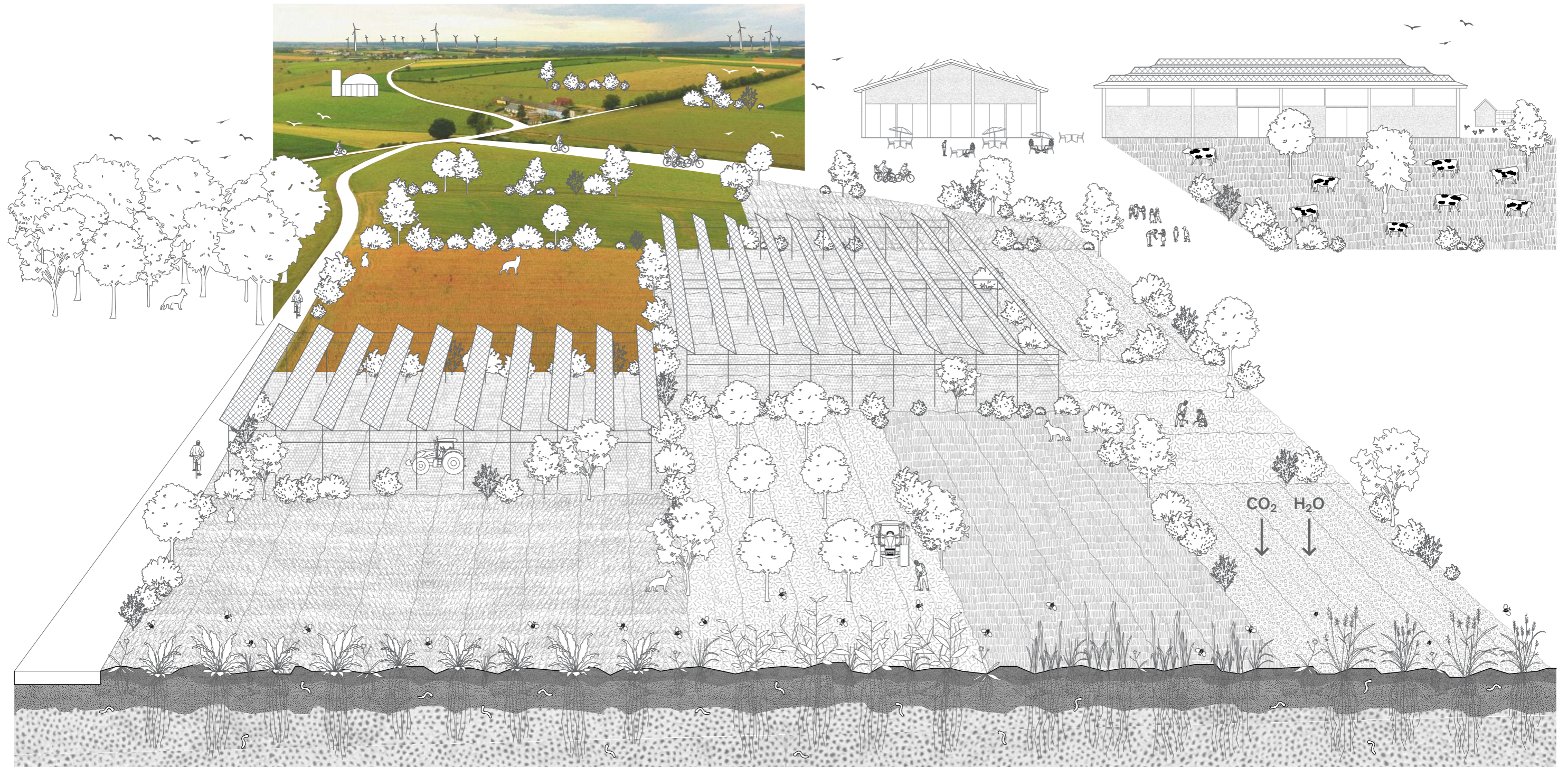


Agro-ecological farmland

In 2040, reducing the consumption of beef means fewer cows that can move from the barn onto the meadow. Cattle are now raised entirely on pasture, supplemented with a feed consisting of field fodder instead of grains through the winter months. The manure collected in winter from barns is enough to fertilize all fields, and we do not require any additional biogas plants to deal with methane emissions from excess manure. By shifting away from grain-fed livestock, the freed-up arable land previously used for feed production is used to produce a more diverse set of crops, including fruits and vegetables. A more diversified crop rotation extended from 3 to 7 crops means pests and nutrients can be managed with fewer synthetic pesticides and fertilisers, which are energy-intensive inputs in agricultural production. Pollinator health improves as a result of reduced pesticide use.



# Strategies



The landscape has become a rich mosaic mixing agro-forestry, biodiversity, energy production, leisure, all while sequestering carbon

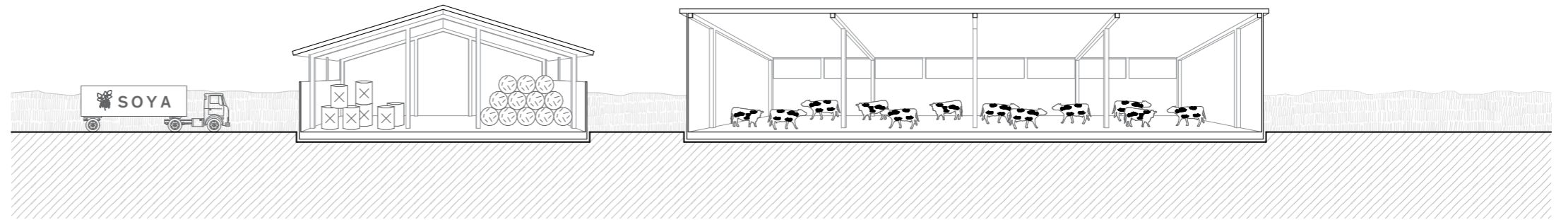
## Practices

It's a sunny April morning on "Dem Irma säin Haff," and the farm dog Koko made it *loud* and clear that they had a visitor—a fox from the nearby forest returning from its nightly hunt. Reassuring Koko that she is still their best non-human friend, Julien and Irma start their preparations for a busy day on the farm. On Fridays, they usually have a visit by kids from local kindergartens, coming to play and learn to take care of animals and plants. If the weather is nice, like today, there is also a lot of visits to their shop and a small restaurant that serves seasonal food from their garden. Luckily, the two of them are not alone in this. Twenty years ago, when they entered the transition to organic agriculture, they decided to split the farm shares with their workers—Dragan, Carlos and Veronica—with whom they now share both profit and responsibility.

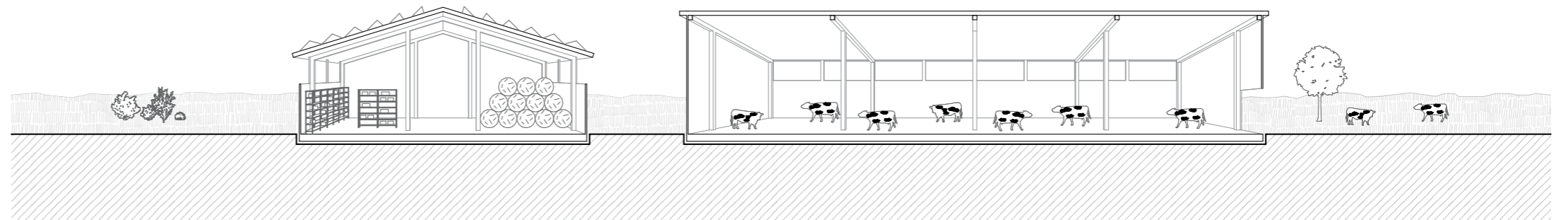
The shift to the then-called 'organic agriculture' (and now simply 'agriculture'), radically transformed the relationship between people, animals and plants on a farm. The former 'industrial logic' of farm management appeared to be the only way to make profit. In reality, the opposite was true. The introduction of conservation tillage and mixing of different crops regenerated the fertility and biodiversity of the soil, thus increasing the food quality. The hedgerows around the field, turning into habitats for beneficial insects and predators, helped replace chemical control of pests. Releasing the cows from the stable made the least attractive job on a farm—collection of cow manure and its transportation to the biogas plant and back—obsolete. Instead of importing soybeans or planting crops for animal feed, the cows are now dining half a year directly on the grasslands, freeing up the land for the production of human food. In a word, less control brought colours, smells and sounds to the farm.

Technology also played a role in this process. The installation of agrivoltaics and a shift towards electric and automated tractors, made cultivation easier and cleaner, leaving space for less repetitive work. With many of the farms turning into co-operatives or adopting other models of collective ownership, they started to look less like 'fortresses' and more like nodes in a network in which tools, knowledge and labour are shared. A shift towards vegetable production helped free space in the stables, allowing many farmers to complement their businesses with shops and restaurants. In this transition, farms became go-to weekend destinations for hikers and cyclists. Two of them, Nora and Paolo, are already on their way.

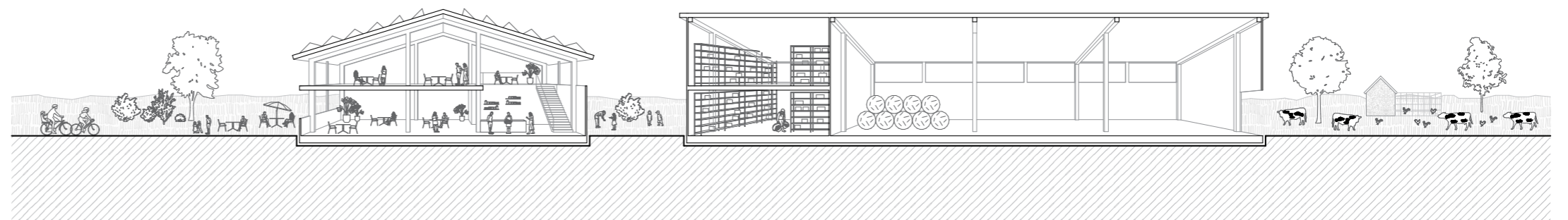
— 2021



— 2030



— 2040



# — 04 Commercial Zones

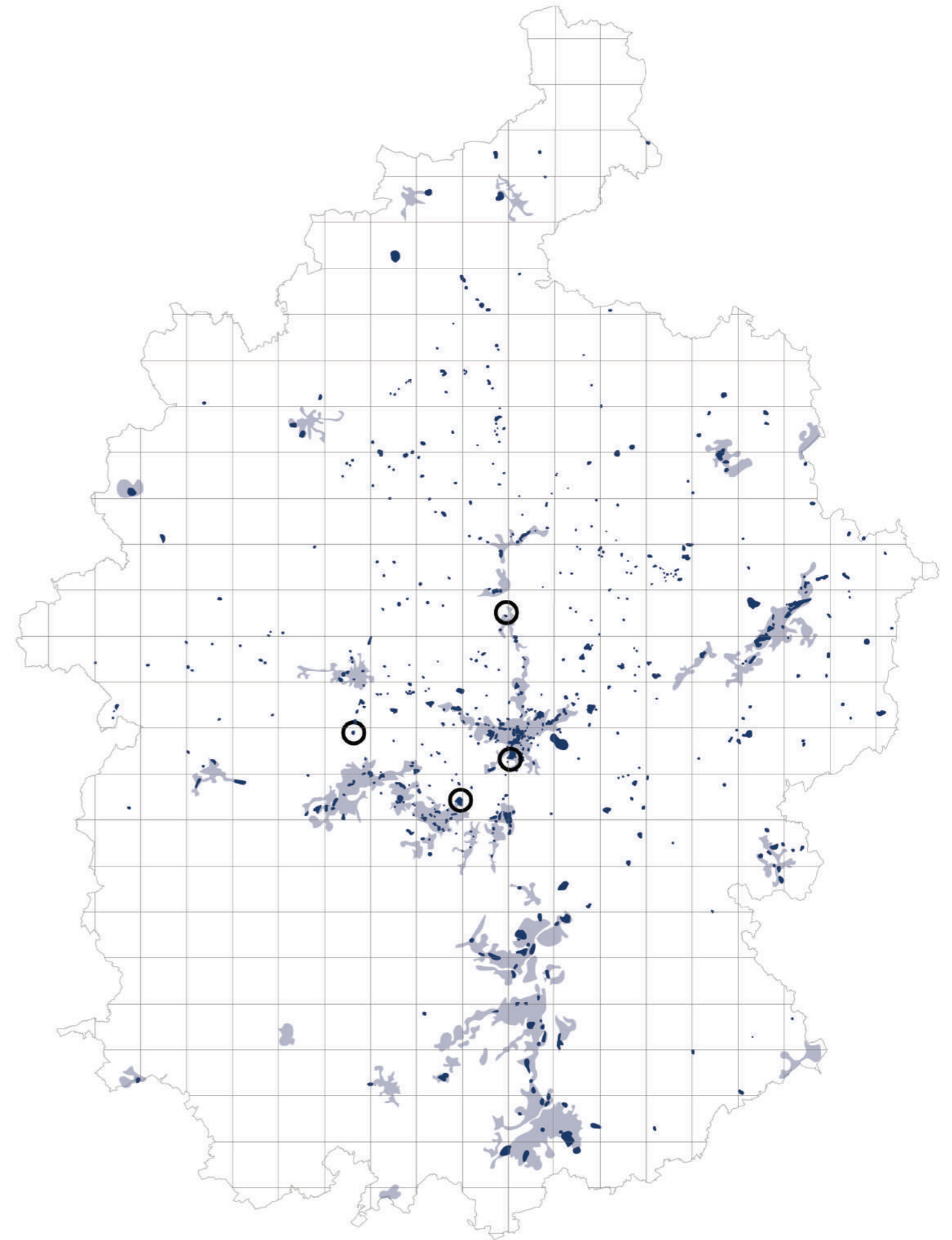
Case study: Foetz Circular Economy District



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## Commercial Zones

The greatest potential of—and the biggest challenge for—the regeneration of the functional area and its transition towards a sustainable city-landscape lies in the transformation of commercial zones. Commercial zones with their shopping centres, DIY stores, drive-in restaurants, and production facilities are the legacy of a functionalist urban planning policy that aimed at moving the formerly dirty production out of the city and organising mass consumption in a car-friendly way. The fact that there are so many commercial zones and shopping centres in the functional area of Luxembourg explains—apart from fuel tourism and the housing shortage—on the one hand the high share of mobility in its carbon footprint, and—on the other hand—the progressive death of the urbanity of its cities.



Commercial zones in the Functional Area

# Commercial Zones



Commercial zones in Luxembourg

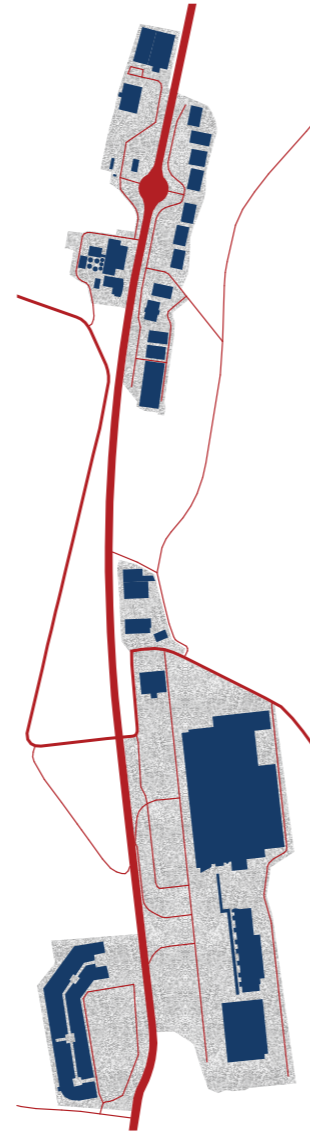


Commercial zones in relation to the size of Luxembourg City

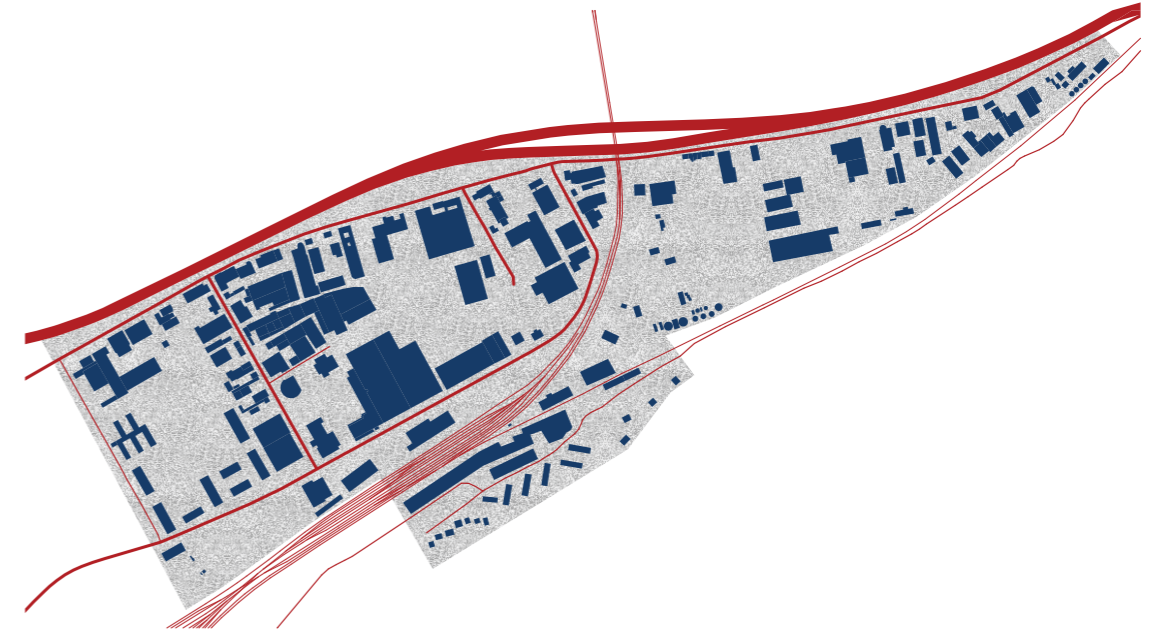
# Atlas



**FOETZ**  
*Mondercange (LU)*  
site area: 74,9 ha



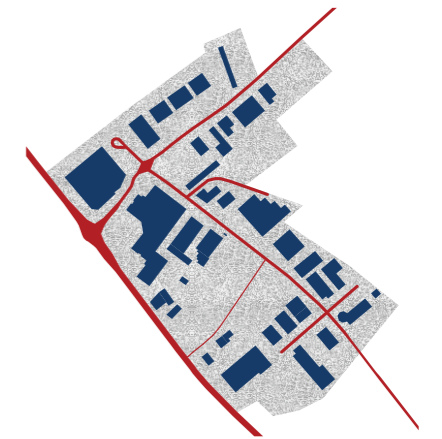
**RUE DES ARDENNES**  
*Messancy (BE)*  
site area: 41,3 ha



**TRIER-NORD**  
*Trier (DE)*  
site area: 92,3 ha



**HOWALD**  
*Howald (LU)*  
site area: 41,1 ha

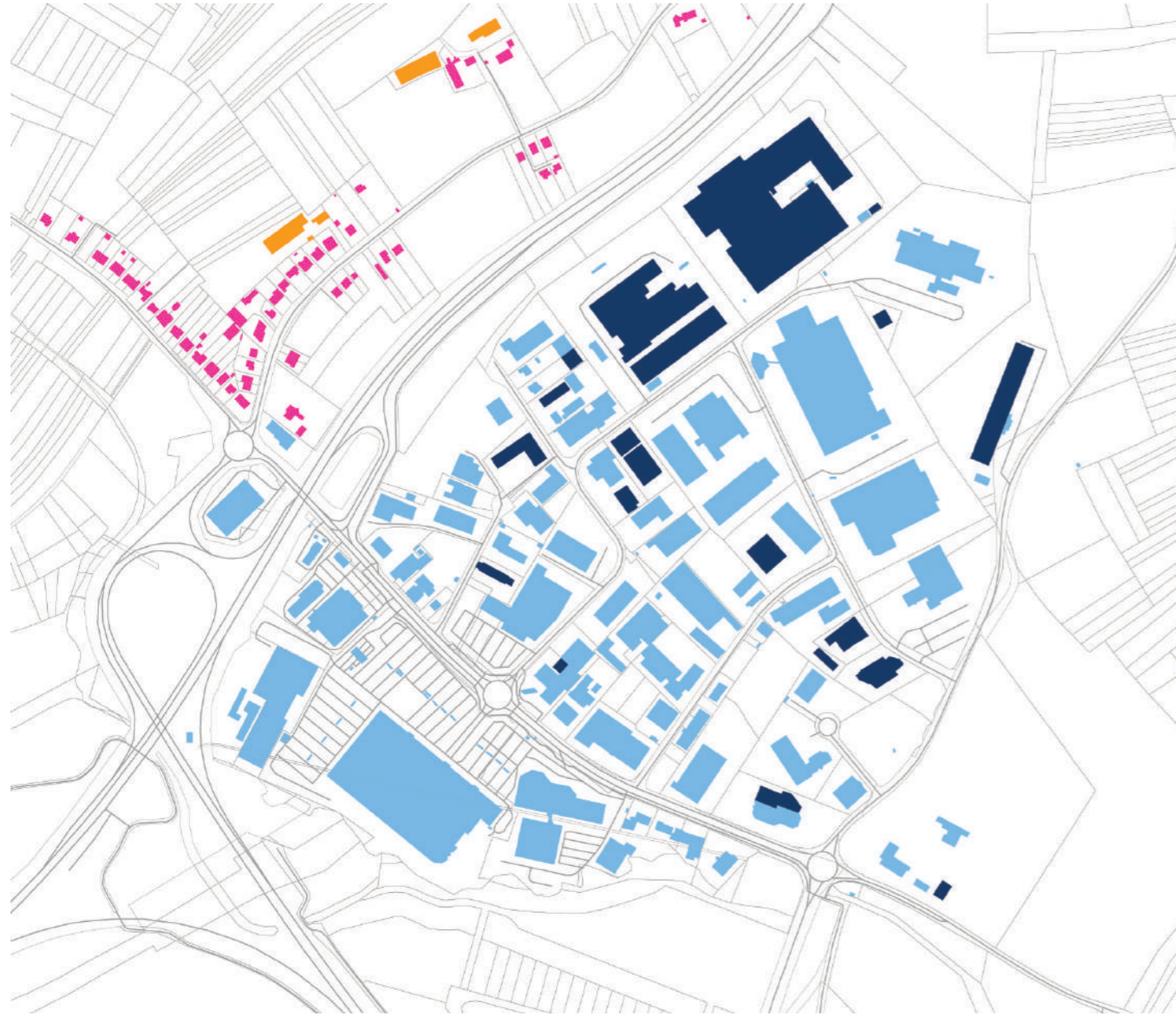


**UM MIERSCHERBERG**  
*Mersch (LU)*  
site area: 26,6 ha

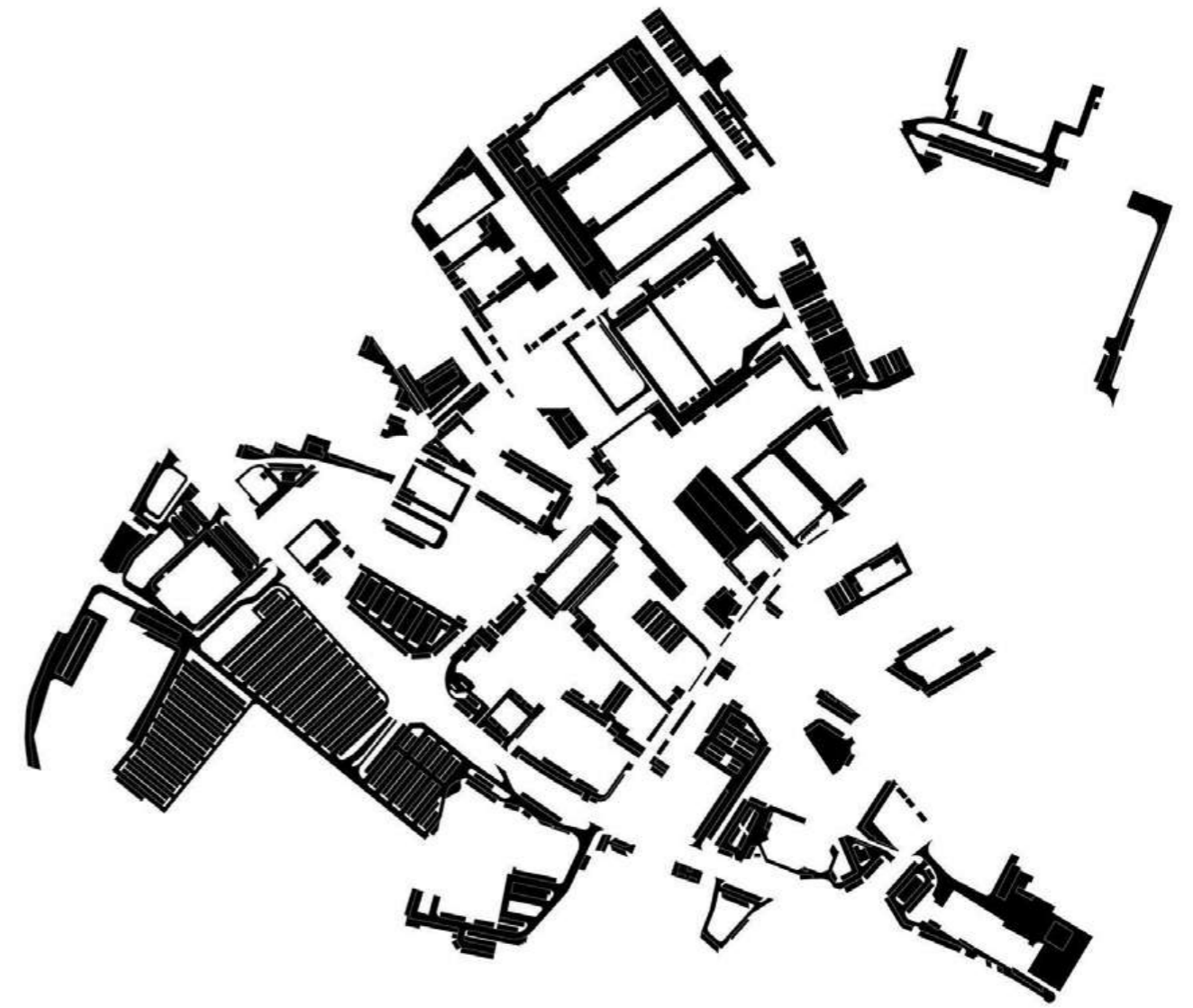


**LUXEMBOURG CITY CENTER**  
area: 41,1 ha

## Potentials



Uses: commercial (light blue), industrial (dark blue), housing (pink), farms (orange)



Parking spaces as a potential for new developments

The commercial area of Foetz, which has been growing since the late 1970s in the course of the construction of the A4 motorway, is a particularly impressive example of that monofunctional spatial typology, which consumes an excessive amount of land and energy. To date, more than 100 mostly international companies of mass consumption and industrial production have settled here in mostly big hangars, around which more than 18 ha of parking areas—comparable to an area of 26 football fields—seal the ground, including more than 6200 car parking spaces. Due to this extremely high degree of sealing, the Foetz site must manage stormwater runoff of 126 million litres per year. Without unsealed surfaces to cool the area through evapotranspiration, Foetz is one of the most glaring heat islands in the region.

But Foetz is also one of those non-lieux that cannot be imagined without the automobile. Apart from the people who work here, the average stay of those who come to Foetz is less than 30 minutes. Like the other commercial areas, Foetz is like an empty city outside opening hours, but extremely busy on weekdays and Saturdays, especially during rush hours. At the same time, Foetz also contributes to the decline of the retail trade in the core town of Esch-sur-Alzette, for example on Rue d'Alzette. While fossil-fuel-driven consumption continues to increase, pedestrian-driven consumption in the cities decline—a development that has been exacerbated during the current pandemic. As on the Route d'Arlon, the Ministry of Transport is now planning to build a tramway next to the A4 motorway by 2028, which will also serve Foetz. This project, as well as the emergency arising from climate change, calls on us to fundamentally transform Foetz—like the other commercial zones.

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## Strategies

- 01 Transforming commercial zones into mixed-use neighbourhoods
- 02 Developing new mixed-used typologies on parking surfaces
- 03 Adapting the hangars to new, resilient uses
- 04 Establishing a Transition Lab in the center in order to activate the site
- 05 Connecting these areas with light-rail-system
- 06 Transforming these areas into car-free areas
- 07 Creating a landscape belt with food production
- 08 Renaturalising sealed surfaces
- 09 Rainwater harvesting on large roofs to manage stormwater runoff

### Planned Obsolescence

Commercial zones are emblematic of today's overconsumption—Luxembourg and its functional area are among the richest areas in the world, where the population's purchasing power correlates with a very high carbon footprint embedded in discretionary consumption. About 3 tons CO<sub>2</sub> eq. are linked with the annual consumption of furniture, appliances, books, electronics, clothing, sports, and hygiene products in the functional area, most of those are purchased in commercial zones. Expanding the lifetime of products, encouraging reuse, as well as simply reducing the amount of objects we own can significantly reduce the impacts of consumption by a factor 8, all the while rendering commercial zones less strategic, even obsolete.

### Monofunctionality

The village of Foetz has a population of 500 and across the A4 sits the commercial zone with 0 inhabitants and 6200 parking spaces.



# Strategies

— 2021



— 2030



— 2040



## City Island

We propose to create a mixed urban neighbourhood for more than 10,000 inhabitants without sealing more land or demolishing buildings on a large scale. The design strategy of this neighbourhood follows a simple principle: new, emission-free residential buildings with urban ground-floor functions and green and energy productive roofs are built on the parking areas of the current shopping centres and production facilities. The large-scale boxes are successively converted into public, communal or such economic uses whose production is not only environmentally friendly, but also by itself increasingly accelerates the socio-ecological transition.

Thus, besides housing units for new residents, the new district of Foetz will offer plenty of space for work, leisure, gastronomy, and urban agriculture. In a first step by 2030, starting from the south-western tram stop in the southern section, i.e. where the area is programmatically more commercial today, open and intermixed perimeter block developments with commercial, community, and tertiary ground floor functions and gen-

erous block interiors will be created. At the same time, the large buildings, which are now no longer located as solitaires on gigantic parking areas, but are integrated and connected into the perimeter block developments, will be repurposed with uses on the scale of the block and the neighbourhood, depending on their dimensions and location: with schools and kindergartens, sports halls, and co-working spaces.

## Empowerment

In the centre of the new urban mix-use neighbourhood, where the perimeter buildings dissolve into groups of solitaires, one of those big boxes will be transformed into the local Transition Hub, which will become an inspiring model for Transition Hubs in the functional region. The centre piece of the Hub is an aula for larger events and exhibitions next to a coop café-restaurant, serving locally produced food that can both be opened to and expanded into the space outside—when weather conditions allow for it. Around the aula meeting rooms and co-working spaces of various size

are arranged. All Hub spaces are co-used through a solidary time-sharing model by the transition working groups, composed of engaged citizens of Foetz and professional representatives of the local transition clusters (repair, food, wood, and learning for transition), continuously exploring the best leverage points for further local decarbonization and resilience building, as well as unleashing ever new synergies among those clusters; exhibitions, fairs and markets showcasing the work, products and services of the clusters; Foetz' turn of hosting the regular co-creative meetings of cluster-specific networks of the functional or Greater Region or of the cross-border network of local Transition Hubs, for exchanging and developing good practices; the new schools and training centres of Foetz if they need additional space like the aula; transition start-ups in their incubation phase responding to identified needs of the local community or regional markets.

# Strategies

## Repair District

To the north of this central transition hub, a repair district will emerge. In the last two decades, the concept of repair cafés, maker spaces and fablabs have become popular among creatives, social initiatives, and eco-activists alike, but it is only when legislations in the EU and in Luxembourg will oblige industry and manufactures to produce modular and repairable devices, furniture, clothing, and even houses, that the “repair everything” approach will become an appropriate answer to “peak everything”. Luxembourg will follow the Swedish model and test a Tax mechanism that will literally boost the sector. Repairing will become not only a nice activity in terms of social exchange, but also in terms of job creation. A number of fossil-based jobs in aviation, the car industry, and other industries were “moved” from 2025 on to this new sector.

The area of Foetz is the ideal spot to develop a “repair city hub”, because the industrial heritage of handcraft schools in Esch, Differdange, but also in Dommeldange and Luxembourg City need reorientation and the need of transition workforces pushes for the creation of a number of new jobs in renewables, wood building, urban farming, ecodesign, and repairing. Luckily LIST has opened its Technoport in Foetz some years ago and managed to rent surrounding buildings at a time when companies such as Mondo and Chemolux moved out. In the same time transition, activities in Esch and Schifflange—like Facilitec, Benu, Formida, and FerroForum—will need more space. Another enabling factor is the SIVEC recycling center that will become the first proper “resource center” in the region—based on a material inventory for each dumped object.

## Timber Production

To the north of this repair district, production facilities for timber will grow. Starting in the 2010s already, wood construction has become an important pillar of Luxembourg’s building industry. The sector has continuously grown, and by 2050, wood construction is the predominant mode for new residential and commercial buildings. This trend has been triggered by circular economy approaches in the construction sector, by new socio-ecological imperatives regarding the use of healthy and climate friendly building materials, and not the least by the industries’ pursuit of regional sourcing of raw materials and components. The latter strategy followed the post-Corona claim for increased resilience through the regionalisation of industrial production chains. This reorganisation went hand-in-hand



## Strategies

with the Greater Region's ambition goals to establish the regional bio-economy.

The substitution of other building materials as well as the trend towards prefabricated and modular timber components has created a flourishing sector comprising innovative manufacturers, specialised craftsmen, as well as qualified architects, designers and engineers. The proliferating wood construction industry has caused a considerable demand for a) suitable infrastructures for production, storage and logistics, and b) for skilled work force, that is in need of respective (vocational) training programs and facilities. In order to respond to these two demands, a dedicated area in Foetz will be established and utilized in order to provide infrastructure prerequisites for both production and training.

In Foetz, existing assembly halls—partially equipped with heavy-duty cranes and other suitable facilities—will be reused and adapted for the pre-fabrication of larger timber modules. The adjacent buildings and their related surfaces will be used for storage, packing and delivery logistics. Smaller workshop buildings are used for maintenance and repair, as well as for the production of prototypes, small series, and tailor-made components. In proximity to the production sites, a training center for vocational training in timber construction will be established, allowing apprentices to combine training with internships in the neighboring firms. The latter are narrowly involved in the conception of up-to-date training programs offered in Foetz. The Wood Construction Hub Foetz, complemented by similar institutions in Wiltz and Colmar-Berg, thus spearheads Luxembourg's successful Wood Cluster.

### Landscape Belt

Foetz lies today like a strange island in a green sea of fields to which it holds no relation whatsoever. Our project envisages integrating the surrounding nature, which is today partly polluted and will be depolluted with conventional means, into this development. A first strip with various communal areas, community gardens, sports and play facilities will enclose this urban quarter. A second ring will extend around it, consisting of allotment gardens, marking the transition to more extensive solidarity farming.

### Short Food Circles

The hangars of Foetz, representing a very large water collection potential, will be used for water collection with underground storage installed in between

them. Depending on the height of these hangars—if shading is limited enough—more fragile high value perennials, such as grapes, figs, and Chinese kiwi, can be trellised on the south side and fed with the irrigation system. Large, raised beds can be used for this purpose. There is a productive interaction possible with the wood transformation unit, since any big woodchips from deciduous hardwood can be used on those raised beds and in the green belt to regulated water evaporation. These raised beds should be made into polycultures to better regulate pest pressure. As an example, this can be achieved with edibles and flowers such as nasturtium (*Tropaeolum*), mallows (*Malva*), rhubarb (*Rheum*), black-eyed susans (*Rudbeckia*), hostas, and many more. Woodchips can also serve as a substrate for exterior mushroom production (*Stropharia rugosoannulata*), further enhancing the polycultures.

The productive landscape belt can be made into a biointensive polyculture orchard. Here the focus will be on associating nitrogen fixers (e.g. *Hippophae rhamnoides*, *Caragana arborescens*, *Alnus*, or *Eleagnus umbellata*) with productive, climate change adapted local varieties of fruit (e.g. apples or pears) and productive nuts (e.g. hybridised hazelnut trees)—both vital for local sugar and protein production. Standard size fruit trees will be interplanted with fruit shrubs (e.g. raspberry, goosberry, or jostaberry) and edible shrubs, whose primary function is biodiversity regeneration (e.g. *Crataegus monogyna*, *Acer campestre*, *Amelanchier*, *Berberbis vulgaris*, *Cornus mas*, *Daphne mezereum*, or *Prunus spinosa*). Woodchip and other wood debris from the wood transformation unit will be used for mulching the greenbelt and for making compost. Compost toilets can serve to keep additional fertility onsite and use it for the fruit trees.

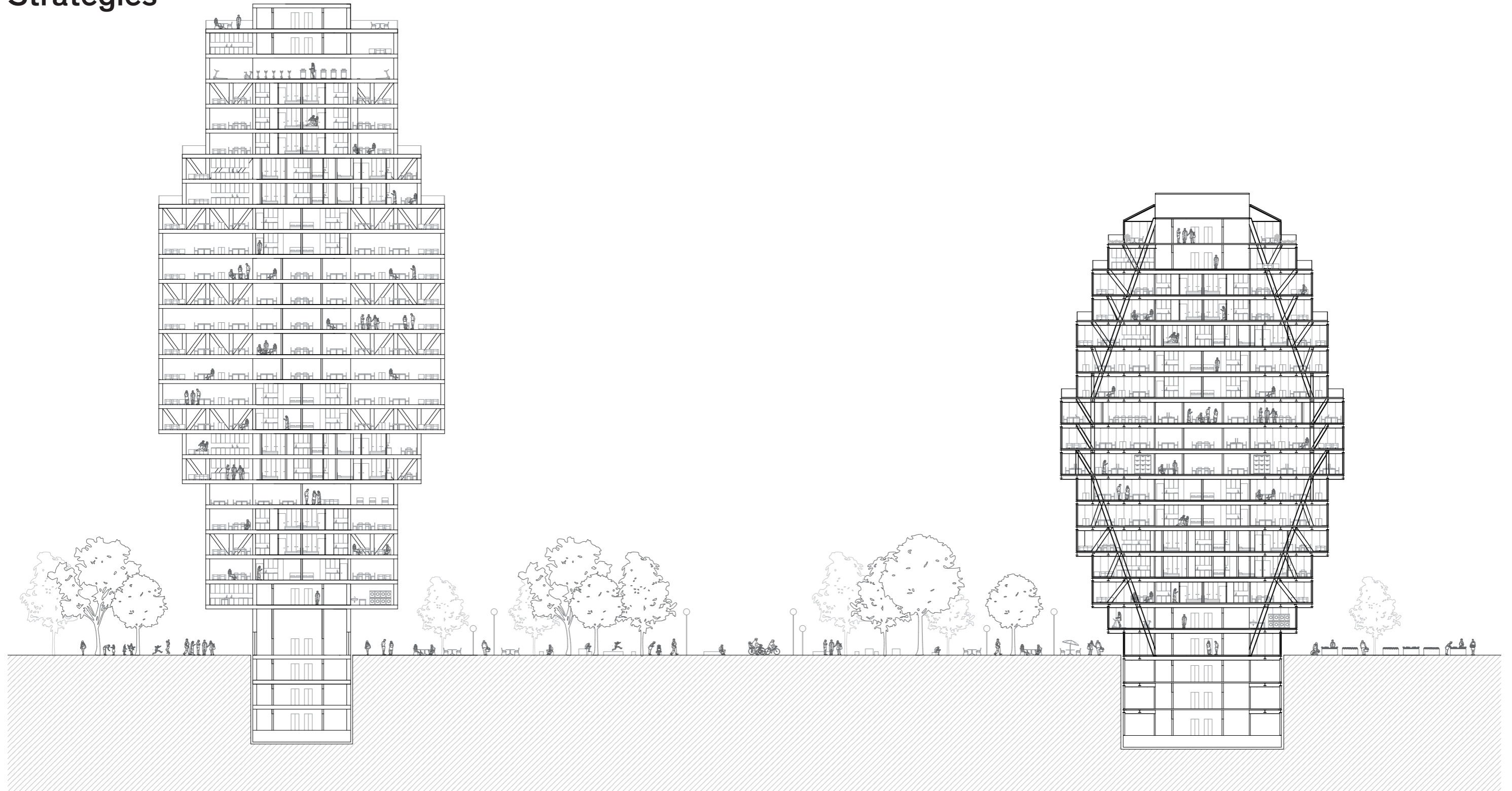
With global warming decreasing the areas used for food production worldwide, and the environmental destruction from industrial development also negatively affecting global food productivity, the Cora shopping mall will be transformed into a food hangar, with food processing, stalls, and catering corners that can also extend to the surrounding open spaces in fine weather. Adding to the nut proteins from the green belt, the hangar will host insect polycultures (e.g. crickets, mold beetle larvae, etc.) that can be transformed on site into ultra-local non-burgers. Other edible mushrooms can be grown in the hangars in controlled conditions. There is also potential for a big food waste reuse shop for the short-term

transition, as none exist in the region (the next one is near Metz) and could be stocked by some of the bigger supermarket supplier or producers' food waste quantities (e.g. local vegetables that cannot be sold, tons of bananas that are going off). There is much creative scope for sweet and sour preserves as well as pickles, soups, and other delicious novelty food.

Foetz is a special example because of its size and location, but—from our point of view—it is not unique. Most of these, or similar, gigantic commercial zones—such as those in Saint-Mont-Martin (Lorraine), Rue des Ardennes (Wallonia) or Trier-Nord (Rhineland-Palatinate)—are connected by car to highways or fast roads on which our mobility concept provides the construction of light-rail trains. This will connect these places—the new diversified urban islands—to the public transport network and calls for their transformation.



# Strategies



## Prototypes

In the entrance to Foetz, next to the tram stop, two prototypes of sustainable construction will be built: a 25-storey tower with a timber structure wrapped around a reinforced concrete core and a 16-storey timber-steel structure. Their form strives to reduce the footprint to a minimum, aiming to support various shared activities while reducing the sealed land necessary for its construction. The variations of slab sizes enable different uses and diverse housing unit layouts. The two lower and upper floors accommodate other community facilities such as a pre-school, living room, kitchen, and sports venues. With a large surface area, the central floors are dedicated

to collaborative workspaces, while the intermediate levels are reserved for residence. The internal arrangement of walls, bathrooms, and kitchens is adaptable since the infrastructure services are integrated into the ceiling. Through the varying categories, these housing units allow the integration of a diversified population. Therefore, the building complex seeks a mixture: between living and working, various social classes, private and common activities. The building structure remains visible and will be fully prefabricated on the site and recyclable due to a material bank.

## Practices

It's Friday, April 20th, 2047. Nora wakes up with a familiar morning sound of Lara and Ben, her young neighbours running (too) joyfully with their dog Buddy up and down their building's common roof terrace. The building, a former storage space positioned next to the (again former) Cora supermarket, was transformed into a co-operative housing complex, and Nora, who used to work for the market chain for more than twenty years—where she got her nickname 'Nora from Cora'—was offered a sunny, 35 sqm apartment on the 3rd floor. Initially, she was worried that moving from her spacious two room flat in Thionville, will be a downgrade of her living standards, but a variety of shared spaces in her new building, such as the common library, a small cinema, a gym, a shared kitchen, and the green rooftop, proved to be an amazing compensation for the small shrinkage of private space. Now, as she is preparing her morning coffee, she looks through the window to her little corner of the vegetable paradise, planted in the agricultural belt behind the large open market (former Cora) to check whether her tomatoes survived the heavy rain from last night. They seem alive. Standing at her window, she now remembers how she used to park her Sedan at that very same spot everyday, while commuting to work. When she just wanted to have a lunch on her own, she would sit in the car and enjoy the peace. Now, cars are gone, but peace is still there—this time, in her garden.

Oh no! It's almost 10 a.m. and she will be late for her shift at Fennel—a small local restaurant run by gardeners from Foetz, where she sometimes works on Fridays. Fennel opens up on weekends preparing vegan food for the local community. Built in place of the former McDonald's drive-through, the locals now jokingly call it 'walk in and roll out,' referring to the hazardous effects of its delicious menu. Nora is supposed to meet Paolo there, her friend and former fellow commuter, who is now biking from Esch to Foetz along the A4 highway. On Fridays, after lunch, they like to check in the local fleamarket at the roundabout on Rue du Brill. The Luxembourg's 'reuse campaign' of the 2020s really boosted fleamarket culture, opening up an entire universe of hidden gems and wonderful objects. Perhaps that vintage IKEA armchair from 2020s that she missed to buy last time is still there. If that's the case, she is certainly getting it and Paolo will have to throw a helping hand this time to bring it upstairs. He is anyway staying over in Foetz, as they are leaving tomorrow for an early morning bike ride and a lunch at one of those farms—probably again "Dem Irma säin Haff." Nora reserved one room for him in her housing complex. She still did not use her three free nights hosting credits for this month, that she has the right to as a resident. Wandering off again with her thoughts, she looks at the clock realising it's time to start her day.

— 2021



— 2047



# — 05 Arterial Roads

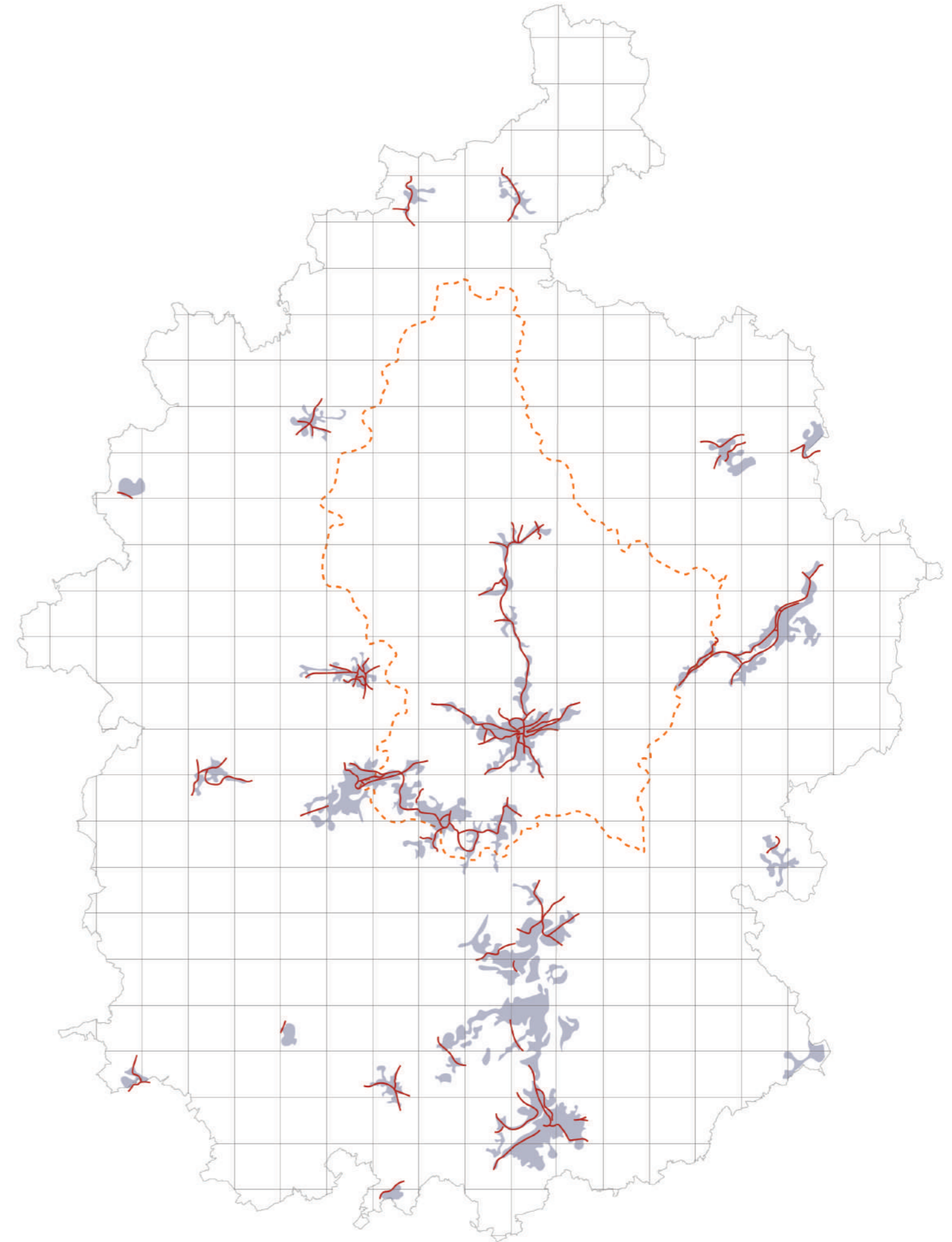
Case study: Route d'Arlon Agri-Urban Strip



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## Arterial Roads

Arterial roads play an important role in the transformation of cities. Many cities, such as Hamburg or Barcelona, are currently working on the transformation of arterial roads into urban avenues inspired by the arterial road par excellence: the Avenue des Champs-Élysées. However, most generic arterial roads, like the Route d'Arlon, are commercial strips—corridors through which people from outside swarm into the city by car, mostly to work—or flow out from the city to their homes. That's why a number of shopping facilities have settled along the route, which—in contrast to classic avenues—are accessed quasi-exclusively by car. Thus, the Route d'Arlon rather resembles the Las Vegas Strip with generic decorated sheds—large shopping infrastructures equipped with gigantic car parks that destroy urbanity.



Arterial roads in the Functional Area

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# Atlas



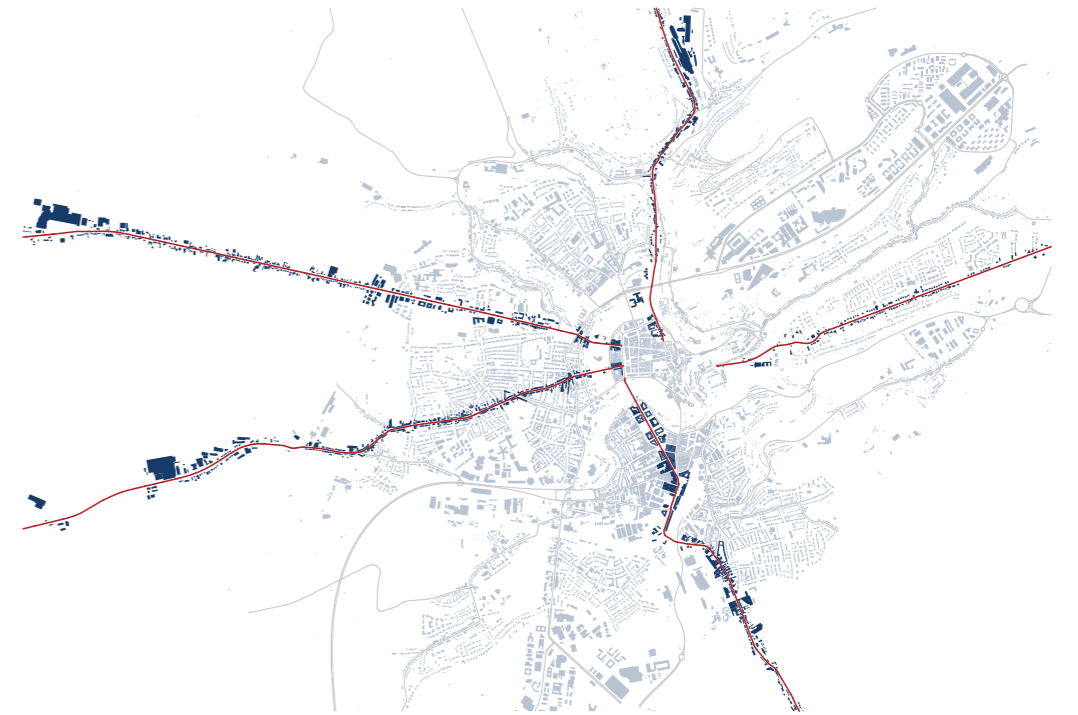
**TRIER**  
*Germany*

site length: 20,6 km



**METZ**  
*France*

site length: 21,2 km



**LUXEMBOURG CITY**  
*Luxembourg*

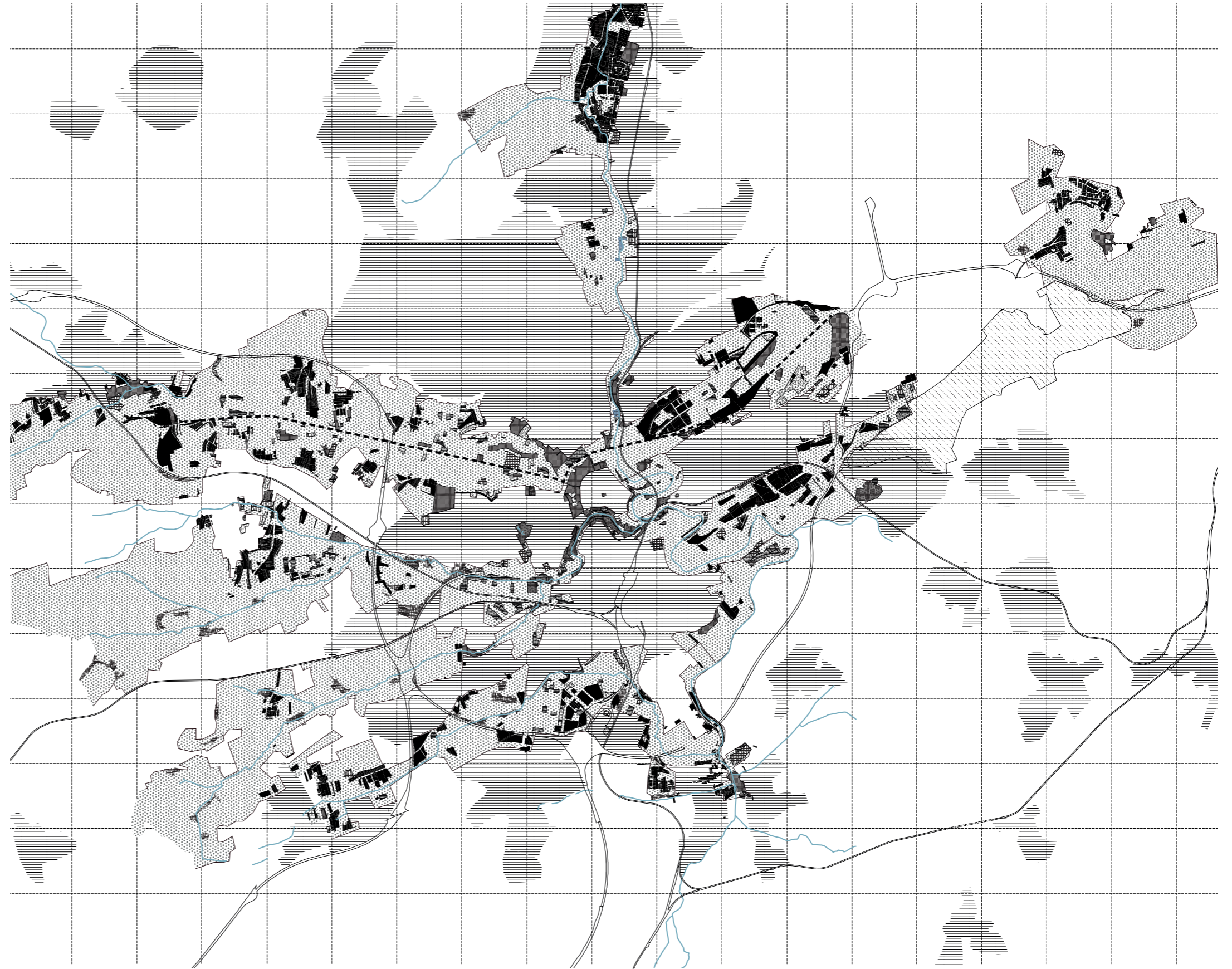
site length: 22,8 km



# Potentials

As these arterial roads collectively spread out into the landscape in a star shape, the landscape conversely stretches to the edge of more compact urban areas. Thus, today, nature mainly in the form of unused meadows encroaches on the Route d'Arlon in many places, making it a curious succession of generic boxes and unused wastelands. However, many of these fields are under pressure for development, and it is easy to predict that in a business-as-usual scenario, these sites will be developed in the future with large-grain buildings like foreseen at Place de l'Etoile—a gigantic developers' green washing project on an artificial platform.

Our team member Ivonne Weichold has demonstrated in her PhD research that these fields along the Route d'Arlon, however, have very fertile soils. Through combining multiple methods and elements such as an agriculture suitability study, an impermeabilisation gradient of the land, existing public spaces, and agriculture fabric, land potentials were defined. Based on that research, she proposes an "Agroecological Corridor" that offers a hybrid form of using open land by interlinking the urban and the peri-urban fringe and limiting urban expansion on fertile land by reserving a territorially demarcated area for agroecological food production and recreational space. However, the "Agroecological Corridor" is not simply a corridor. Instead, it comprises multiple functions such as: a corridor for providing access to land and supporting small-scale farming practices; a corridor along an existing water artery to steward the watershed through agroecological practices; a corridor for leisure, recreational space—public parks and squares; a corridor for education; a corridor for the rising demand for allotment gardens; a corridor for securing food production through open (public) spaces; a corridor for "air" for cooling the urban heat islands by guaranteeing enough air circulation within the urban area; a corridor for agri-urban developments; a corridor for supporting agro-forestry.



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## Strategies

- 01 **Densifying and diversifying arterial roads without sealing more land**
- 02 **Placing tramway on arterial roads and reducing car traffic**
- 03 **Intensifying arterial roads around tram stops**
- 04 **Building alternative forms of affordable housing**
- 05 **Transforming hangars for new sustainable uses**
- 06 **Protecting unbuilt land and making it productive**

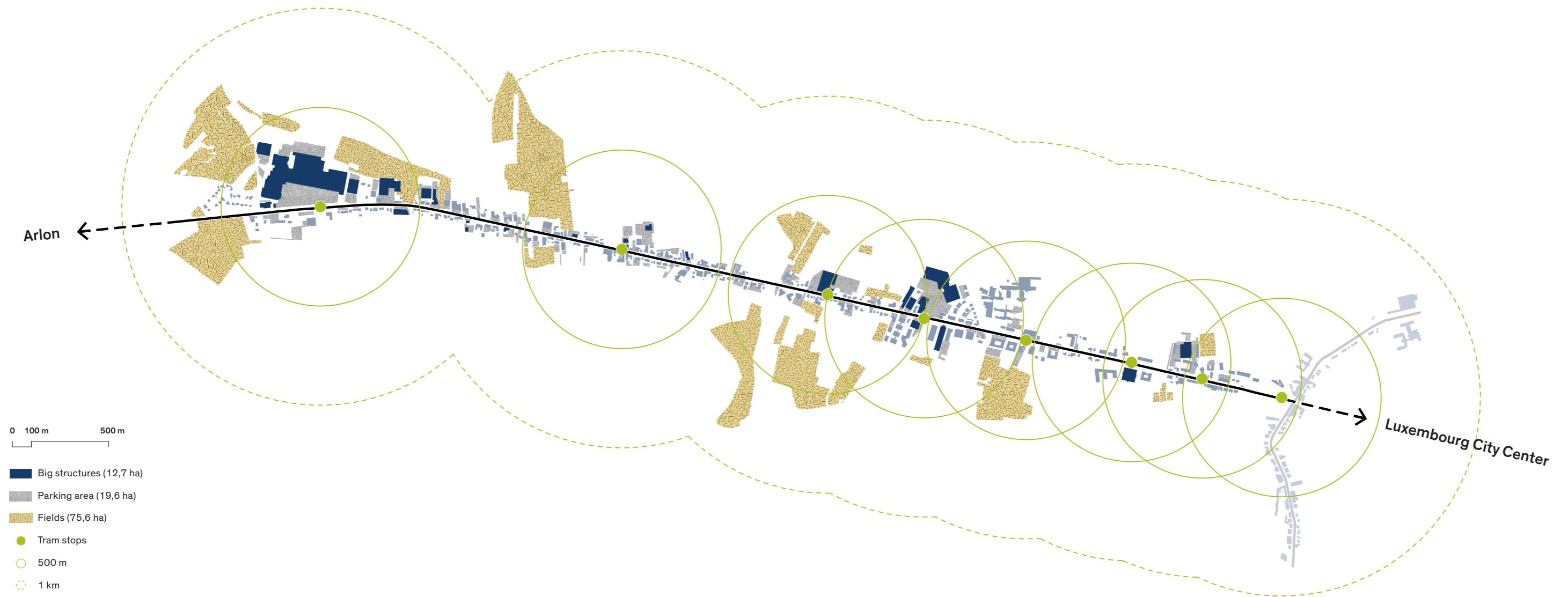
### Luxembourg's Obsession With Cars

For about a third of the Luxembourgish workforce, home-to-work distances are under 5km, but half use the car to cover the distance (Modu2.0). Biking that distance instead of driving would mean avoiding emissions of 2.1 kg CO<sub>2</sub>eq/day.

### From Car to Tram

The tram has the lowest GHG impact of all public transportation modes. Its impact at 21 g CO<sub>2</sub>eq/passenger-km in 2020 is less than half that of travel by rail and 90 % lower than travel by car. Electricity decarbonisation will reduce tram's impact to 15 g CO<sub>2</sub>eq/pkm in 2050.

# Strategies



## Agri-Urban Avenue

At the same time, the Ministry of Transport is already planning to implement a new tramway on the Route d'Arlon, which is foreseen to run east to Steinfort. This new infrastructure will successively limit automobile traffic up until 2050, which currently in January 2020 (pre-covid) stood at 8,500 cars and trucks driving towards Luxembourg every morning during the work week and a peak rush hour of 900 vehicles per hour during the 8am hour. Historic precedents show that the creation of the tramway fundamentally changes the surroundings areas and, if planned with foresight, can lead to a mixed-use avenue, where people not only consume, but also live and enjoy a range of different leisure activities.

This situation engages to a couple of substantial strategies for the Route d'Arlon: Firstly, protect undeveloped areas and transform them into a productive landscape, depending on their size, with park areas, sports

facilities, agro-forestry, urban farming and the like. Secondly, in walking distances, i.e. within a radius of 500 to a maximum of one kilometre around the new tramway stops, densify urban development primarily, but not exclusively, with typologically diverse housing projects – in accordance with our approach, only on already sealed areas such as car parks or existing buildings. Thirdly, convert the large-grained decorated sheds, especially shopping malls like the Belle Etoile, into smaller-grained, more diverse structures. This will turn today's Route d'Arlon into an agri-urban Avenue d'Arlon, where people live and work and enjoy proximity to open spaces. As the star narrative had been present (no one really remembers why) in both names Place de l'Etoile and Belle Etoile, the tram stops are named according to famous star constellations. Each tram stop has an identity on its own, like an urban village with a diversity of multiscale condensed housing and green spaces.

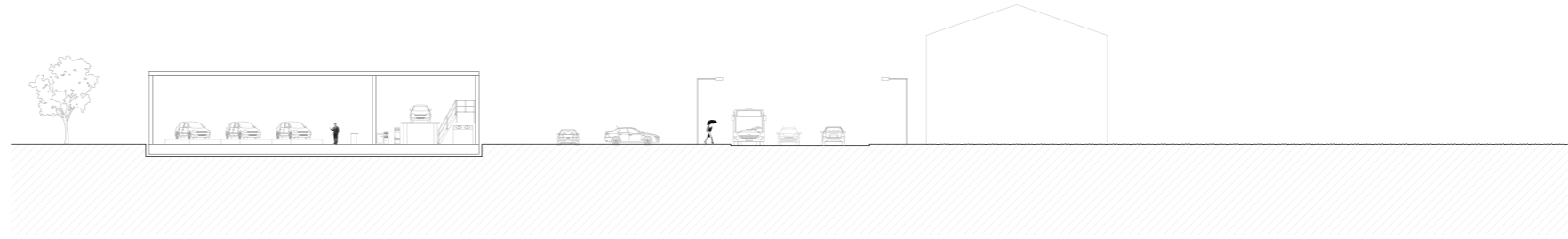
## Strategies

The section demonstrates how this transformation is taking place: in a first step, the tram line will be realised by 2025. As a result, car lanes and consequently car traffic will be reduced. Simultaneously, undeveloped fields will be transformed into productive landscape while the first residential buildings will be built on car parks. Our focus here is on hybrid, prefabricated, reusable, and recyclable typologies with diverse forms of living.

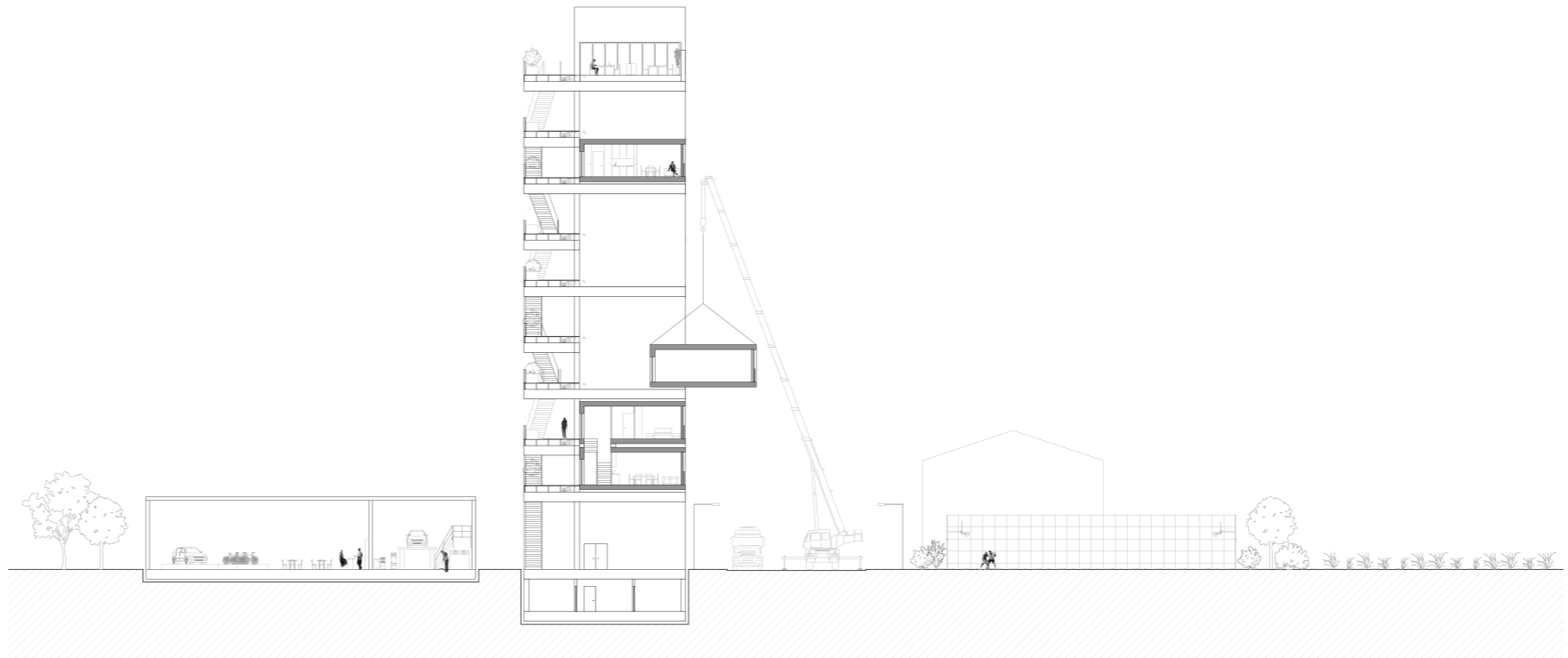
### New Housing Typologies

Luxembourg is in urgent need of housing capable of addressing the ecological challenge and social changes. The current housing stock does not do justice to an increasing need for common, hybrid, and trans-generational activities, for singles and mono-parental households. Moreover, the current housing production does not take into account neither the reusability nor the up- and recyclability of architecture. The built environment is too often reduced to the building's lifecycle, ignoring the grey energy required for the construction and deconstruction of these buildings as well as the CO<sub>2</sub> emissions produced during these two cycles. Team members Marielle Ferreira Silva, Florian Hertweck and Danièle Waldmann<sup>7</sup> tackled these challenges with the development of alternative housing models based on entirely prefabricated, reusable, demountable and recyclable due to a material bank inventory organized in BIM. The prototype we show in this section is an 11-story slab building, consisting of a primary reinforced concrete structure and housing units in timber. The shelf-structure provides a stable slab with a structure extending over two floors for standardized, prefabricated, and portable housing modules similar in dimension to Frei Otto's famous Ökohäuser. These modules offer a living space of 25 m<sup>2</sup> designed for either a single person or a couple. For each one of these modules, there is a 6 m<sup>2</sup> share of the common areas, which adds up to a significantly below-average floor surface per inhabitant as per Luxembourgish standards. The modules can be added or removed by a crane at any time according to the Metabolist principles. Thus, the building can grow or shrink according to demand. The optimisation of the housing surface area is associated with a range of communal activities on the top floor. These activities are theme-oriented and depend on the critical mass of the modules, ranging from a shared living room to co-working spaces and recreational facilities. The ground floor offers an envelope that can be filled in the beginning by pop-up stores until becoming more stable uses. The building is a module itself that can be extended depending on the terrain and demand.

— 2021



— 2026



— 2031

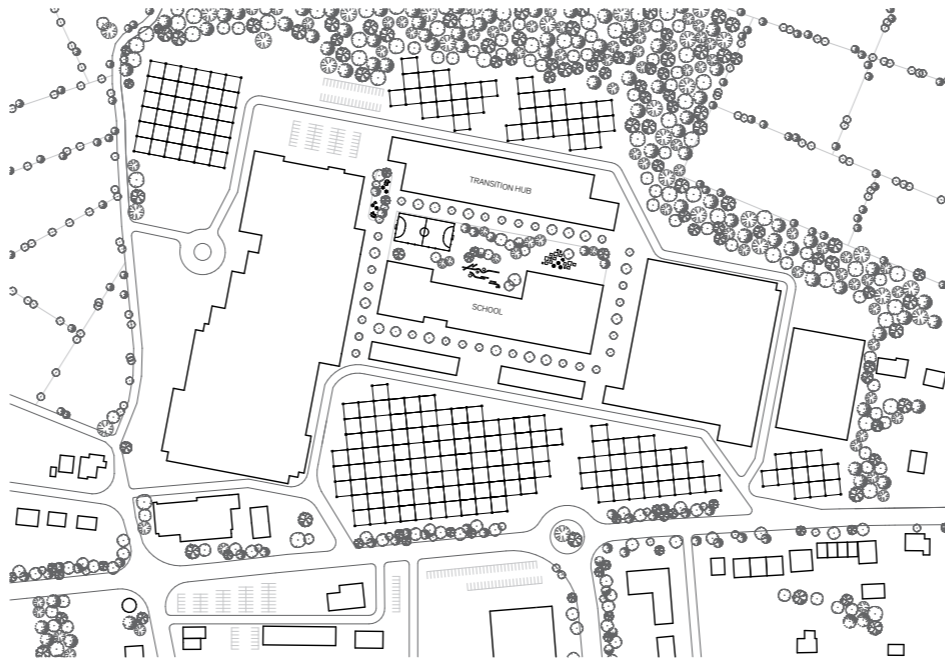


# Strategies

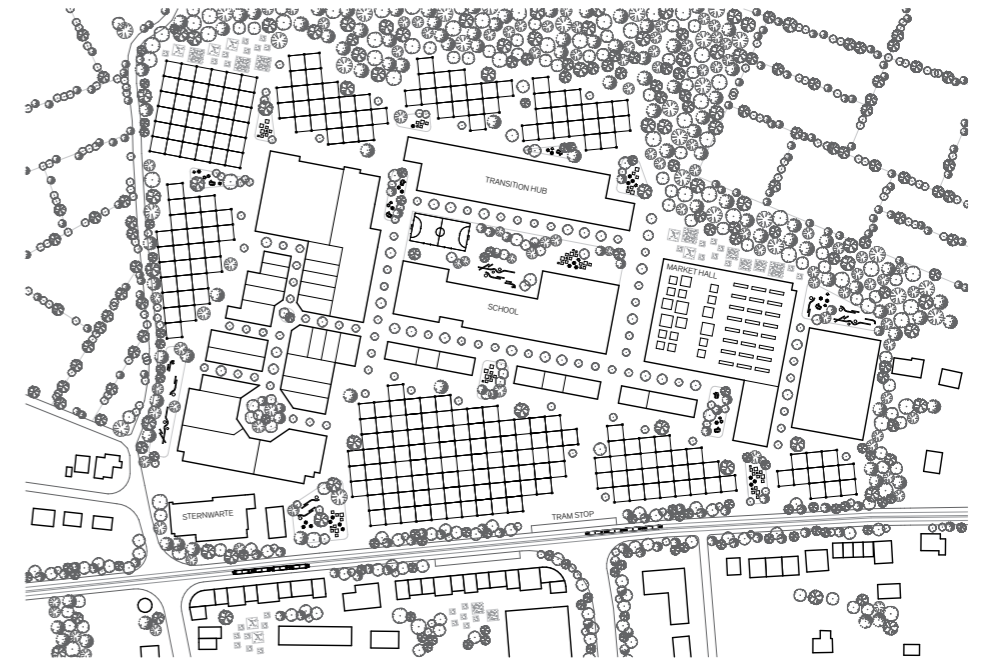
— 2021



— 2026



— 2031



## Transition

To the west of the avenue—where the Belle Etoile shopping mall now stands surrounded by huge car parks, fields, and single-family houses—there will be a similar transformation. This place presents the transition from suburban to more rural areas, from the foothills of Luxembourg City to the surrounding municipalities. The tram planned by the Ministry of Transport to Steinfort, which we want to extend to Arlon, will take on a higher speed from here on, the distances between stops will become longer. By the end of the 2020s, the tram will reach as far as here, but probably not yet Steinfort and Arlon. In the middle of the transition, many people will still need or want to travel to Luxembourg-City by (e-)car. The stop in front of Belle-Etoile will therefore act as a park and ride node for a

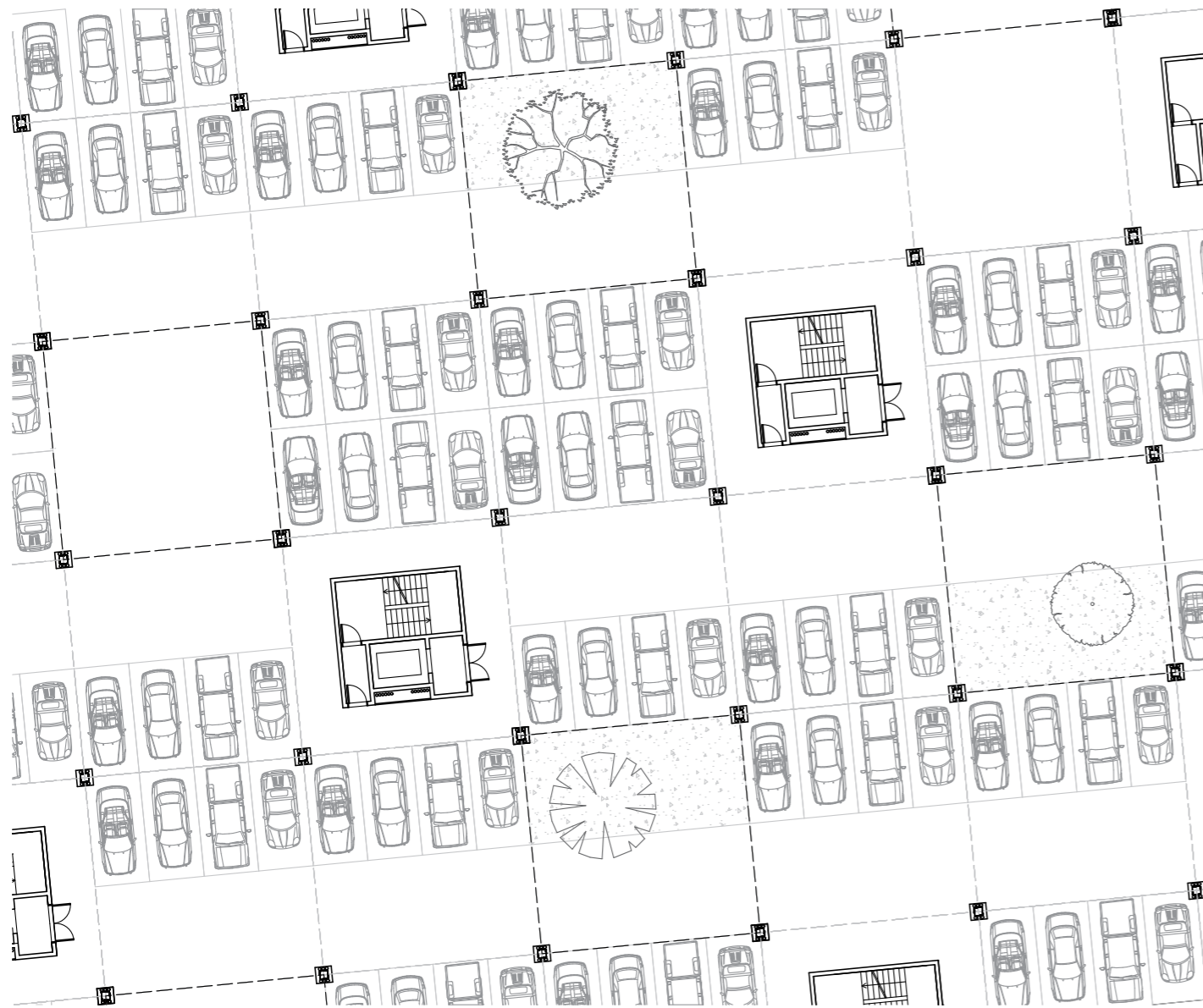
few years, until the line is extended further west. Therefore, we propose to build on the Belle Etoile a series of car parks—analogueous to the disc apartment building—a hybrid, prefabricated, reusable and recyclable timber structure. The building starts from a prefabricated basic standard block that can grow in all directions, adding more components or whole blocks if needed to facilitate the disassembly process. The internal span length of the generic model allows different uses. In the first stage, the structure will ensure parking spaces on the ground floor for multimodal mobility with the tram, but will allow on the first and second floor the creation of co-working spaces and apartments. This structure makes it possible to accommodate different uses over time: for example, once the tram line has extended to Arlon, the entire ground floor can also be used for co-working spaces.

## Observatory

At the same time, the Belle Etoile itself is being converted. The former shopping mall will still host small shops, but the roofs of the interior passages that now serve the shops have been removed, in order for these interior spaces—which so far have been climatically controlled by air conditioning—will now be turned into public streets. The big hall of the Mall will be divided into transition hub and a school. In another existing building next to the Avenue a very special and unique feature in Luxembourg will be located: the astronomic observatory “Belle Etoile” with an open air rooftop hotel.

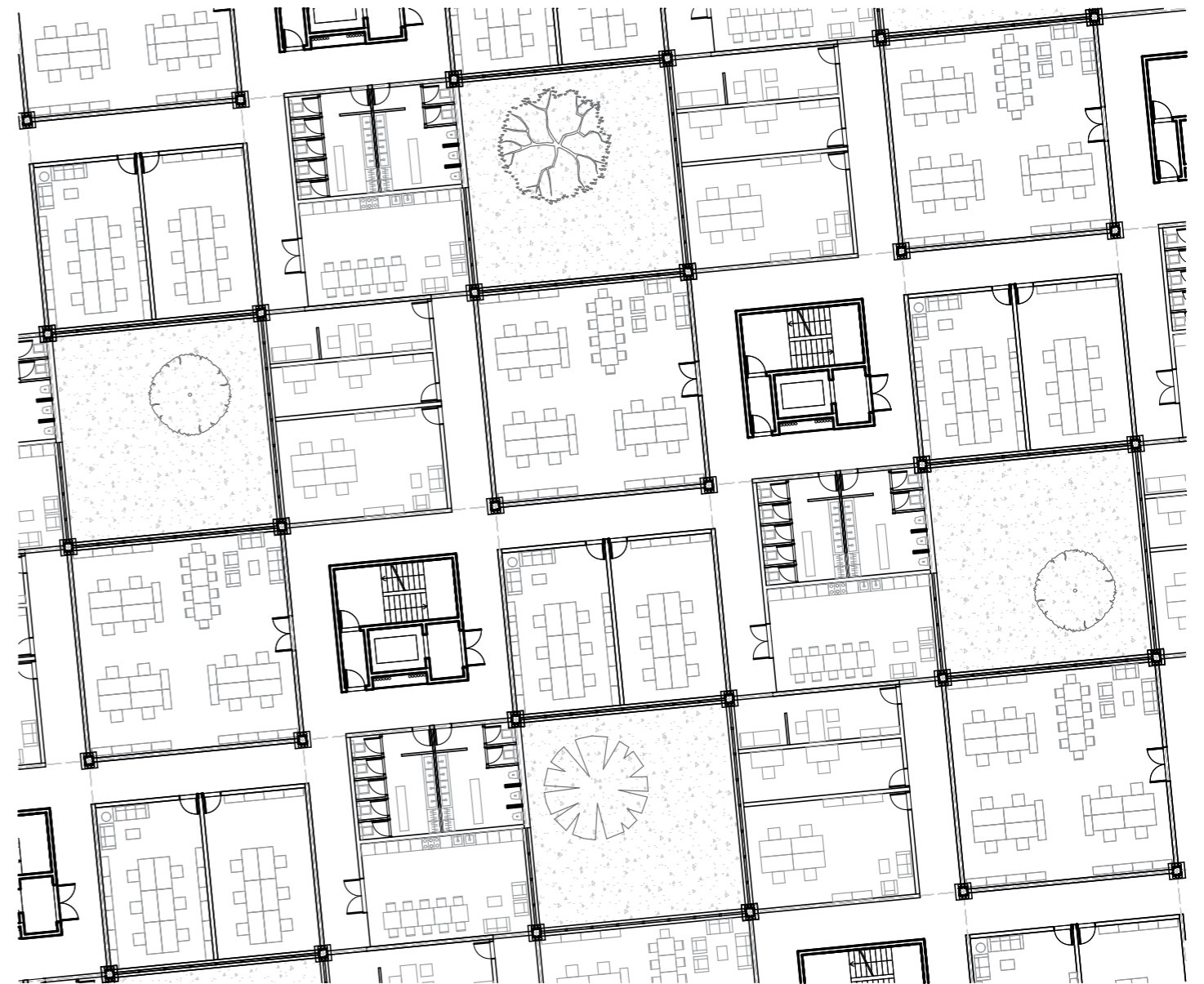
# Strategies

— 2026



First transition use: Park and Ride

— 2031



Second transition use: Co-working

0 5 m 20 m

# Strategies

— 2026



First transition phase: Park and Ride

— 2031



Second transition phase: Co-working

# Practices



It's Thursday afternoon, and together with her classmates, Tabia is heading down the street from her school towards the 'Schoenacht Field.' Today, they have a traditional pre-summer-break volleyball competition with several other high schools. She is excited and slightly anxious, but that is supposed to be good for the game, they say. As they are walking down the street, she looks up to the 6th floor of the building across Schoenacht Field, spotting her mother, Ime, waving from the balcony.

Tabia, now fifteen, was only three years old when she moved in 2023 with her mother from Nigeria to Luxembourg. As a single parent, Ime applied for a small apartment in a modular housing project that was just being built on the former parking space at 345 Route d'Arlon. Their

housing unit was essentially a studio with a separate small kitchenette and a private bathroom, but fully equipped for Ime's wheelchair needs. However, Tamia's experience of home was not confined only to their small apartment—instead, her childhood also took place in the building's shared spaces, including a large common kitchen, a swimming pool, and later also the small Nigerian restaurant her mother opened on the ground floor. Several years ago, Ime's and Tamia's flat was joined with another module, extending into a comfortable 2-room apartment.

The two are also a living archive of the radical changes that took place in Route d'Arlon. The introduction of the tram line and a bike lane in 2028 transformed Route d'Arlon into an urban boulevard, changing the character (as well as the soundscape) of a busy corridor that bore up

to 50.000 commuters daily. Le Belle Etoile, formerly a shopping mall, turned into a semi-open public space with streets, squares and local shops, extending into a carpet-like housing, constructed on the sealed surfaces around it. The function of Le Belle Etoile changed, but the name stayed, inspiring the re-naming of the new tram stops (and their emerging urban micro-cosms) by star constellations, and Route d'Arlon itself into 'Milky Way.' The 'no-net-land-take' policy of the early 2020s 'froze' the development of empty lots along the street and stopped further conversion of agricultural fields into construction land (at times, reverting this process). Schoenacht Field, named after the former Schoenacht bus station in front of Tabia's home is a case in point—from void as a real estate potential, to void as a social prospect.



# — 06 Urban Motorways

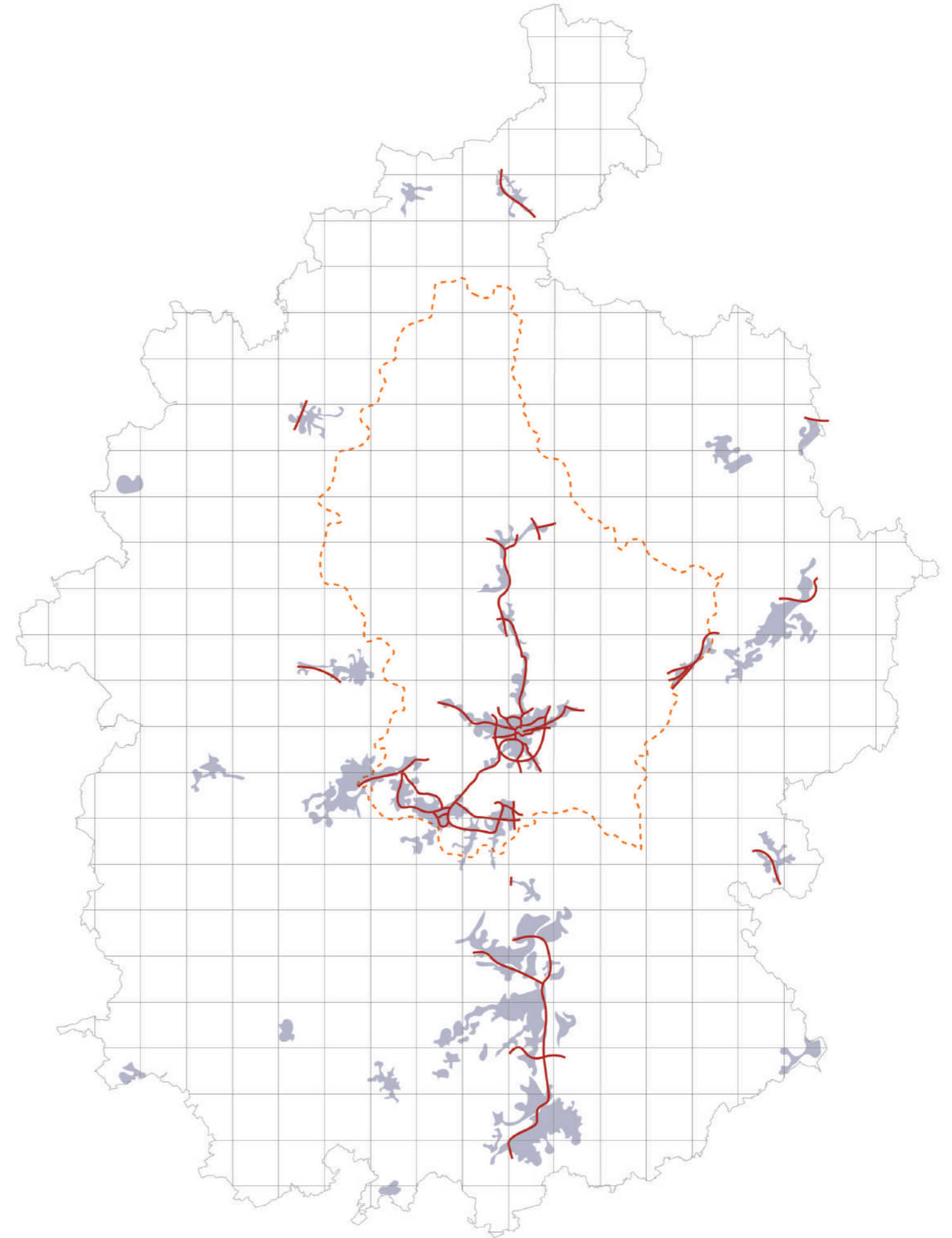
Case study: A4 Park Avenue



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## Urban Motorways

In the 1960s and 70s, urban motorways were planned all over cities in Europe, which—analogueous to rural motorways fragmenting landscapes and animal habitats—brutally cut through urban textures and caused a lot of noise and bad air for surrounding residents. Reversing these processes, which many cities in Europe are currently working on, is one of the most important aspects for urban regeneration. In the functional space of Luxembourg, there are many motorways and expressways that come very close to agglomerations as in Esch-sur-Alzette or Luxembourg-City or even cut through them as in Thionville or Metz. Reversing the processes, however, does not mean completely dismantling them at great expense, but rather using their surfaces, where they are on the ground, for urban infrastructures—essentially avenues and boulevards—that allow pedestrians and cyclists to cross them, thus weaving together what was formerly separate.



Urban motorways in the Functional Area

# Atlas



**CONTOURNEMENT**  
*Luxembourg City (LU)*

site length: 16,6 km



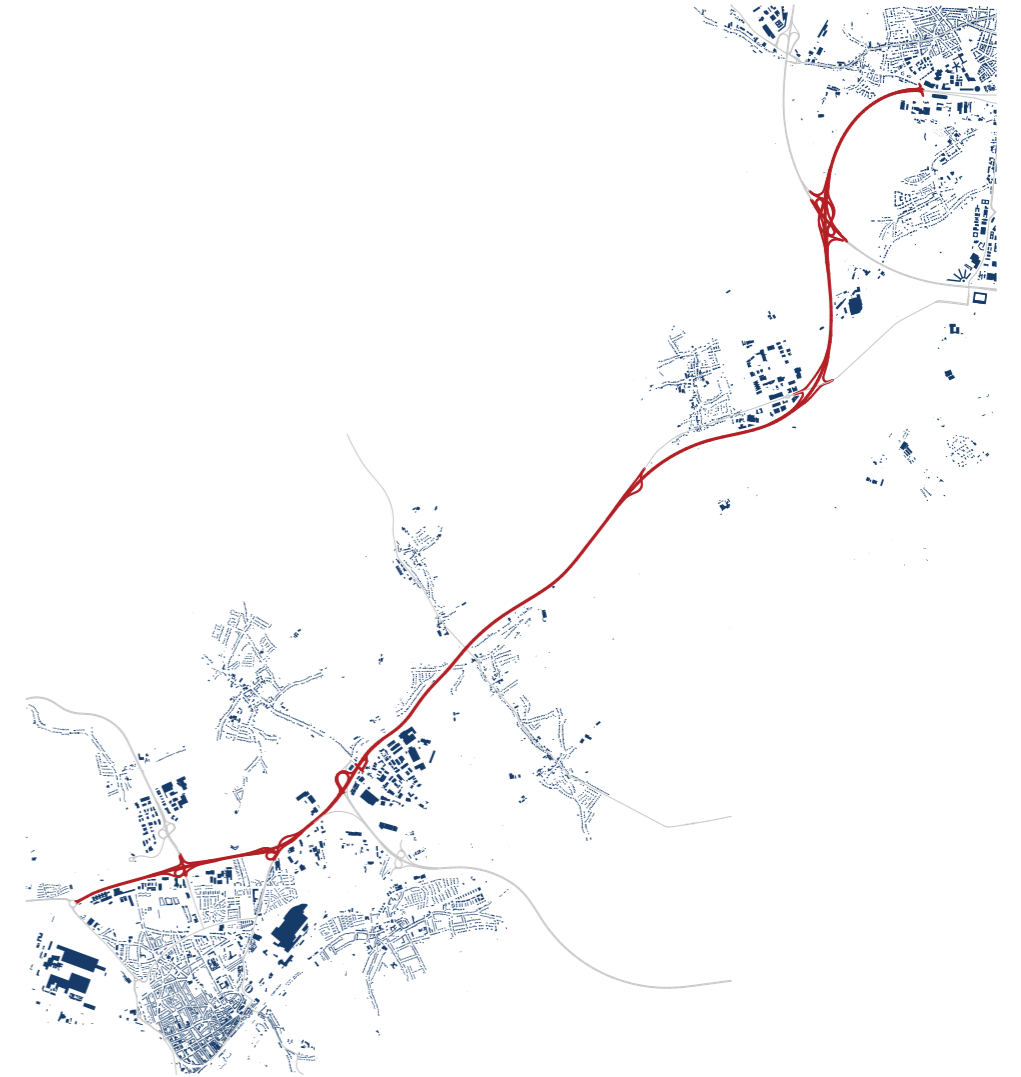
**AUTOROUTE DE LORRAINE-BOURGOGNE**  
*Metz (FR)*

site length: 9,4 km



**VERTEILERKREIS**  
*Trier (DE)*

site length: 5,4 km



**ESCHER AUTOBUNN A4**  
*Luxembourg*

site length: 16,1 km

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## Strategies






- 01 Placing light-rail trains on major highways and reducing car traffic
- 02 Establishing one lane for high-occupancy vehicles
- 03 Dedicated fast bike lanes next to motorways
- 04 Transforming highways close to cities into urban boulevards or avenues
- 05 Reconnecting forests through large eco-bridges over highways

### Traffic Congestion Increases Stress and Emissions

Cross-border workers from France face the most congestion—it takes them 30 % longer than their counterparts in Germany and Belgium to commute the same distance. If congestion reduces highway speeds below 70 km/h, fuel consumption and emissions increase—by 20 % for a speed reduction from 70 to 40 km/h.

## Strategies

We have chosen the A4 for this study for five reasons: Firstly, the A4 connects the two major cities of Luxembourg over 16 km. Secondly, it is the busiest motorway in the region with 32,000 cars and trucks driving towards Luxembourg every day during the workweek in January 2020 (pre-covid) and a maximum flow of 3,000 cars per hour in the morning rush hour. Thirdly, a tram line is planned along the motorway, which we think should be put on and not next to it. Finally, because on the one hand it is close to urban and suburban textures in several places, on the other hand it also cuts through natural spaces that could be potential biodiversity corridors. Therefore, we divide the A4 into different sectors, alternating more urban to more landscape situations: (1) An Urban Boulevard from Raemerich to Lallange; (2) A Park Avenue from Lallange to Foetz; (3) An Urban Avenue running through Foetz; (4) A Park Avenue between Foetz and Pont-pierre (5), where it becomes more urban again; (6) A Park Avenue between Foetz and Leudelange to allow the landscape to be interconnected; (7) A more Urban Avenue running through Leudelange – a place of transformation analogous to Foetz; (8) Again a Park Avenue until the intersection with the Urban Ring Boulevard on the former A6; (9) finally a very Urban Avenue until the Porte de Hollerich.

-  Urban boulevard
-  Park avenue
-  Eco bridge
-  Forests
-  Urban area close to the A4



Transformation of A4 motorway into alternating urban avenues and parkways

# Strategies

— 2021



We have examined two zoom-ins in more detail: a first one in Foetz, where this transformation is reflected in particular by the stop of the tramway which induces a new modal sharing of the avenue focused on soft mobility. Thus, while the A4 Highway appeared in the form of a real limit between the fields to the north-west and the current commercial zone and new mixed-use district in the south-east, the new Avenue becomes a place of intensity with multiple uses and increased porosity. The current sin-

— 2030



gle-family houses on the northern side will be included in the urbanisation of the avenue. The main tram stop acts as a link and crossing. It directly serves, to the north, a new residential area, which has a common space at its heart. This woodland edge, a veritable urban forest, is made possible by the intensification of the afforestation. Within this forest, sporting, leisure, or simply suitable for strolling routes take shape. The vegetation gradually interferes in Foetz and forms the crossing planted towards the south of

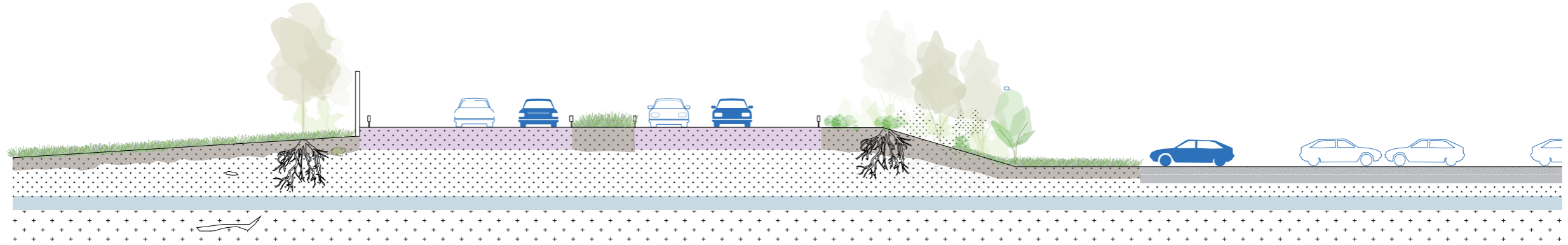
— 2040



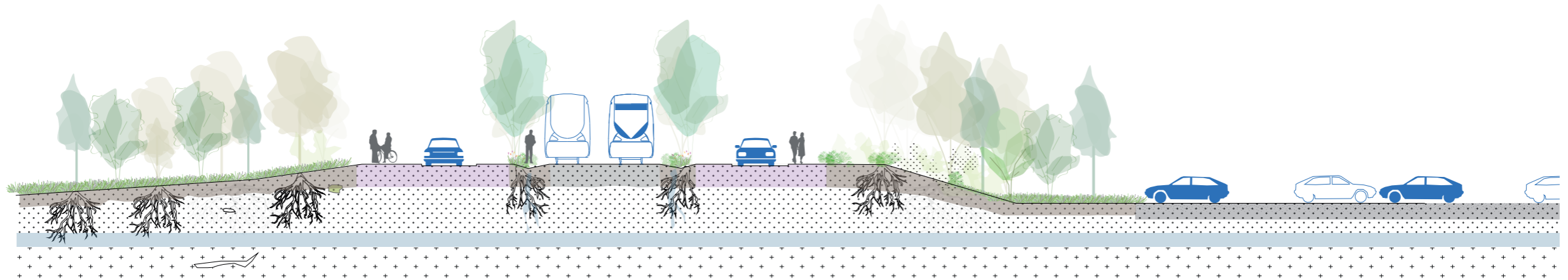
the territory. From the tram stop, a planted alley leads to the centre of the new mixed-use district with the transition hub and the food court in the former Cora shopping mall. This hall allows local farmers, producers, and restaurateurs to offer their services in a short circuit and thus make the link between the many fields, which are now somehow without any relation to Foetz.

# Strategies

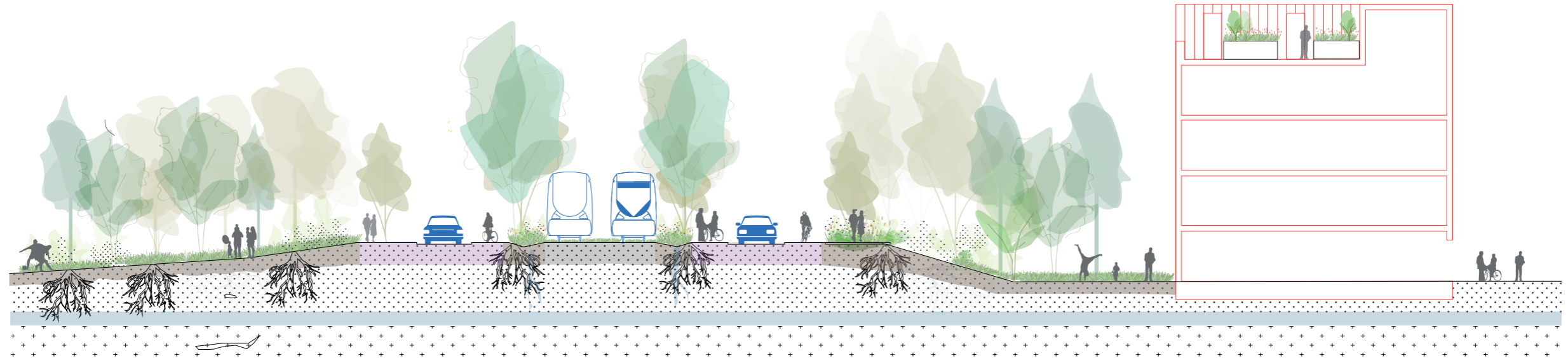
— 2021



— 2030



— 2040



# Strategies

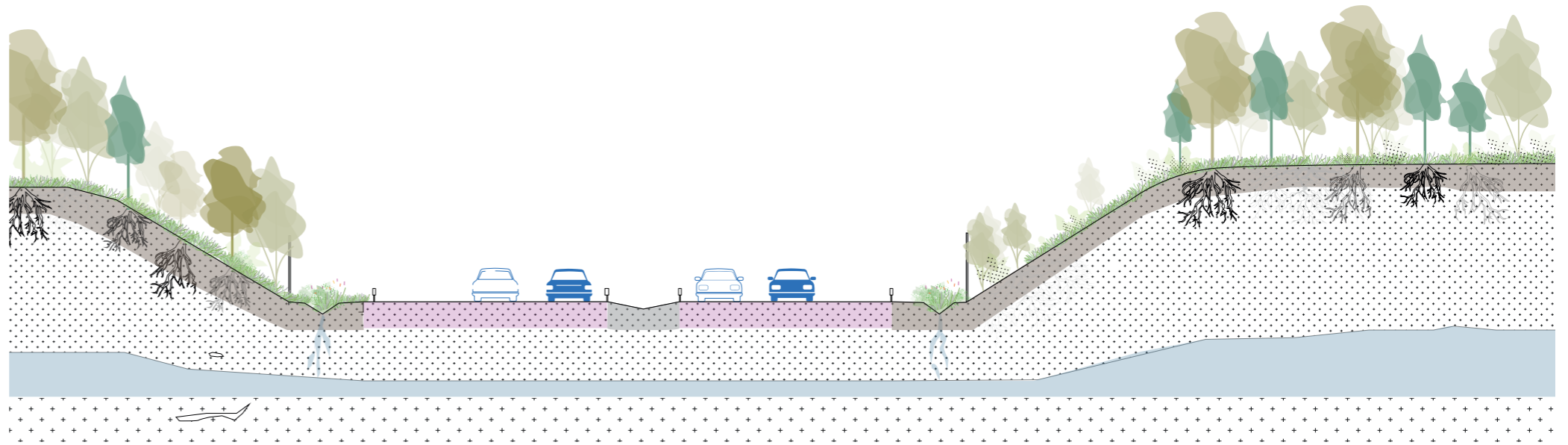
## Wildlife Crossings

The two strategic actions for biodiversity enhancement will be complemented with the implementation of wildlife crossings.

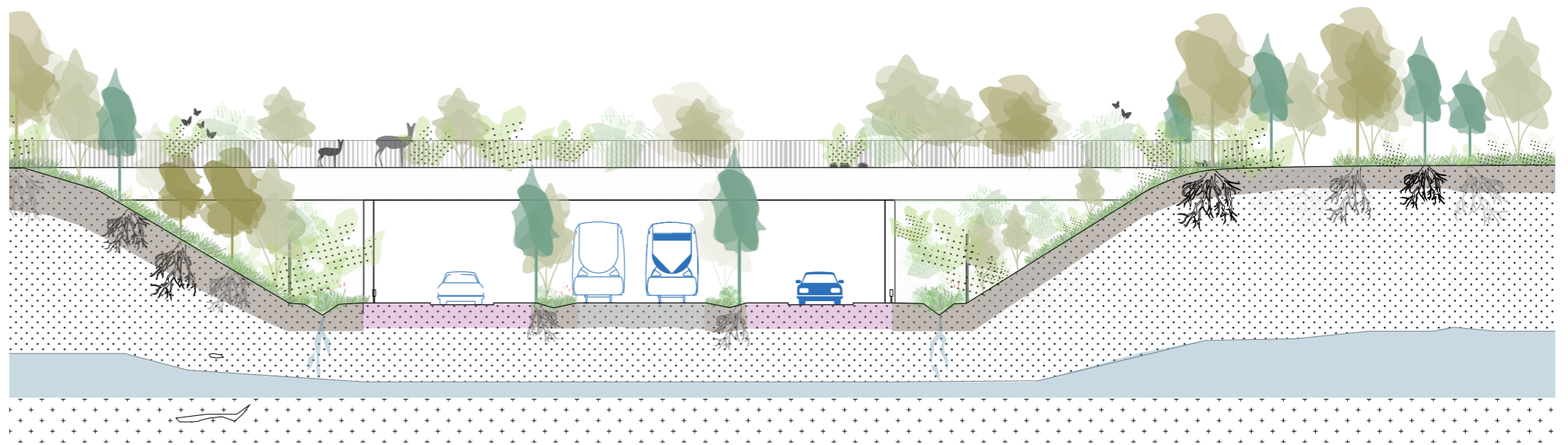
Ecoducts or wildlife bridges will be placed on key problematic spots of the transport infrastructure. Despite the transport network will be reconfigured, some zones still could act as a bottleneck for animal movement. The monitoring record of roadkill in Luxembourg illustrates where the problematic spots occur (e.g., the stretch of the A4 crossing the forest south of Leudelange) and that deer and medium size mammals, such as wildcats and martens, would be among the main beneficiaries of this mitigation measure on major transport infrastructure routes. Bat species will be a secondary beneficiary on those crossing points, since in general they avoid crossing large transport routes and use tree lines or small forest patches to guide their movement.

Wildlife crossings close to urban areas and on secondary roads will be mostly implemented in the form of underpass crossings. The primary beneficiary of this mitigation measure will be small mammals, amphibians, and reptiles, such as hedgehogs, common toads, common frogs and sand lizards. In the functional areas, these groups of animals inhabit periurban landscape mosaics formed by strips of natural grassland, shrubland, and small forest patches. The development of underpasses in periurban urban road intersections will mitigate movement bottlenecks for the above groups of animal.

— 2021

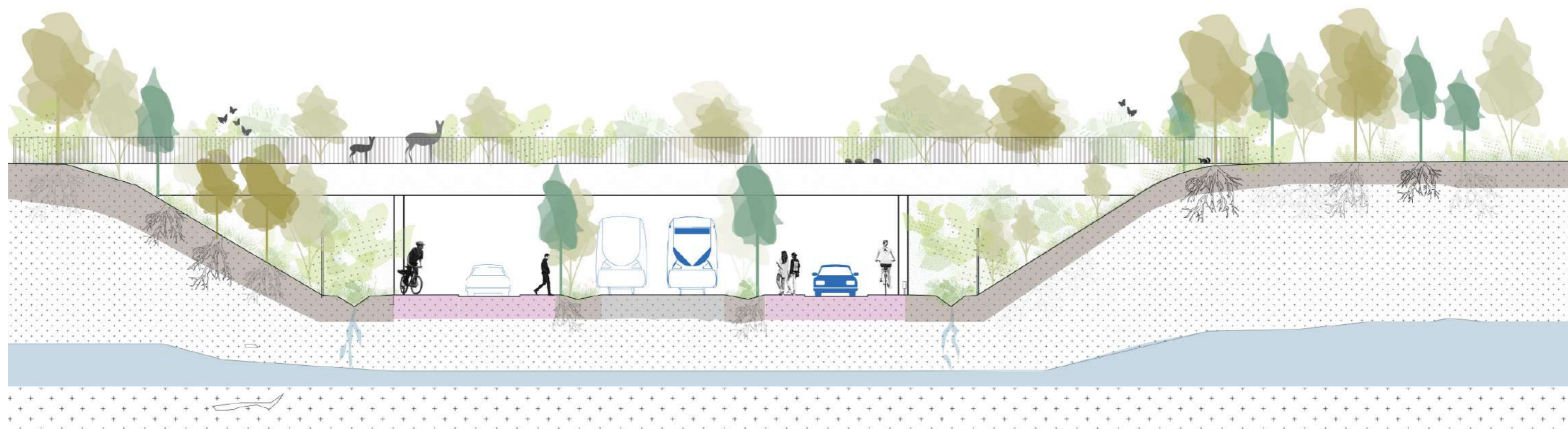


— 2030





## Practices



Paolo is on his way to meet Nora in Foetz. Former colleagues who share two decades of memories working at the Cora supermarket, the two also share memories of all the hours, days and possibly months they spent in their cars on the A4 highway between Esch and Foetz. Well, memories. Today, it rather feels like a single, long journey, out of time and place. The transformation of the highway and introduction of the public tram entirely transformed not only Foetz, but all of the towns, villages, and more broadly, sprawling residential and commercial zones, along the way. Many of the former commuters, like Nora, moved to Foetz into the new cooperative housing projects. Paolo, on the other hand, continued travelling, until he, together with several friends, opened a shop in Esch. Now, as he is biking to Foetz along the A4—the first highway that entered the process of transition from ‘car-only’ to, as locals like to say, ‘car-barely’—it feels as if he is getting to know this route and its surrounding landscape for the first time, again and again. The bike path, together with the walking trail, at times

runs in parallel with the tram line and the road, also detaching from them into the separate route going through the forest. The white noise a car-traveler is so used to, is now replaced by the sounds of the city—the tram passing by, people coming in and out, restaurants, shops and all other things one could find on an urban boulevard, interrupted by sequences of the forest silence. He decides to make a break on a bench next to that corridor over there. This time not a corridors for humans, but rather animals passing by from one side of the road to another. As he is sitting there and hoping to see that family of deers he saw crossing the road last time, he realises how it was not only the animals that got their corridor, but humans as well. The transformation of the highway helped all those people cross over the dependency on cars and daily commutes, thus connecting them better to what’s on the other side—more time, more meaningful experience of travel, and what one might call the emergence of ‘mobility commons.’

# — 07 Gas Station Strips

Case study: Wasserbillig–Merttert Co-Working Strip



## Gas Station Strips

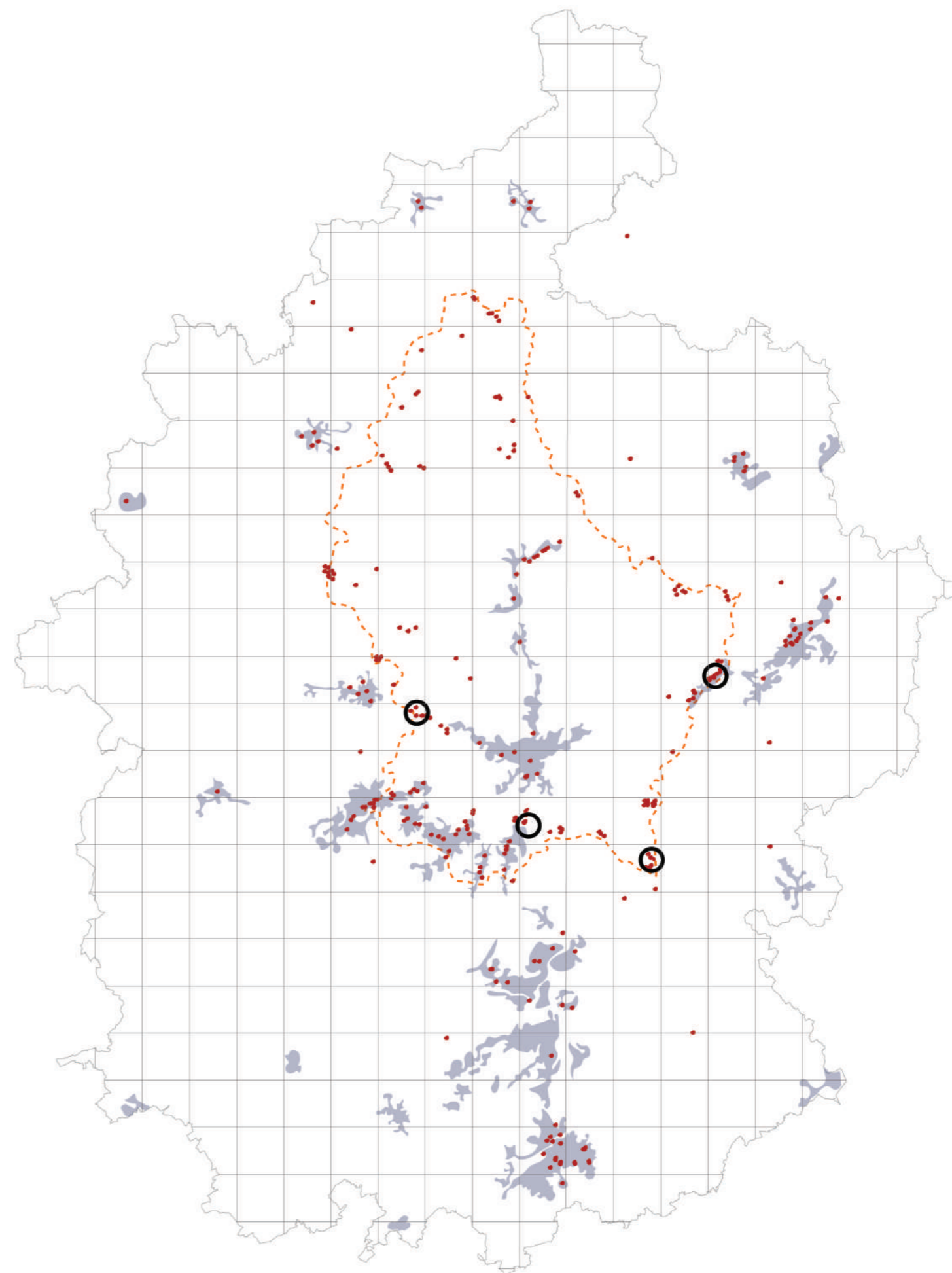
Today, Wasserbillig represents one of the quintessential semi-rural sites of the fossil age in the European Union: a borderline-dystopian site characterised by its ambition to capitalize on the tax-gradient between Germany and Luxembourg. The resulting landscape is one that contextualizes itself in the strip typologies of the US-South-West. The municipality of around 3,000 local inhabitants bordering the Mosel river contextualises itself as an enterprising location of both service industry and manufacturing—nevertheless, its primary economic driving force for many decades has been that of cross-border trade, mainly petroleum, alcohol, tobacco, coffee—the spirited driving forces of the 20th century thanks to the remaining tax differences across the EU.

Apart from the overbearing presence of gas stations and integrated tax-reduced micro-markets, alongside the Grand-Rue and Route de Luxembourg a set of diverse businesses and makers have established work- and retail spaces over the years.

### Turn around

The municipal council has already claimed that there will be no new permissions for gas stations. Since 2017, the council runs the world's first-ever total emission-free, solar-only-powered car ferry across the river Mosel, from Wasserbillig to Oberbillig. The train station in Wasserbillig has continuously been spreading its reach and now unites a series of connections including superregional InterCity destinations well beyond the German border, i.e., to Cologne or Düsseldorf. There are already existing coworking initiatives in place, which unite workforces across the border.

The primary aim in regard to a socially and ecologically sound turn around will be the dismissal of tank tourism. In its place, Wasserbillig will work towards becoming a local hub for cross-border business initiatives, manufacturing and regional tourism.



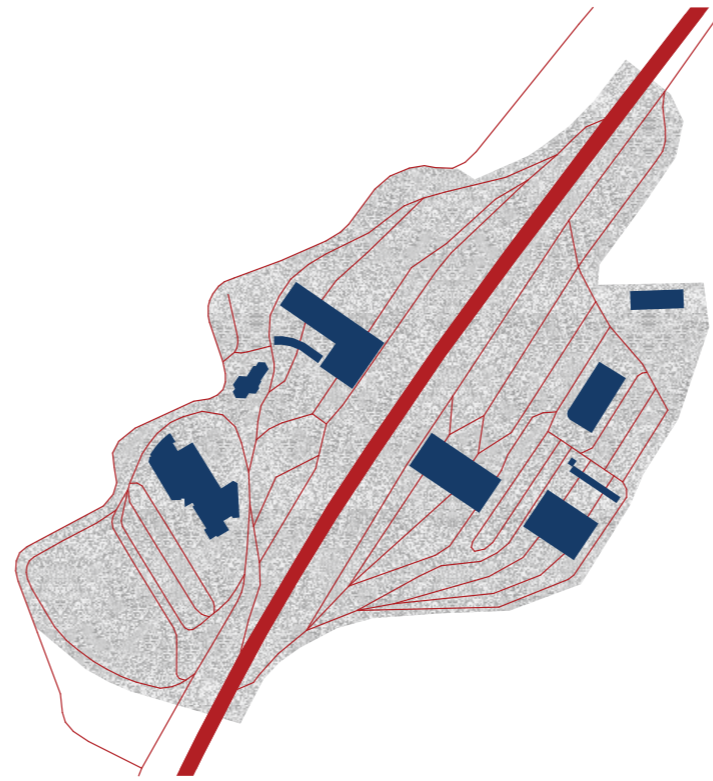
Gas stations in the Functional Area

# Atlas



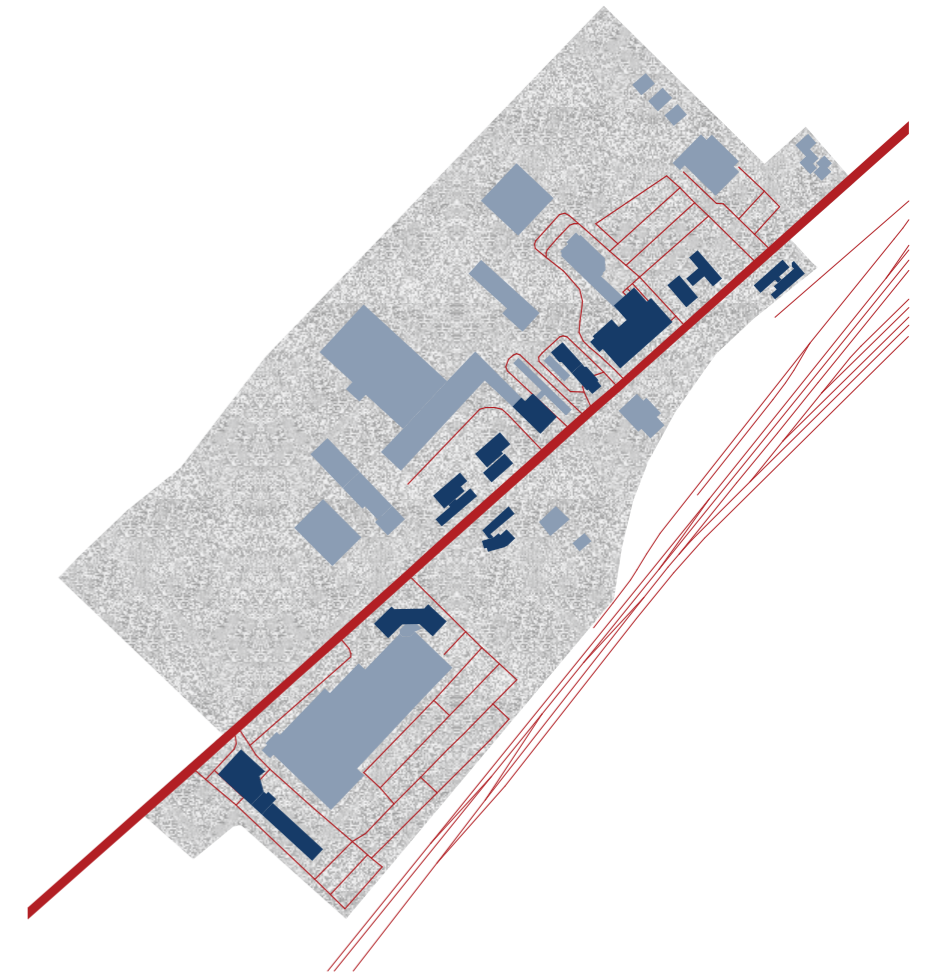
**SCHENGERWISS**  
*Schengen (LU)*

site area: 5,0 ha



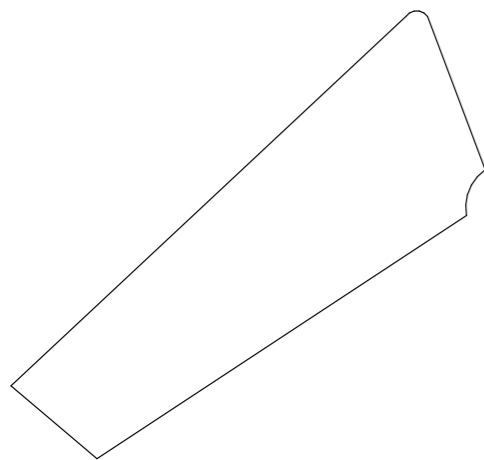
**AIRE DE BERCHEM**  
*Roeser (LU)*

site area: 13,8 ha



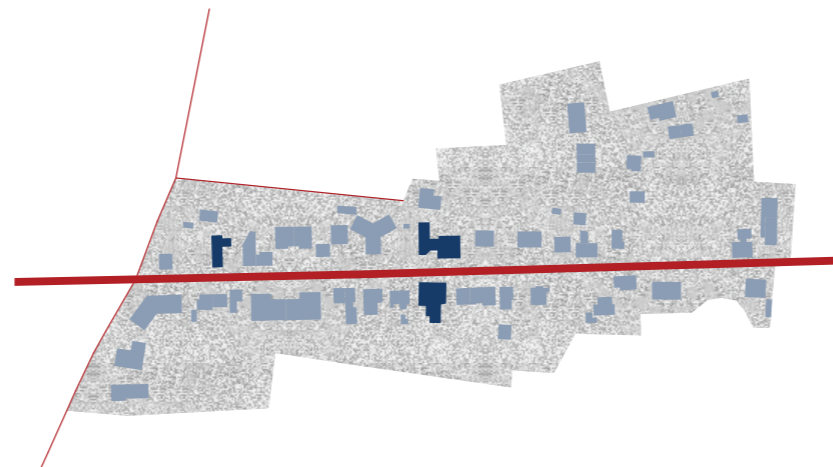
**ROUTE DE WASSERBILLIG**  
*Mertert (LU)*

site area: 18,7 ha



**GLACIS**  
*Luxembourg (LU)*

site area: 4,6 ha



**ROUTE D'ARLON**  
*Steinfert (LU)*

site area: 8,4 ha

## Strategies

- 01 **Aligning Luxembourg's fuel taxes with those of its neighbours**
- 02 **Shifting away from fossil-fueled transportation**
- 03 **Establishing a network of fast-charging stations for electric vehicles**
- 04 **Decontaminating gas station sites and renaturalising sealed surfaces**
- 05 **Transforming gas station structures into co-working spaces**
- 06 **Repurposing the roofs of former gas stations for public activities**
- 07 **Transforming gas station strips into mixed-used streets**
- 08 **Densifying spaces in-between gas stations on sealed land**

### Fuel Tourism Fuels Climate Change

Luxembourg has more than 200 gas stations, the majority of which are located along the border. The gas station in Berchem along the A3 is 30 times larger than the average European gas station and Shell's largest in Europe. Fuel tourism accounts for 70% of fuel consumption in Luxembourg, emitting more than 4.26 Mt CO<sub>2</sub>eq per year and accounting for 40% of Luxembourg's GHG emissions. A new CO<sub>2</sub> tax introduced by Luxembourg in 2021 increased diesel prices by 6 cents/L.

### Switching to electric vehicle cuts mobility emissions in half

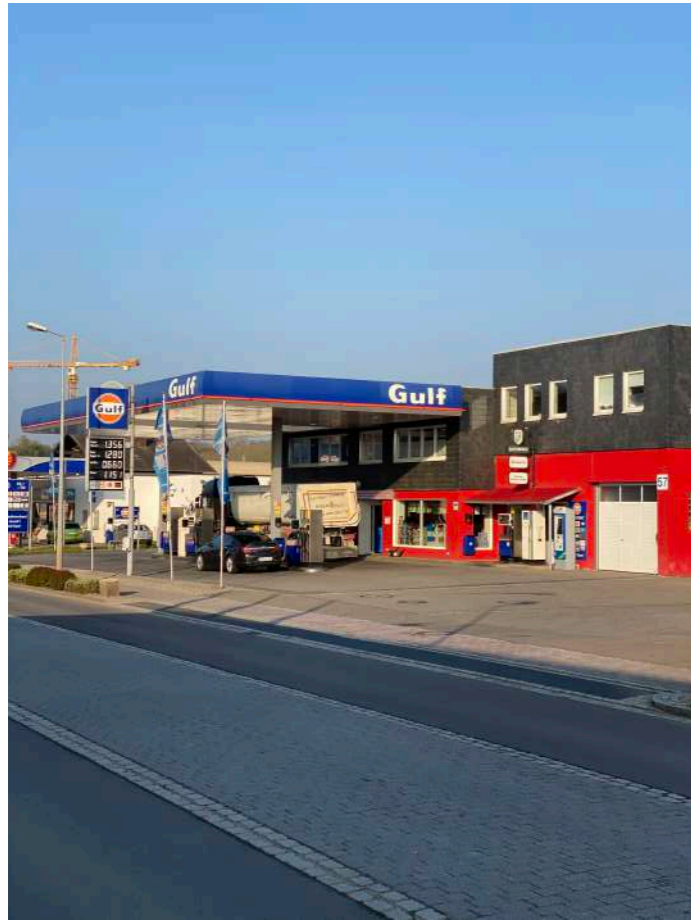
Today, an electric car charged in the functional area produces 120 g CO<sub>2</sub>eq/vehicle-km, half as much as the average gasoline car. This difference is expected to increase by 2050, with an electric car producing 45 g CO<sub>2</sub>eq/vkm thanks to electricity decarbonisation compared to 177 g for the average gasoline car.

### Fewer kilometres driven or fewer cars?

Reducing car use does not only mean reducing the share of annual distance driven (or ridden) in a car. The "private vehicle" fleet of 2050 need to be smaller as in 2020, and less "private:" cars, especially electrified ones, are material sinks, that need to be shared as much as possible. The share of life cycle impacts of electric vehicles from capital (chassis, body, motor, battery) is indeed higher as with an internal combustion engine vehicle (ICEV), especially when the use phase is heavily decarbonized, with more than 75% (from about 20% for an ICEV)—this capital needs to be amortized over as many passenger-km as possible when in use.

# Strategies

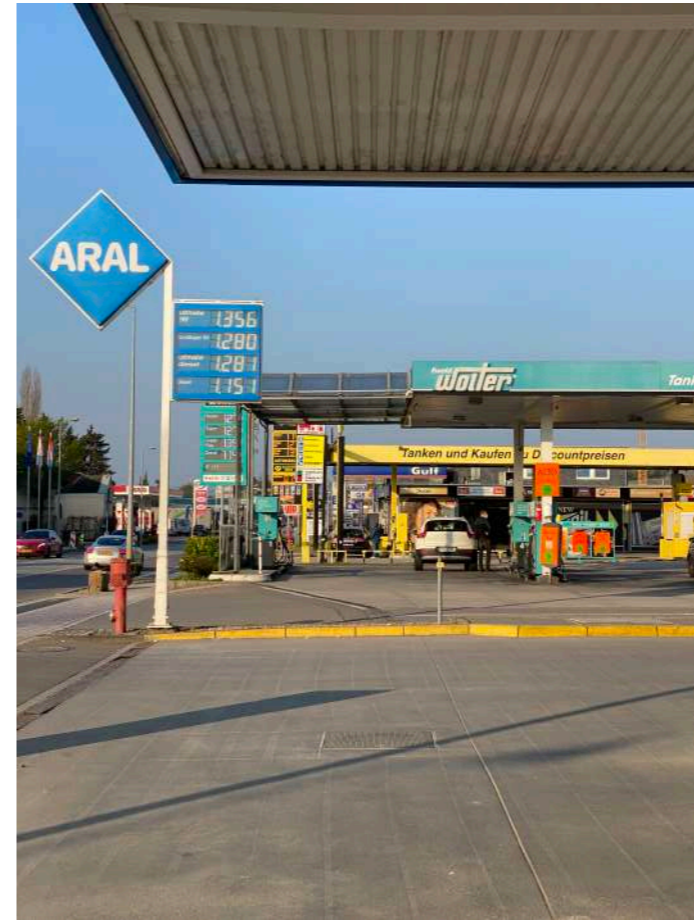
— 2021



— 2030



— 2021



— 2030



As a first step of transformation, a substantial section of the Wasserbillig Strip will have to undergo a process of unpolluting. Simultaneously, a phased plan regarding programmatic alternatives in light of the transformation and retrofitting of the former gas stations will be realized. The entire Wasserbillig Strip will be densified while already sealed but unbuilt areas will be integrated into to operative urban fabric. The first step of the transformation will include a new tram-station next to former Wolters gas-station.

Our phased strategy will also include expanding the already existing models of cross-border co-working efforts and spaces. As part of the new policy package, a set of incentives for cross-border businesses will be developed, which will include superregional education schemes. One of the first lighthouse projects to be implemented in this regard will be a Luxembourgish-German cross-border wine academy and oenology school of international standing. In its vicinity, a series of restaurants, bars, and wine-related shopping experiences will be established. This ambition will be integrated into a larger strategy, which has—partially—already been triggered off, which attempts to locate the region on the leisure tourism map.

Alongside the infrastructure for electric vehicles across scales, the revamped Wasserbillig Strip will be characterised by a heterogeneous array of workplaces, businesses and shops, which will be organized in the spirit of carpet-urbanism and modular and expanding structures that lend themselves to incremental change. In this regard, one of the main features of the area will be its architectural and urban openness in the sense of the territo-

ry being developed through a linear sequence of spatially porous units and flying roofscapes, which will allow for a spatial perception of a sequential market- and makerspace.

Programmatic units will contain farmers markets, co-working, service industries including software development, coding, printing, engineering, finance, medical development as well as doctors' offices, planning and construction companies, and repair shops. On the scale of 1:1 social development, the Wasserbillig Strip will also be presenting a number of educational facilities including care facilities for the elderly and nature kindergartens close to the work-hubs of their parents. In regard to diverse sports practices and their associated spatialities, the new Strip will include facilities for different kinds of boating, golf, tennis, water playgrounds by the Mosel, as well as different typologies of cycle tracks and parks.

The transformation will be underpinned by a diverse set of local small- to medium-scale agriculture, driving towards self-efficiency. In order to work against the existence of already sealed surfaces, a new policy will be implemented that will ensure that all roof-scapes that are not already being used for solar-energy-production will be integrated into micro-agricultural production.

Without losing out on any of the existing business, this phased plan is based on the ambition to spatially densify and create a more hub-like atmosphere that will strengthen the community spirit.

# — 08 Garage Parks

Case study: Differdange Mixed-Use Neighbourhood



## Garage Parks

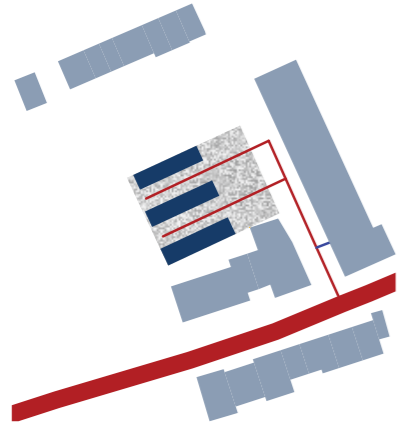
Many innovations and companies were born in garages: Disney, Google, Facebook, Steve Jobs and Bill Gates worked on their first ideas here. Garages are free spaces, where tinkering and experimenting is possible when they are not filled with cars. Our decarbonisation strategy of reducing mobility in general and excluding cars from the city, allows us to rethink the numerous individual garages and garage parks, especially in cities. In Differdange, all garages together cover an area of 153,498 m<sup>2</sup> or more than 15 hectares, an equivalent of 100 houses of 150 m<sup>2</sup>. For our case study, we have chosen a garage park that, as is often the case, is located in the middle of a perimeter block composed of terraced houses. On the eastern side is one of the arterial roads that are used intensively by French commuters from 5 a.m. in one direction and until 8 p.m. in the other. To the north and south of the block are cul-de-sacs that are used by the surrounding residents as parking spaces. Between them are rubbish bins, a few trees and children playing. Behind the houses are narrow gardens, which—in the south—are used as vegetable gardens by some residents. Between the gardens and the garage park are two long strips that are currently unused. The garage park is completely sealed and is used by some residents of the block to store their cars and spare car parts.



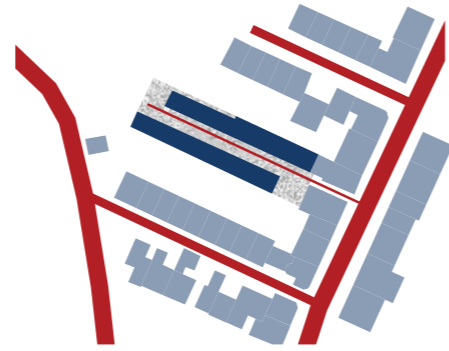
Garages in Differdange



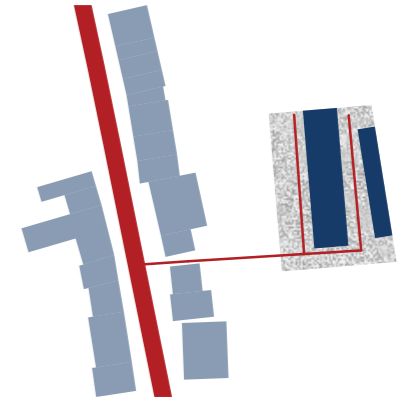
# Atlas



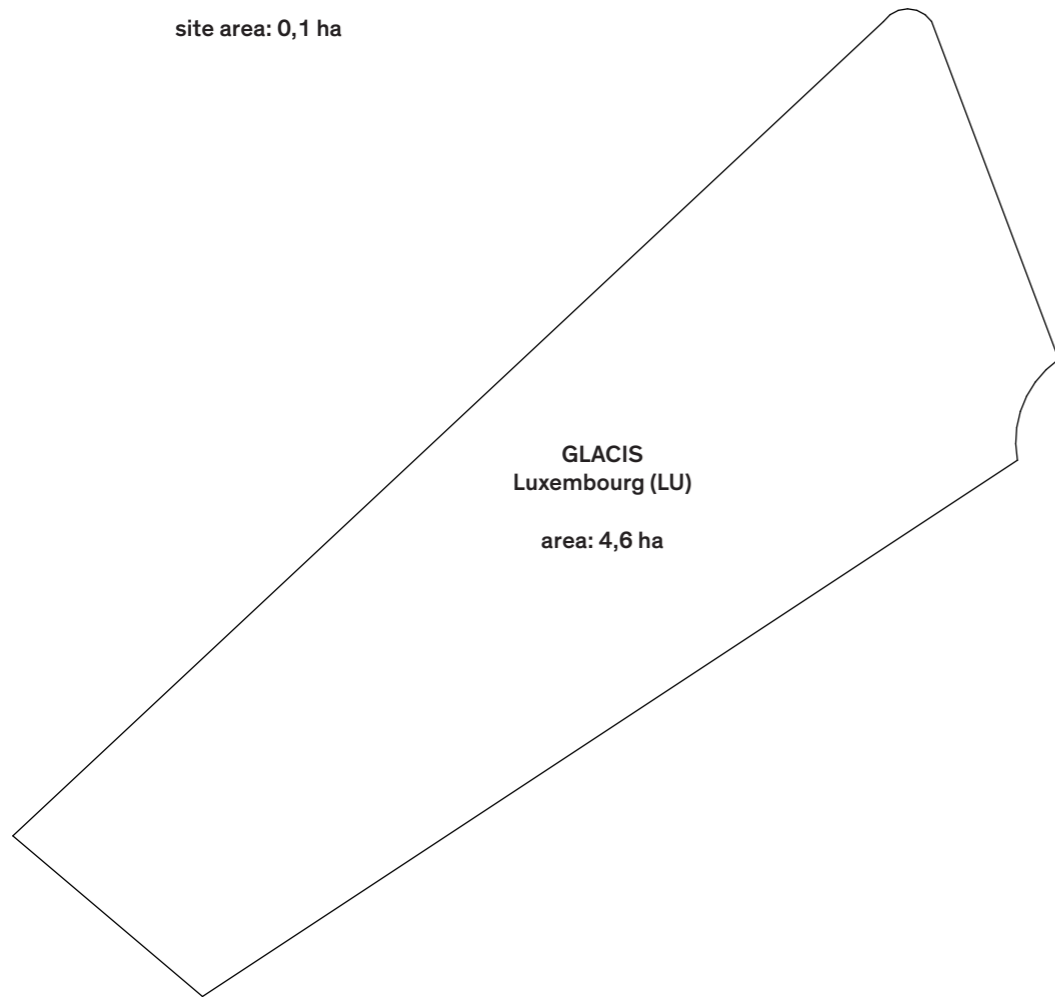
**TERRACES DE LA VILLE**  
*Differdange (LU)*  
site area: 0,1 ha



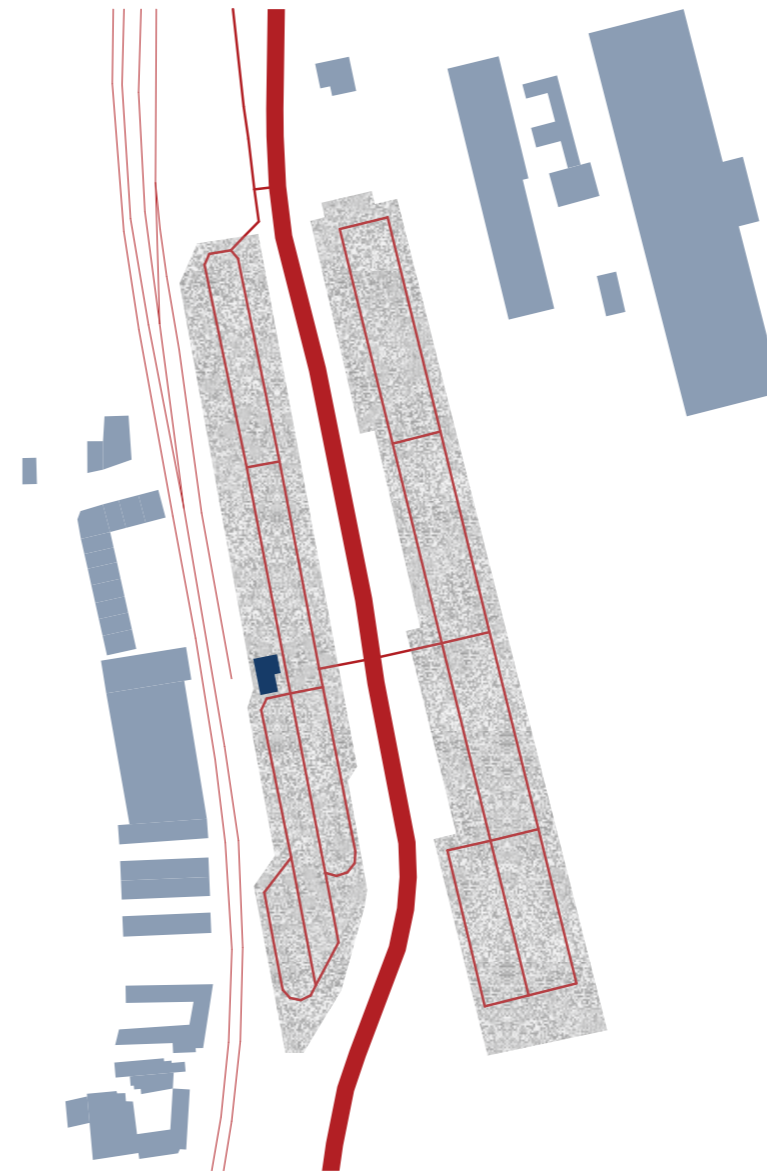
**RUE ROOSEVELT**  
*Differdange (LU)*  
site area: 0,1 ha



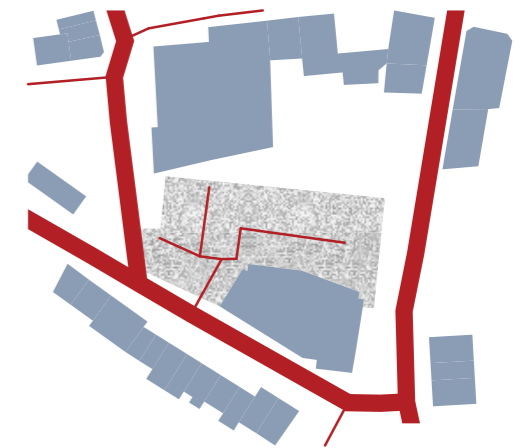
**AVENUE CHARLOTTE**  
*Differdange (LU)*  
site area: 0,2 ha



**GLACIS**  
Luxembourg (LU)  
area: 4,6 ha



**PARKING HAUT-FOURNEAUX**  
*Differdange (LU)*  
site area: 1,8 ha



**PLACE NELSON MANDELA**  
*Differdange (LU)*  
site area: 0,2 ha



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## Strategies

- 01 Reducing car ownership and shifting to mobility as a service
- 02 Increasing car sharing and car pooling
- 03 Transforming garages into ateliers and offices
- 04 Overbuilding garages by studio and co-working spaces
- 05 Converting garages into covered bike sheds

### Going Car-Free

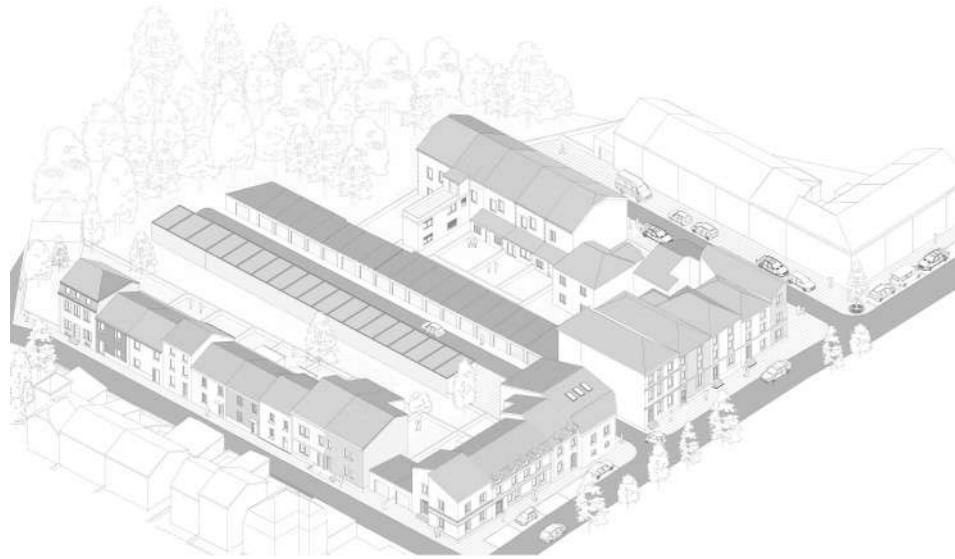
With an average travel distance of 37 km/day (Modu2.0), going car-free and switching to the current functional area's mix of bus, rail, tram, biking, and walking would mean avoiding GHG emissions of 2.4 t CO<sub>2</sub>eq/year or reducing the functional area's average carbon footprint by 15 %. In the future, we expect people to travel less too – further reducing mobility-related GHG emissions.

### Car Ownership in Luxembourg is the Highest in Europe

The car is the preferred mode of travel in the functional area, accounting for 75 % of passenger km. At 68 cars per 100 inhabitants, car ownership in Luxembourg is the highest in Europe.

# Strategies

— 2021



## Densification

Our transformation is divided into three stages up to 2040: In the first stage, the cul-de-sacs will be closed for cars and partially naturalised. Waste disposal will be organised centrally for each cul-de-sac. At the same time, the house owners will be incentivised with subsidies in order to renovate their houses energetically and to equip the roofs with photovoltaics and greenery. Many will take advantage of this opportunity to add one or two storeys to existing buildings. The two strips between the garages and the vegetable gardens will be offered to the community and used as community gardens.

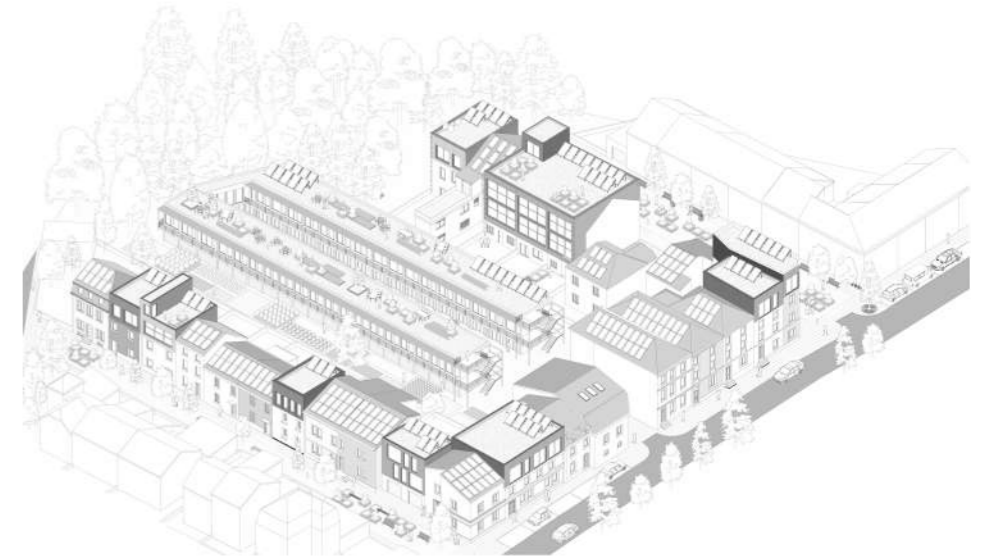
— 2030



## Diversification

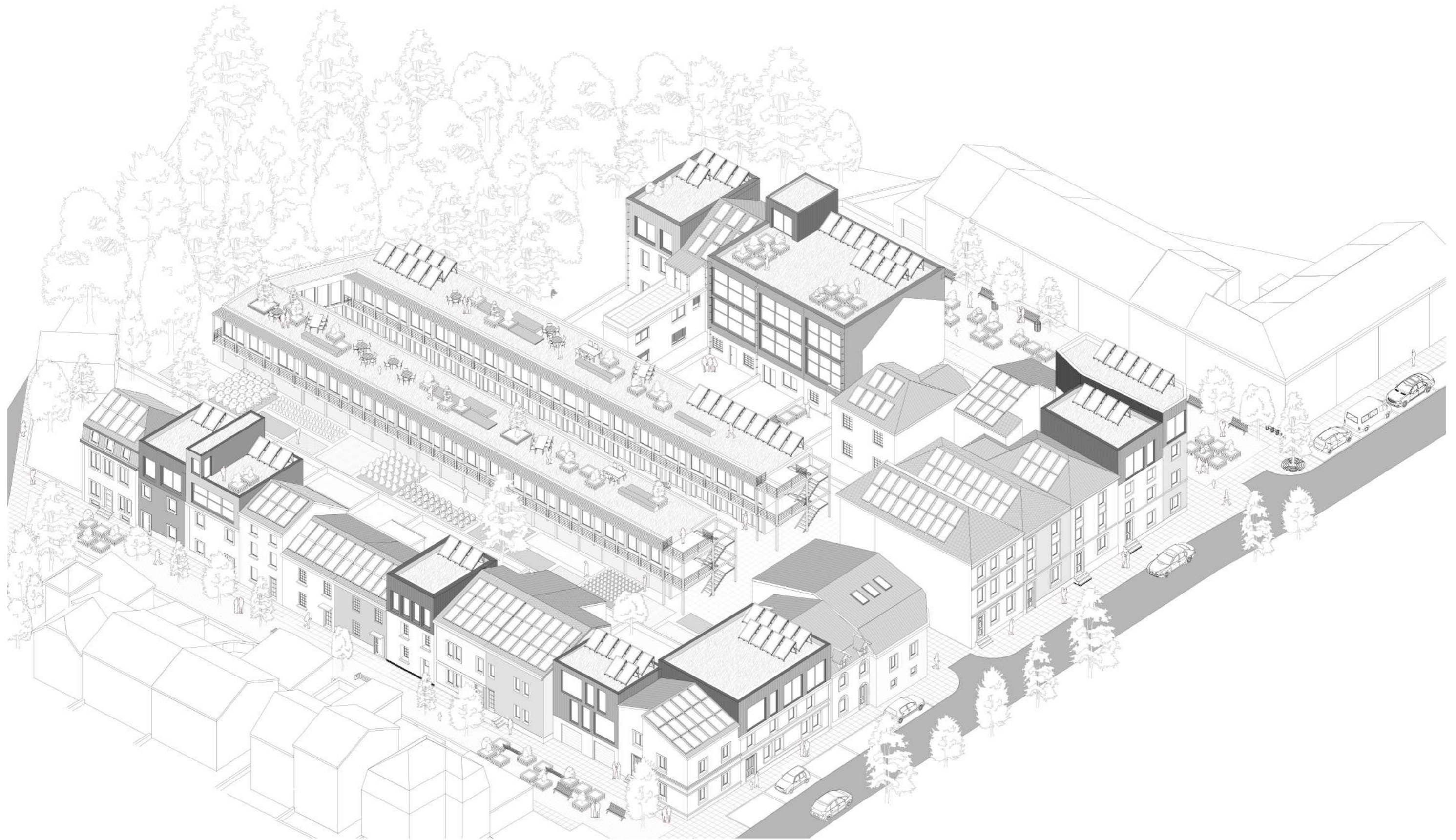
The tramway will also serve Differdange, which will have gained many new inhabitants and amenities. In a second step—in the course of reducing mobility in general and individual mobility in particular—the garages will be converted into workshops and offices and will be built over: on one side with studios for singles, students, and (climate) refugees, on the other for and into co-working spaces. Today's purely monofunctional perimeter block is being transformed into a mixed and dense neighbourhood where most people only have to go to the heart of the block to go to work.

— 2040



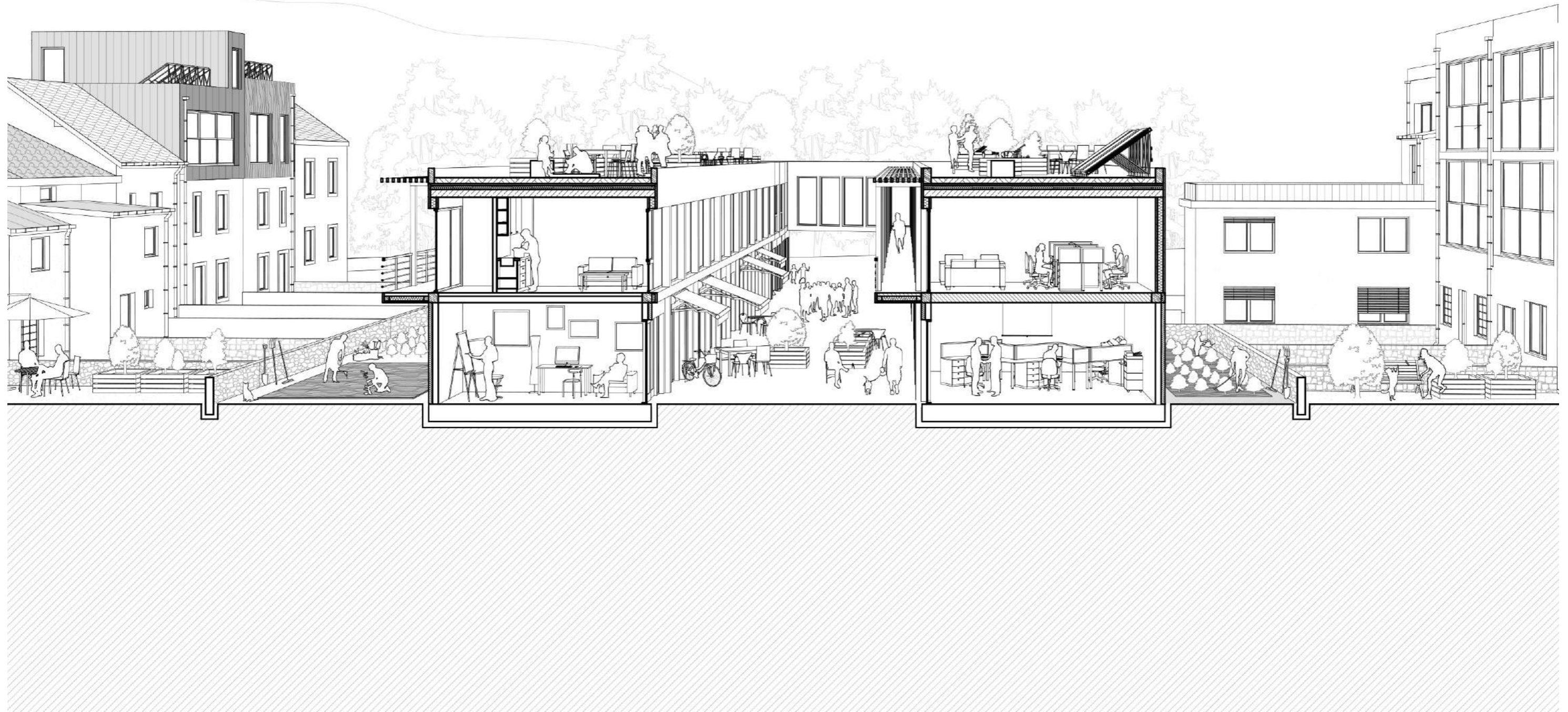
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# Strategies



**A densified and diversified neighbourhood**

# Strategies



## Practices

— 2021



Back in the 2020s, Stefan was suspicious of the way ‘ecological transition’ was about to take place. To make things clear, he knew, we, as a society, had to do something about climate change. Less plastic? Sure. Photovoltaics on the roof? Why not. Electric cars? Absolutely. He himself was already thinking of getting one. But give up on a car? That was just utopian, or if you ask him, rather dystopian. Why would he give up on his freedom to move? How would he travel from his home in Differdange to his office in Luxembourg? How would him or his wife pick up their kids from the kindergarden? How would they go shopping? The list of questions was endless, and he would be annoyed at the very thought that somebody would propose such an obnoxious thing: a car-less life in 21st century. To make things worse, he just bought a garage at the back of his house, and let’s just put it this way—it wasn’t cheap.

Today, almost twenty years later, Stefan lives without a car. He also lives without a need to commute everyday to his office. Instead, his office moved to his garage, which he is now sharing with Guillaume and

— 2040



Antoine, a young couple that moved into one of the temporary studio apartments built on top of the garage park. Stefan’s long-term neighbours, Joana, a furniture restorer, and Dinis, a construction worker, both from Portugal, who now moved their workshops to the former garage space, are also their usual after-work company. To celebrate the beginning of spring, they spontaneously agreed to meet later today for a dinner. Wait, or not? Tonight is also the meeting they scheduled with the entire neighbourhood regarding the transformation of the rooftops. Initially, the rooftops were divided as private lots—each apartment had their share of the ‘new land’ above. But, as everyone agrees, today, this model seems a bit outdated. The question is now on the table—why not create a single, large common space where everyone can enjoy the entire rooftop, instead of staying bound to their little territories? And, to make it more pragmatic—why not discuss this tonight over a common dinner upstairs?

04 —

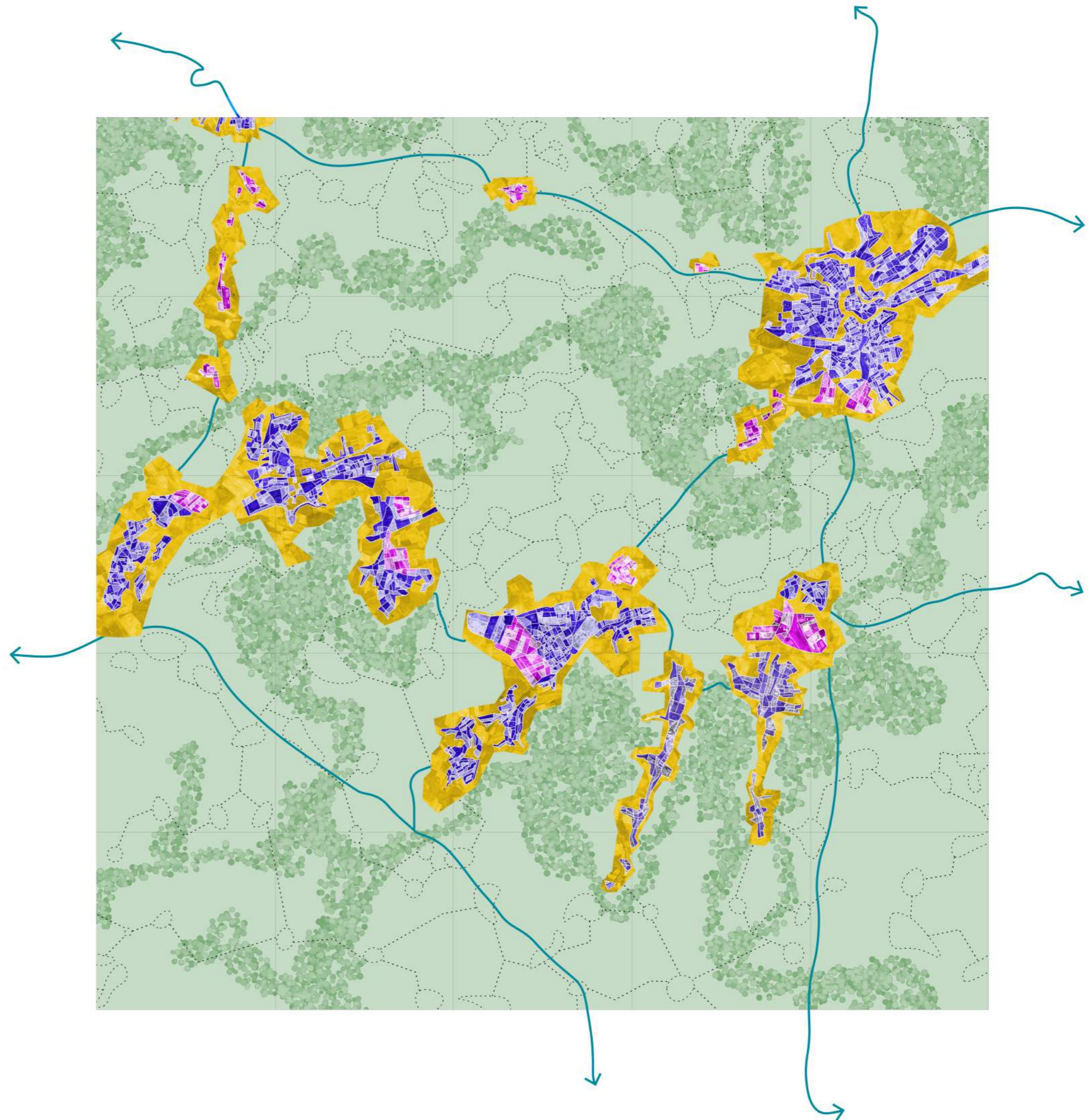
TRANSITION

FIGURE

## Intermediate Scale

In the synthesis of our decarbonisation and resilience strategies, socially and functionally mixed cities are emerging—on the one hand—with a high degree of both density and porosity. More people are now living together within the perimeter of cities, taking up less individual housing space while benefiting from diverse shared, commercial as well as public amenities within walking distance. Living, working, retailing, and social infrastructures intermingle through the different grains of the city—its neighbourhoods and its buildings. This leads to a renaissance of urbanity in which the automobile no longer plays a significant role. The removal of privately owned cars from the city has created many new (open) spaces for transition activities and has flourished alternative economies. The now hybrid buildings made of natural materials produce more energy than they consume, are convertible in use without much effort, and are recyclable. At the same time, there are more open spaces in the cities that are used in a variety of ways as community gardens, park areas and sports facilities. In combination with green roofs and cold air corridors, these productive landscapes contribute to reducing heat islands and make the cities more resilient when it comes to pandemics. Moreover, the cities are enclosed by productive landscape belts, which also accommodate different landscape typologies, but—above all—bring the food system into smaller cycles through an abundance of agricultural typologies such as solidarity farming, community gardens or allotment gardens in proximity to or within the urban fabric. The surrounding landscape is no longer a passive resource, but now—as topologies of biodiversity and agro-ecological fields—plays an equivalent role to the city islands becoming a valuable public good.

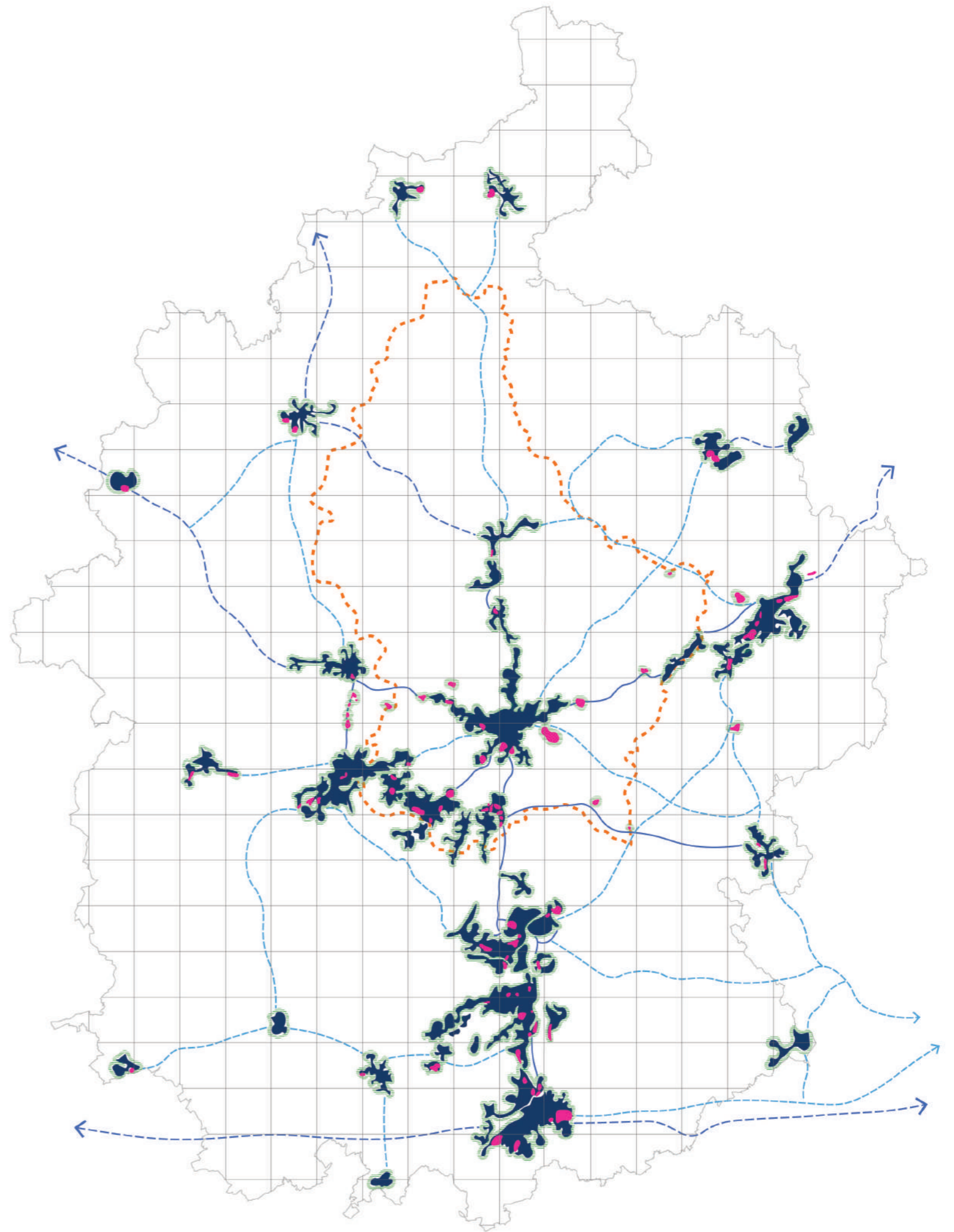
On the other hand, a set of sustainable networks have emerged at different scales. Even though the islands have gained a higher degree of autonomy in terms of food, energy, commercial as well as public services, and the elementary functions such as living and working, these islands are not isolated. In addition to the sustainable energy grid, an efficient light rail train system—partly built on former highways, partly running through the cities—connects each of these cities to other cities in the region and, in conjunction with the express train system, beyond the functional area of Luxembourg. Unlike the traditional train network, the new light rail network does neither destroy urbanity nor landscapes. It connects but does not fragment. In the rural area, the many villages and micro-towns that have not grown further have joined to become a multiplicity of networks in order to ensure basic services and create synergies. The realisation of diverse co-working spaces in these communities has not only drastically reduced private transport, but also strengthened social life. Each of these villages is equipped with sharing car stations and is served by e-buses on the periphery, connecting their residents to the urban federation. The agro-ecological turn has also re-established a productive relationship between the inhabitants of the rural areas and the surrounding landscape, which—beyond recreational activities—includes closer food cycles as in the urban islands.





## — Wunschbild: Archipelago 1.6 CO<sub>2</sub>

At the scale of the functional space, a low carbon and resilient city-landscape has emerged: an interconnected archipelago of more sufficient and equal urban islands embedded in a productive, colourful, ecological landscape co-inhabited by all living things.



# — Assessment

Decarbonisation results from a wide array of identified levers, for various sectors, and different scales. In Phase 1 we estimated a potential decarbonisation pathway for Luxembourg, based on three proofs-of-concept combining technological and behavioural measures, as well as other sector-specific efforts. The functional area of Luxembourg includes about 2 million people, and more carbon footprint inequalities—specifically between households in which at least one member works in Luxembourg and the others, as a higher income translates strongly into higher greenhouse gas emissions and other impacts from household consumption.<sup>8</sup>

When it comes to compliance and GHG emission reporting on the global stage to the UNFCCC or the European Union, emissions are measured and accounted using the territorial approach. Thus, Luxembourg reports GHG emissions that occur within its borders, such as from agriculture or steel production. Also included are GHG emissions due to gasoline and diesel consumption, even though vehicles may leave the territory after refuelling. Fuel tourism accounts for 37 % of the 10.8 Mt CO<sub>2</sub>eq emissions total for Luxembourg. The territorial or production approach to reporting has the advantage of being easier to measure, producing more accurate estimates. Luxembourg has set a target of reducing GHG emissions by 55% by 2030 compared to the 2005 level. Compared to the current level, this target translates into a reduction of 45 % from now to 2030.

Another way of accounting for GHG emissions from a country is to focus on consumption as the driver of production. Consumption-based accounting includes GHGs emitted anywhere in the world and embodied in the goods consumed in Luxembourg, such as clothing produced in Asia. Consumption-based emissions in Luxembourg amounted to 15.6 Mt CO<sub>2</sub> eq. in 2018, or about 25 t CO<sub>2</sub> eq. per capita. Life-cycle emissions are more difficult to account for, as it requires tracing all purchases made abroad back to their point of production; consumption-based estimates therefore have a higher variance than production-based estimates.

Both accounting systems measure GHG emissions attributable in some way to Luxembourg (either through production or consumption) and overlap only when it comes to GHGs emitted in Luxembourg for the production of goods consumed in Luxembourg (see Annex for a detailed accounting). This includes, for example, domestic food production for domestic consumption or residential energy demand.

Luxembourg, like other rich countries, has a larger consumption-based footprint than production-based footprint. Thus, while consumption by Luxembourg residents has a real impact on climate change, the government of Luxembourg—bound by international climate treaties—is primarily focused on reducing production-based emissions. No national target exists for reducing GHG emissions due to consumption by Luxembourg residents.

Our goal is to reduce GHG emissions wherever possible, such that we use the Paris Agreement target emissions to keep global warming well below 2°C and convert it into a per-capita emissions target for 2050 based on global population projections. Thus, we must reduce GHG emissions from about 26 to 1.6 t CO<sub>2</sub>eq per capita per year – a more than 90 % reduction.

## Carbon footprint and decarbonisation strategies

At 26 t CO<sub>2</sub>eq per capita per year Luxembourg has a higher per-capita, consumption-based carbon footprint than its neighbours. France has the lowest carbon footprint at 10 t CO<sub>2</sub>eq per capita per year, followed by Germany with 14 and Belgium with 10 t CO<sub>2</sub>eq per capita per year. We have calculated the average, consumption-based carbon footprint for the functional area (FA) at 16 t CO<sub>2</sub>eq/cap/yr as the population-weighted average footprint of Luxembourg and its three neighbouring regions. The consumption-based carbon footprint consists of mobility (19 %), fuel tourism (10 %, export outside of the FA), aviation (6%, without connecting flights), housing (21 %), consumption goods (19 %), food (12 %), and public services (12 %).

In general, efforts to reduce GHG emissions typically involve one of the following categories of strategies: avoid, shift, improve. The optimal hierarchy is first to avoid activities that cause emissions, second to shift to less emission-intensive

modes of completing the activity, and third to improve (reduce the emissions intensity of) a mode of activity. Historically, however, a reverse hierarchy has been applied. In the transportation sector for example, governments have long mandated fuel economy standards (improve), followed by improving public transportation and soft mobility options (shift), and only recently seriously considered measures to reduce the demand for transportation, such as through telework (avoid).

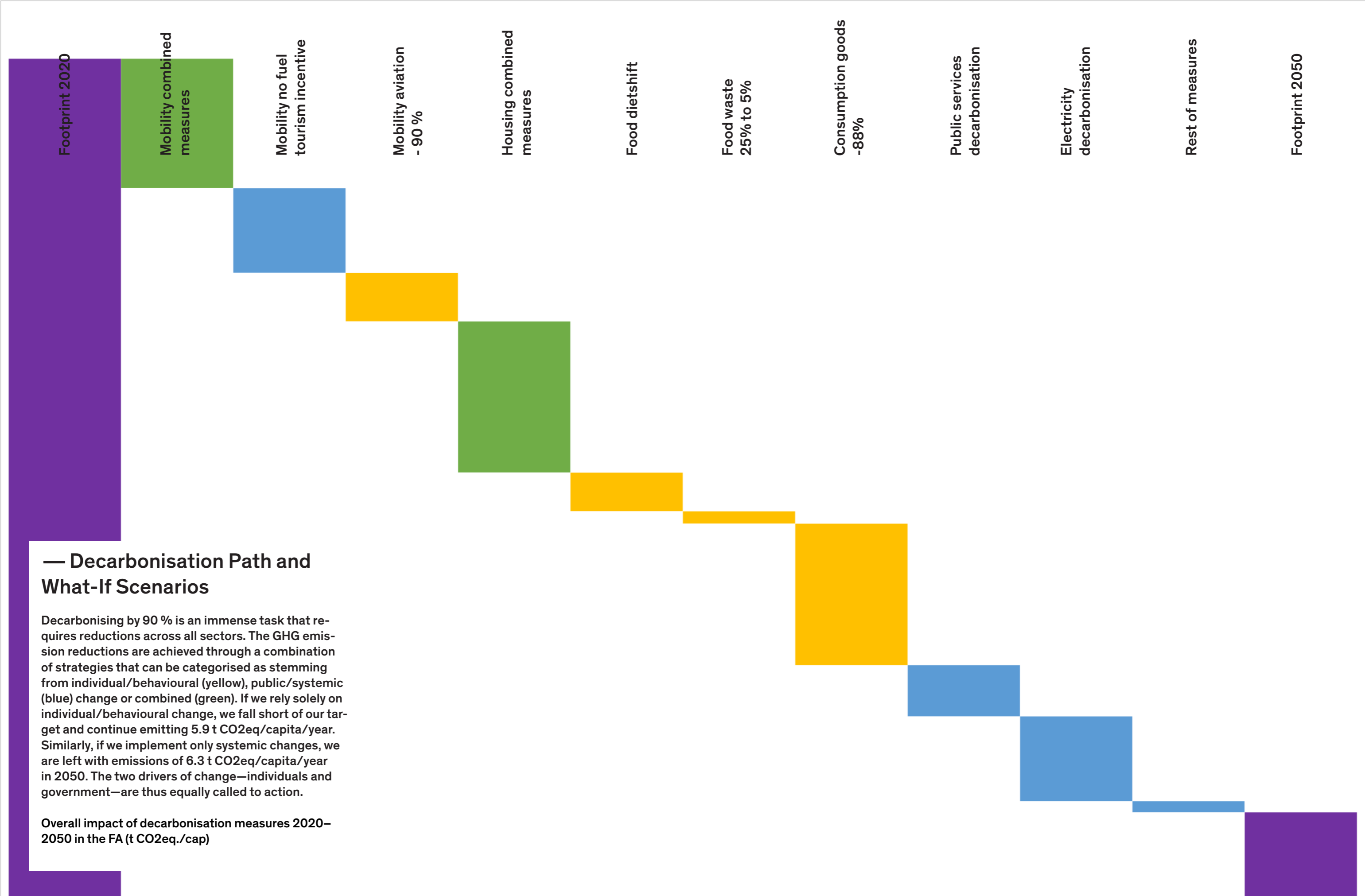
The most powerful tool for reducing GHG emissions (avoid) has received less attention, due also to the international practice of reporting production-based emissions to the UNFCCC, allowing richer countries, such as Luxembourg, to ignore the impacts of the consumption habits of its population on GHG emissions occurring elsewhere. Our report avoids this pitfall and focuses mainly on reducing consumption-based GHG emissions, in which “avoid”-measures play an important role. The previous sections described how our set of strategies reduces GHG emissions and other environmental pollutants. Below we calculate the combined effect of these strategies on mobility, housing, food, consumption goods, and the public sector. We also demonstrate how our strategies in reforestation and agro-ecology significantly increase annual carbon sequestration in the functional area.

Our strategies are grouped together as follows: “Mobility combined measures” includes our strategies to reduce demand for transportation, halve the national car fleet, increase car-shar-

ing from 1.2 to 1.6 passengers/vehicle, shift to public transportation and soft mobility, as well as a decarbonisation of these modes of transport over time through increased electromobility. “Mobility no fuel tourism incentive” means that Luxembourg’s fuel taxes are aligned with those of its neighbours. “Mobility aviation -90 %” involves consumers taking the train instead of flying when a less than 5 hour train alternative exists and limiting flying to only one flight every two years. “Housing combined measures” includes a reduction in living space from 53 to 35 m<sup>2</sup> per person, increasing efficiency to 110 kWh/m<sup>2</sup> and phasing out fuel oil and natural gas. “Food diet shift” includes shifting diets to a flexitarian diet that is vegetarian for 6 days per week and omnivore for 1 day per week, while “food waste 25 % to 5 %” reduces the share of food waste from 25 % to 5 %. “Consumption goods -88 %” includes extending new product lifetimes by a factor of 2, increasing the sharing economy to get double the service per product, and creating a large-scale second-hand market for a second product life. “Public services decarbonisation” involves decarbonising the public service sector by 50%. “Electricity decarbonisation” includes decarbonisation of electricity produced in the functional area and imported from neighbouring countries, but excludes the increase in electrification already accounted for in “mobility combined measures” and “housing combined measures.” Finally, the “rest of measures” includes decarbonisation of freight and refrigeration.

These strategies can be categorised into their type: to avoid or reduce the activity, to shift to a more environmentally friendly mode of the activity, or to improve the efficiency of the activity. Our set of strategies in the mobility and housing sectors, for example, include both “avoid”, “shift”, and “improve” components. In mobility, the shift strategy (switching to public transportation and soft mobility) reduces GHG emissions by 73 %. The avoid strategy (reducing demand for transportation) reduces GHG emissions by 40 %. Combined, shifting and avoiding reduces GHG emissions by 87 % in road transportation.

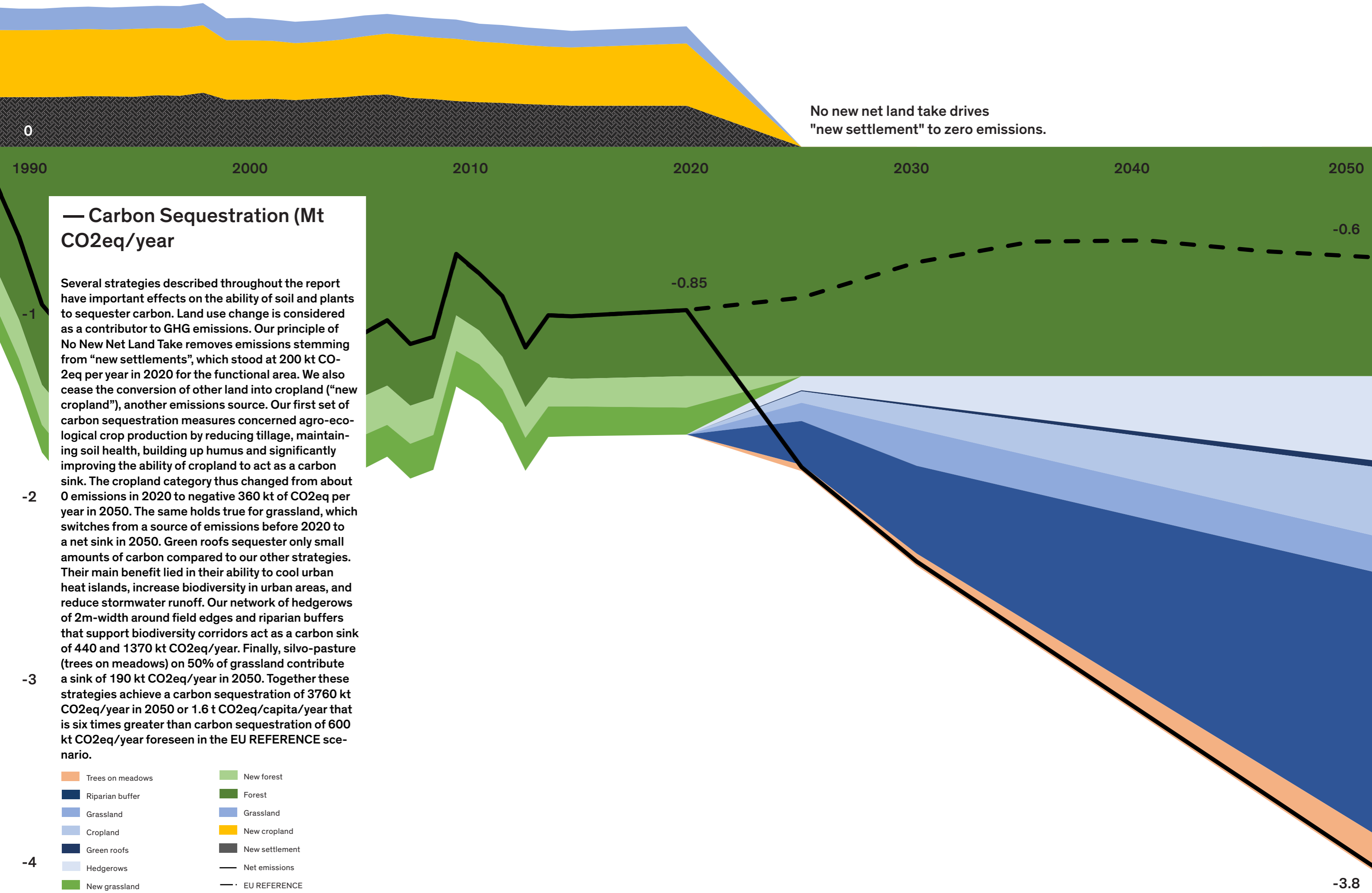
15.6      -2.4      -1.6      -0.9      -2.8      -0.7      -0.2      -2.6      -1.0      -1.6      -0.2      1.6



### — Decarbonisation Path and What-If Scenarios

Decarbonising by 90 % is an immense task that requires reductions across all sectors. The GHG emission reductions are achieved through a combination of strategies that can be categorised as stemming from individual/behavioural (yellow), public/systemic (blue) change or combined (green). If we rely solely on individual/behavioural change, we fall short of our target and continue emitting 5.9 t CO2eq/capita/year. Similarly, if we implement only systemic changes, we are left with emissions of 6.3 t CO2eq/capita/year in 2050. The two drivers of change—individuals and government—are thus equally called to action.

Overall impact of decarbonisation measures 2020–2050 in the FA (t CO2eq./cap)



No new net land take drives "new settlement" to zero emissions.

-0.85

-0.6

-3.8

0

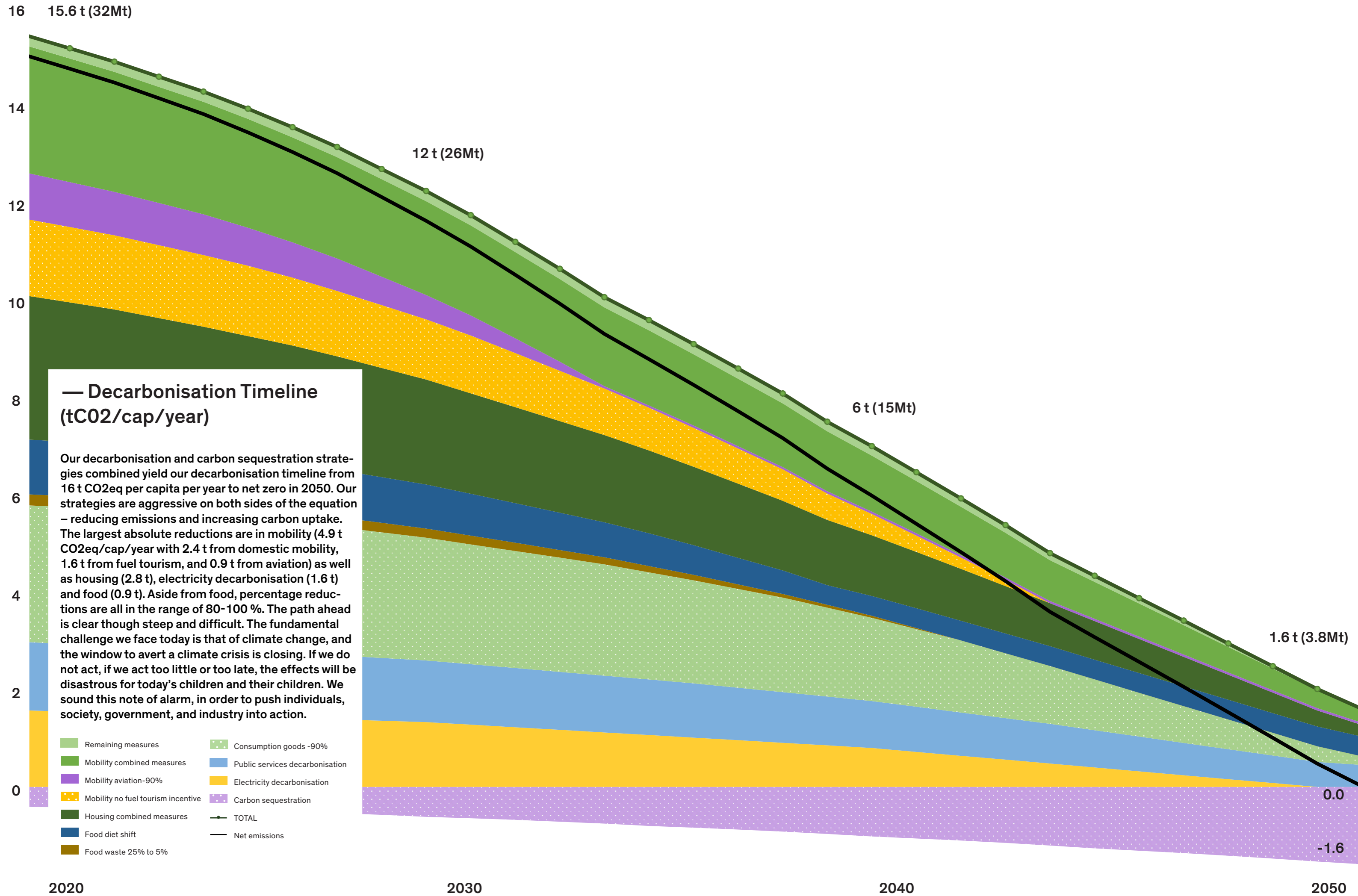
1990 2000 2010 2020 2030 2040 2050

-1

-2

-3

-4



# — Governance

A sustainable transition of Luxembourg and its neighbour-territories bears enormous challenges for the institutional systems (rules, regulations, organisations) that are asked to respond properly to the imperatives of carbon reduction, climate resilience and overall sustainability. The reasons for the magnitude of these challenges are threefold at least: Firstly, the gap between the current state of the system and future targets is wider than elsewhere. Secondly, economic dynamism poses a big constraint to the forces of intended change, rendering the system more inert than it would be appropriate in the light of the problems faced. Thirdly, the institutional systems in charge of governance have had major problems in the past to adapt to environmental and sustainability transitions, also given the complex configuration of territorial governance in Luxembourg being a local, regional and global endeavour simultaneously.

This point deserves particular attention, as the country's economic and demographic growth has not only established close linkages to networks and territories in the Greater Region and beyond. The enlargement of its socio-economic reach has left a considerable vacuum in governance terms: functional space and the territory of governance (in terms of binding policies) are no longer congruent. While the economy was successfully opened towards global flows of services by a fostered growth-machine approach, the actual governance practice appeared to be introverted and thus limited. The systems of infrastructure provision and land-use planning had difficulties to

catch up with the high speed and pressure of development, resulting in inertia and a certain lack of strategic orientation at various levels of spatial governance. Also, there is a wide-spread perception that politics in the Grand Duchy and around have been subject to more top-down oriented decision making until recently. These issues need to be taken into account when formulating ambitious goals, both as concerns the systems of formal politico-administrative practice and in citizen participation.

## Aims and objectives

Our team seeks to inspire a regenerative transition pathway to a low-carbon and climate resilient functional region under conditions of possible further demographic growth. Our approach suggests reconfiguring space into a polycentric grid. We have shown in this report how mono-functional areas of the fossil age can be transformed into multi-functional places offering a high quality of life for present and future residents. The more this kind of regenerative city-landscape becomes reality, in which all essential functions are available for everybody in 15 minutes reach, the stronger will be the affordances for behavioural changes of the population, which are the other essential component of the transition equation.

Both the place-sensitive local implementation of the suggested spatial reconfiguration and the associated generalisation of low-carbon lifestyles require the strongest possible active

participation and collaboration of all stakeholders across sectors (households, public sector, private sector, civil society, research, education...). Simultaneously, substantial reforms of the traditional system of politics, governance and administration will be needed, in order to support the various transition projects and domains.

## Reforming territorial governance

What could be strategic steps in the right direction for reforming urban and territorial governance in such ways that the targets mentioned above can be pursued? While there is good reason to be cautious about the limitations and constraints to radical change, the following ideas may offer both opportunities for fundamental transitions and also for reforming the existing structures and patterns of governance. They aim particularly at resolving three basic problems that have hindered an innovative urbanism coming to terms in Luxembourg and its surroundings so far: the commodification and financialisation of land; the unsolved dilemma of both overlapping and competing responsibilities for urban-regional development of state and communes; the lack of strategic orientation particularly at the level of decision making that has most authority to set up binding rules: the municipal level. Such strategic steps could include as follows:

A public land and housing policy (and land taxation adapted to it), more common-good orientation instead of private interests in planning and

territorial development;

The introduction of "concept allocation" in the development process, where scarce land is allocated primarily according to the quality of an asset, instead of to willingness to pay or yield;

Better equipping the municipalities (ideally, in terms of personnel and finances) as the central level of urban practice, but also the introduction of independent expertise at the top of the city: Luxembourg needs professionally arguing, politically independent urbanists;

The simplification of the complicated legal instruments, perhaps in exchange for more transparency and binding content in the planning process?

Accelerating the process of designing a territorial vision for the Greater Region or parts of it.

#### A focus on civil society intervention

There are some distinct while complementary paradigms for increasing stakeholder participation (in quantitative terms), deepening the levels of participation (from information to consultation to decision-making to co-construction), and expanding the impact of participation on the transition goals. Most importantly, we consider the following strategies and measures as being essential:

Inviting citizens to engage with the representative governance institutions between and beyond elections through reforms of or add-ons to the existing governance structures and processes. There are many options such as consultative citizen committees as introduced in the present

consultation, participatory budgeting Dudelange is seeking to champion inspired by the experiences in Metz, or environmental monitoring based on citizen science as prototyped in the EU project GROW (<https://growobservatory.org/>). For an overview of approaches related to this paradigm see Civicus' Participatory governance toolkit.<sup>9</sup> In Luxembourg, citizen participation is now supposed to become mainstreamed at communal level as part of the second national Climate Pact, but also in other pacts, such as in the area of nature conservation and of housing. At this point, there is yet a strong capacity building need for communal councillors and public servants to become enablers and promoters of participatory citizen engagement. At the level of the functional region, the paradigm of transition in and through existing governance structures is limited by a range of institutional and cultural barriers.<sup>10</sup>

Implementing transition labs and hubs at neighbourhood and town levels (such as is already happening in Esch-sur-Alzette or in the Canton de Redange with a multitude of bottom-up initiatives) and in rural regions, connecting them through cross-border networks. The family of labs and hubs (living labs, future labs, social innovation labs, real-world laboratories, impact hubs, creative hubs, collective impact initiatives, quintuple helix innovation systems, etc.) are facilitated spaces for cross-sector collaborative experimentation and innovation, co-creation of knowledge and practices, identification of leverage points and implementation of multi-stakeholder impact projects. Cultivating such labs by means of professional

facilitation of multi-stakeholder collaboration in physical and virtual spaces has multiple benefits: "transformative place-making, activating network partners, replication of lab structure, education and training, stimulating entrepreneurial growth and narratives of impact" (Wirth et al 2019). Such an experimental and collaborative transition governance approach realized through cross-sector local labs, regional hubs and cross-border networks is particularly flexible, open and inclusive. In an international perspective, Luxembourg and the functional cross-border region are lagging behind on making use of this transition governance paradigm. Capacity building in terms of infrastructure, training, resourcing, monitoring and transfer is needed.<sup>11</sup>

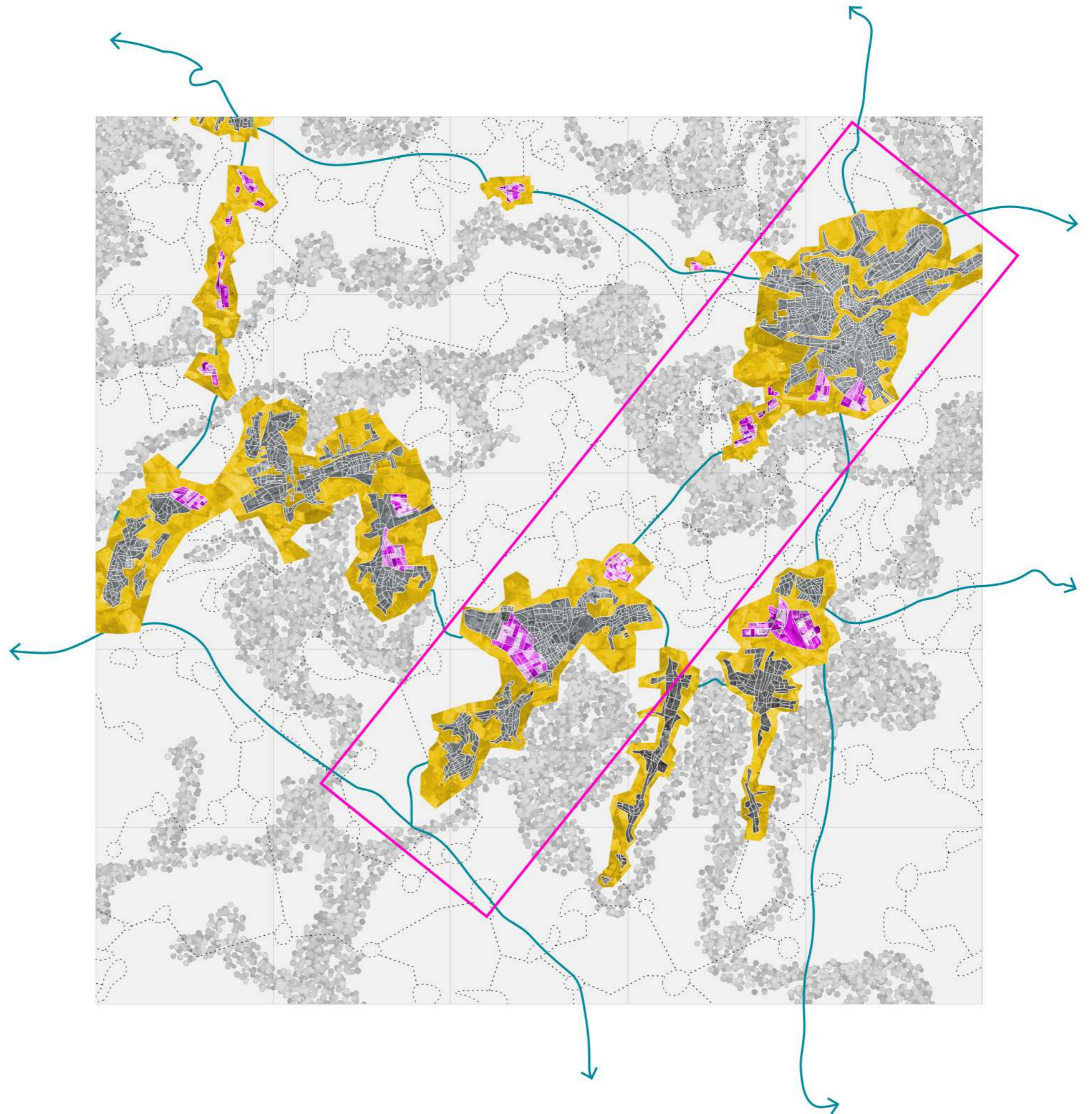
From a systemic perspective, we expect the greatest advances on the suggested decarbonisation and resilience pathway, if approaches pertaining to these different climate and transition governance paradigms co-exist to challenge each other through their different "operating systems" and co-evolve into a new synthesis. The cross-border functional space is particularly suitable for unfolding such a multi-paradigmatic participatory transition governance as one of the strategic pillars of the recently published first operational strategy for the Greater Region (2020) is "to develop together the projects and structures of the territory by involving citizens more" based on the insight that "the interest of citizens in transition issues could help establish and strengthen the links necessary to respond collectively to the challenges of the ecological transition."<sup>12</sup>



## Outlook for Phase 3

The third phase would give us the opportunity to translate the spatialised strategies of this report into real pilote projects. Beyond the case studies, we would develop through a participatory process a land planning and urban development pilot project in the region. An area has emerged in our study that concentrates particularly many case studies: a transnational territorial corridor from Luxembourg City to Villerupt, via Leudelange, Foetz, Esch-sur-Alzette and Audun-le-Tiche. In addition to an integral territorial design for this corridor (with plans, 3D representations, physical models, video), we would now transform different emblematic places such as the Kirchberg Plateau or Foetz in a co-design with experts, activists and citizens. We would prepare these pilot projects in such a way that both the desired image for 2050 clearly emerges, but also the immediate transitions are defined in such a way that implementation could start right after the call.

A second focus in the third phase would be the elaboration of policy recommendations. The precise comparison of our strategies with the current regulations and plans (Plans Sectoriels, PDAT, PAG, PAP ...) would result in a catalogue of concrete proposals on how current land planning and urban planning should be concretely changed. We would make concrete proposals for the conception of the new PDAT. Here, too, what counts is: Not only the final image is crucial, but how the transitions are to be designed through a process. Finally, we would estimate the costs of our project and compare them with the costs of the effects of global warming in Luxembourg. Together with the plans and the metrics of the Wunschbild, with trans-scalar pilot projects, we would have a rich and scientifically validated material to launch a broad public debate and thus set the political course for the transition.



# Endnotes

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4

Precise maps of decontamination are not accessible.

5

This rate is currently applicable between Germany and France, and between Geneva and France. The current agreement between Luxembourg and Belgium to provide compensation with a lump sum (30million€/year) is exceptional in the EU, source: CoE, (2019): <https://rm.coe.int/une-repartition-equitable-de-l-impot-dans-les-zones-transfrontalieres-/16809897cf>.

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See Map 4 in Pigeron-Piroth, I. et al. (2020): [https://orbilu.uni.lu/bitstream/10993/43501/1/BorderObs\\_COVID\\_PlgeronEvrardBelkacem\\_040620\\_FINAL\\_sec.pdf](https://orbilu.uni.lu/bitstream/10993/43501/1/BorderObs_COVID_PlgeronEvrardBelkacem_040620_FINAL_sec.pdf)

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This project, directed by Prof. Dr. Danièle Waldmann, has been developed in the framework of ECON4SD, financed by the EU and the Luxembourg Research Fund.

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# — Annex

Luxembourg 2050 — Prospects for  
a Regenerative City Landscape —  
Report Phase 2

# Participatory Workshops

We organized and facilitated the following four online workshops to collect feedback and suggestions on our approach and our intermediary results with citizens and with practitioners of the ecological transition, economic development and spatial planning from all four countries of the cross-border region.

1. Luxembourg Transition Day workshop, 22nd March 2021, 17.30-19.30
2. Cross-border workshop 1, 27th April 2021, 17.15-18.45
3. Cross-border workshop 2, 5th May 2021, 12.15-13.45
4. Cross-border workshop 3, 6th May 2021, 12.15-13.45

## Documentation of the Transition Day Workshop 22nd March 2021

Press release after the event in French and German:

### Luxembourg 2050 - Perspectives pour un paysage urbain régénérateur

Le progrès technologique ne suffira pas à lui seul pour assurer la transition écologique nécessaire. C'est le point de départ de travaux d'une équipe luxembourgeoise de chercheurs, de planificateurs et de praticiens de la transition dans le cadre de Luxembourg in Transition.

Lundi 22 mars 2021 l'équipe autour du prof. Florian Hertweck a présenté les résultats de ses travaux dans le cadre de « Luxembourg in Transition » aux Transition Days en ligne à une centaine de participants.

Avec sa consultation urbano-architecturale et paysagère „Luxembourg in Transition“ lancée en 2020 le ministère de l'Énergie et de l'Aménagement du territoire a voulu stimuler le développement de visions territoriales pour un futur décarboné et résilient à l'horizon 2050 pour le Grand-Duché de Luxembourg et ses territoires frontaliers. Une équipe luxembourgeoise, parmi neuf autres, a relevé le défi. Cette équipe interdisciplinaire, composée de chercheurs, de planificateurs et de praticiens de l'Université du Luxembourg (UL), du Luxembourg Institute of Science and Technology (LIST), du Centre for Ecological Learning (CELL), de l'Institut für biologische Landwirtschaft und Agrarkultur in Luxemburg (IBLA) et de l'Office for Landscape Morphology (OLM), s'est concentrée sur cinq sujets étroitement liés : l'agroécologie, les systèmes d'énergie régénérative, les économies alternatives et les processus de gouvernance/participation, ainsi que l'aménagement et l'architecture. L'équipe s'est engagée à explorer les perspectives d'une transformation plus structurelle de notre société dans une ère de post-croissance. En janvier 2021, l'équipe a soumis son rapport pour la première phase, en mettant l'accent sur les paramètres chiffrés d'un avenir décarbonisé et résilient. Lors de cette conférence les auteurs présenteront les résultats de leur travail et exploreront huit perspectives pour le Luxembourg 2050.

Des intervenants des régions frontalières étaient invités à donner leurs perspectives concernant la transition sur le territoire pour les décennies à venir, parmi eux Lorraine : Éric Marochini, directeur de la Communauté de communes du Saulnois et chercheur à l'Université de Lorraine, Harald Kreutzer, coordinateur de l'association Weltveränderer à Sarrebruck, ainsi qu'Olivier Thunus, vice-président de l'Observatoire de l'Environnement à Arlon.

Le visionnage de la conférence est disponible sur [https://youtu.be/p\\_PKXeoJ8ml](https://youtu.be/p_PKXeoJ8ml)

### Luxembourg 2050 - Perspektiven für eine regenerative Stadtlandschaft

Technologischer Fortschritt allein wird nicht ausreichen, um den notwendigen ökologischen Wandel herbeizuführen. Dies ist der Ausgangspunkt der Arbeiten eines Luxemburger Teams von Forschern, Planern und Transition-Praktikern im Rahmen von Luxembourg in Transition.

Am Montag, 22. März 2021 hat das Team der Uni Luxemburg um Prof. Florian Hertweck seine Arbeit im Rahmen von Luxembourg in Transition bei den Transition Days online vor etwa 100 Teilnehmern vorgestellt.

Mit der 2020 gestarteten städtebaulich-architektonischen und landschaftlichen Konsultation "Luxembourg in Transition" möchte das Ministerium für Energie und Raumplanung die Entwicklung territorialer Visionen für eine dekarbonisierte und resiliente Zukunft bis 2050 für das Großherzogtum Luxemburg und seine Grenzgebiete anregen. Ein luxemburgisches Team, neben neun anderen, nahm die Herausforderung an. Das interdisziplinäre Team, bestehend aus Forschern, Planern und Praktikern der Universität Luxemburg (UL), des Luxembourg Institute of Science and Technology (LIST), des Centre for Ecological Learning (CELL), des Instituts für biologische Landwirtschaft und Agrarkultur in Luxemburg (IBLA) und des Office for Landscape Morphology (OLM), konzentriert sich auf fünf eng miteinander verknüpfte Themen: Agrarökologie, regenerative Energiesysteme, alternative Ökonomien und Governance/Partizipationsprozesse, zusätzlich zu Regionalplanung, Stadtplanung, Städtebau und Architektur. Das Team hat versucht, die Perspektiven einer eher strukturellen Transformation unserer Gesellschaft im Zeitalter des Postwachstums auszuloten. Im Januar 2021 legte das Team seinen Bericht für die erste Phase vor, mit einem Schwerpunkt auf den Metriken für eine dekarbonisierte und resiliente Zukunft. Während dieser Konferenz haben die Autoren die Ergebnisse ihrer Arbeit vorgestellt und acht Perspektiven für Luxembourg 2050 erkundet.

Referenten aus den Grenzregionen waren eingeladen, ihre Sichtweise für den notwendigen Wandel für die kommenden Jahrzehnte zu teilen, darunter Éric Marochini, Direktor der Communauté de communes Saulnois und Forscher an der Universität Lothringen, Harald Kreutzer, Koordinator des Weltveränderers in Saarbrücken sowie Olivier Thunus, Vizepräsident des Umweltobservatoriums in Arlon.

Die Konferenz kann rückblickend hier angeschaut werden: <https://youtu.be/hiBz7iAqhlk>

After the presentation of the approach of our team (in French with translation in German), a round of break-out groups took place according to language preferences, in French, German and Luxembourgish, around the question:

As resident of the Greater Region what are your priorities for a decarbonized and resilient territory?

#### Break-out room 1

Thema Resilienz triggered mech scho méi laang als Student hun ech schon de letzebuenger Footprint kalkuleiert. Aménagement du territoire a PAG, all Joer 13.000 nei Leit déi vill Potential zur Verännerung matbrenn. ZB vegetresh Alimemntation bei menge Kanner, Urban gardening och Promoteuren fänken un sech dofir ze interesseieren a vill Leit probéieren nei Solutionen ze fannen obwuel Zuelen schrecklech sin an soguer an der metzelfresteger Planung ons drastesch aschrenke mussen. Daat muss och am PAG berücksichtegt gin an un dénen eischten 10 Schrett déi mir dohéem maachen tiefenbewusst Entschéedungen treffen fir ewesch ze kommen vun de fossilen Energie. Et gesait éen och Initiativen am communale Raum

Mir schwetzen vun enger post croissance a gleichzaitig soe mir daat Letzebuerg op 1.000.000 Awunner kritt. Op waat bauen déi Graphiken op ? op décroissance oder op bevölkerungswachstum Muss daat sin daat letzebuerg esou wächst.

Mir sin an der Studie vun Wuestum ausgegangen, et ass vielleicht e salto mortale an e Widerspruch ass méi mir hun ons als Equipe dofir entschéed

De fait daat d'Bevölkerung wiest ass inévitable well mir soss an faschisteschen Tendenzen erakomme. Waat fir mech wichteg ass ech gesin ewéi d'Stadt sech entweckelt zb Cloche d'or ass eng absurd Entwecklung a mir brauchen eng fundamental Verännerung an der Politik fir sech an eng richteg Verännerung ze dirigieren.

Ech mengen daat een als eenzelene selwer muss kucken wou een Aboussen maache kann, ech mengen mir müssen bei ons selwer kucken am Konsum, an der Mobilitéit a er Education vun der Kanner. Anstatt mam Fanger op Promoteuren an op dse Staat ze weisen.

Mir hun och vill saachen wou mir ofhängeg sin, bei mir get et kee Bus an keng possibilitéit mam Velo an den Akaafszentrum ze fueren (Schengen)

Ech fuere vill duerch Frankreich a mir draineieren immens vill leit aus déene Geigenden un a ronderem kreierte mir eppes ewei e vacuum. Et gin gudd Plaazen wou Ackerland brach leit a schei Dierfer ei eidel sin. Mir zeien alles un.

Ich sehe in meinem persönlichen Umfeld, dass sich viele Menschen fragen, wie wir unser Lebensstil ändern können. Selbst in der

Schule meiner Kinder ist vegetarische Ernährung ein Riesenthema geworden, vor einigen Jahren noch undenkbar.

Bauunternehmer sind heute an urban gardening interessiert und wir berechnen bereits bei neuen Projekten wieviel man anpflanzen muss, dass es für die Anwohner reicht.

Der Wandel der hier zahlenmäßig vorgerechnet wurde ist heftig, und 2050 ist nicht einmal ein langfristiges Ziel, da muss rasch vielen hinterfragt werden so etwa Wohnraumgröße, Transportart, und da muss die öffentliche Hand auch ein Angebot machen, denn durch reines forcieren wird das nichts.

Wenn wir bei Neubau weiterhin Garagen planen, dann planen wir damit den Fortgang der fossilen Mobilität, und davon müssen wir weg.

Müssen wir denn nicht hinterfragen ob Luxembourg überhaupt noch wachsen muss?

Ich bin nicht optimistisch, wenn ich sehe wie der Raum um die Stadt in den letzten Jahren verbaut wurde. Die Cloche d'Or wurde hinter meinem Elternhaus gebaut, was das beste Beispiel einer absurden Entwicklung der Planung ist. Schon nur der Auchan dort ist überdimensioniert und die ganze Nacht beleuchtet. Da ist jetzt ein gewaltiges Umdenken notwendig.

Das Konzept der 15-minuten Stadt scheint interessant aber liegt noch meilenweit entfernt.

Luxemburg ist wie ein Singapur und zieht alles an sich, dabei schafft es um sich herum ein Vakuum.

#### Break-out room 2

Ich würde mir eine Stadt wünschen mit viel weniger Autos und viel mehr Fahrrädern. Das bringt mit sich, dass man in allen Ortschaften eine Möglichkeit zum Einkaufen hat, und dass man sich dort mit dem Fahrrad sicher fortbewegen könnte, mehr und sicherere Fahrradwege für jeden. Damit kann man sich sehr gut fortbewegen, aber vor allem nur wenn es sicher ist. Und zur Arbeit könnte man mit Bus oder Tram und das würde viel schneller gehen, wenn viel weniger Autos auf den Strassen wären.

Zur Dekarbonisierung gehört für mich auch Lebensqualität dazu. Da müssen wir die Autos und vorallem die grossen Lastkraftwagen aus den Ortschaften bekommen, damit da Lebensqualität herrscht.

Man sieht in Sanem, dass die Landschaft immer mehr zerstückelt wird, immer mehr zubetoniert wird. Wenn ich auf den Belval sehe, das sind hässliche Gebilde, ich sehe kein grün. Wenn ich durch Clôche d'Or gehe, das ist gruselig.

Wenn man die Charts sieht, dann ist man erst mal geschockt, auch wenn man sich bereits mit dem Thema beschäftigt hat - aber die Leute, die hier teilnehmen, sind bereit sich damit zu beschäftigen, aber wir sind auch in einer Bubble. Wie kann man das in größere Teile der Bevölkerung bekommen kommunikativ, damit die ihre Einstellungen ändert? Sonst

passiert nichts als "preach to the converted".

Ich kann mir das Thema noch nicht so richtig vorstellen, wenn unsere Natura 2000 Zone abgerissen wird, um eine Umgehungsstraße zu bauen, wenn die Landschaft immer mehr zerstückelt wird, Cloche d'Or ist gruselig, deswegen kann ich mir diesen Übergang nicht vorstellen, wenn so etwas heute noch alles passiert.

Die Leute schauen, wie sie am schnellsten zum Ziel kommen, unabhängig davon ob der Nahverkehr kostenlos geworden ist.

Die Planungsvorläufe sind sehr lang im Städtebau. Wir befinden uns in einer Übergangsphase, Tram, Fahrradwege etc. werden ausgebaut. Als Langzeitperspektive müssen aber die städtischen Archipele so angelegt werden, dass Wohnen, Arbeiten, Hobbies etc. in der Nähe sind, so dass der Bedarf an Mobilität abnimmt.

In Zukunft muss man es fertigbringen Wohnort und Arbeitsplatz viel näher zusammen zu bringen (Beispiele Telearbeit, Co-working places). Es kann nicht sein, dass in 20 Jahren noch immer eine große Mehrheit mit einem Auto zwischen 20-80km zu ihrem Arbeitsplatz fahren. Die Arbeitsplätze müssen auf die Großregion verteilt werden.

Der Glaube an Kompensationsmassnahmen ist nicht groß - wir brauchen unseren Wald in der Nähe jetzt, nicht einen neuen Wald woanders in 100 Jahren, dann sind wir alle tot.

#### Break-out room 3

In der Groß-Region sehe ich die ganzen Fahrten im Auto zur Arbeit als Hauptproblem, 90-95% der Leute fahren zum Teil alleine im Auto, das sind dann 230.000 Leute. Vielleicht haben wir ja mit home office in der Corona Krise was gelernt.

Mir der Finanzindustrie haben wir in Luxemburg einen Hebel mit dem wir dort eine global große Wirkung haben können. Das würde heißen ernsthaft ökologische und soziale Kriterien miteinbeziehen und nicht nur Greenwashing zu machen. Das würde deutlich mehr ausmachen als vielen kleine Aktivitäten.

Ich erlebe die Leute in der Politik die kriegen die tollsten Studien vorgelegt, aber was wird im Nachhinein daraus gemacht? Mir fehlt dieser Druck von der Straße der da aufgebaut werden muss. Das erreicht man nicht alleine dadurch, dass man auf tolle Konferenzen geht. Das sind diese kleinen Schritte wo man Plattformen aufbauen muss aber wo die Leute sich dann selbst in Bewegung setzen müssen.

Wir haben das große Problem, dass CO2 unsichtbar ist und dass es für viel Leute immer noch ein sehr abstraktes Problem ist. Die Frage ist also wie bringen wir die Dringlichkeit an die Leute heran? Es gibt bereits ein Bewusstsein, dass etwas getan werden muss, aber der Glaube daran, dass man selbst was beitragen kann, der ist nicht da. Alleine auf die Reduktion des Tanktourismus zu setzen, das wird nicht reichen. So sollte zum Beispiel auch das Waldsterben im Norden des Landes mehr thematisiert werden.

tisiert werden, was uns dahin bringen sollte das Thema viel emotionaler zu behandeln.

Wir sind nicht glücklicher durch mehr Konsum. Wir müssen diese Konsumverhalten hinterfragen, aber es braucht ein gutes Narrativ dazu.

Wenn wir von Suffizienz und von „weniger“ reden, dann müssen wir auch unsere Sozialsysteme hinterfragen. Leider ist unsere zukünftige Rente auf mehr Arbeit ausgelegt. Das Rentensystem ist heute nicht nachhaltig, denn ohne Wachstum bricht unser Rentensystem zusammen. Wenn wir jetzt alle mal entscheiden 5% einzusparen was würde das für unsere Wirtschaft heißen am Ende des Jahres? Wir hätten massive Arbeitslosigkeit, das Sozialsystem wäre am Ende und die Leute würden auf der Straße stehen und würden schreien wir müssen Wirtschaftsprogramme auflegen damit wir wieder Arbeitsjob kreieren. Das ist ein richtiges Dilemma in welches wir uns hineinmanövriert haben. Wir müssen uns also davon lösen von der Rechnung „je mehr Konsum, desto mehr Wohlstand“, im Sinne vom systemischen Wohlstand, nicht auf individueller Ebene. Unser Wirtschaftssystem wird zusammenbrechen bevor wir die Welt retten. Wir reden über CO2 aber wer spricht über die soziale Dimension was das wirklich heisst?

#### Notes taken during the session:

Bewusstsein schaffen, Fahrrad, Natur! naiv aber sehr wichtig, Verständnis für das was passiert

Persönliche Vorbilder, gerade bei Ernährung, sehr langsamer Abbau von Fleischprodukten in der Ernährung, einfache Dinge, auf die man nicht kommt, hier braucht es Vorbilder. Grossregion Verkehr im Auto zur Arbeit, 90-95% alleine im Auto, Homeoffice? zusammenfahren? 2. Punkt: Finanzindustrie hier Hebel ansetzen, kein greenwashing sondern wirklich soziali und ökologische Nachhaltigkeit

Wie dahin? tollste Präsentation aus der Politik, aber nichts passiert, Druck aus der Bevölkerung mitreißen, Plattformen; Ansatz bei der Finanzwirtschaft; Sprechfähigkeit nicht vorahnen

CO2 ist unsichtbar! sehr abstraktes Problem, wie die Dringlichkeit an die Leute? Glaube, dass man selbst was beitragen kann, China, USA, Grenzgänger, alle anderen, dann Problem gelöst. Kleines lokales Problem, da fährt kein LKW weniger; Greifbarkeit und Erlebbarkeit; Hauptsache keine Eigenbewegung; Waldsterben thematisieren, lösen von den fakten, sondern emotionale Ebene erreichen; Katastrophen aber auch positiv

20 Grad im Februar, wie schön, es wird noch positiv gesehen, Daten werden benötigt um Bewusstsein zu schaffen,

Zukunft neu denken: wie lädt man Leute zum Umdenken ein. Konsumenten denken, Konsum, Neues macht uns glücklich, Konsumverhalten hinterfragen; keine Verurteilung von unmodischen Händen; dazu brauchen wir ein gutes narrativ, 90% weniger Güter

Wenn wir über Suffizienz reden, dann müssen wir über soziale Änderungen reden, ohne Wachstum bricht Rentensystem ein; ab morgen sparen wir 5% Güter ein; was bedeutet das für die Wirtschaft? Arbeitslosigkeit, soziale Absicherung... da ist ein Systemwechsel ändern, soziales System ändern, systemischer Wohlstand; wie soll das funktionieren, basiert auf Wachstum, Zusammenbruch des Wirtschaftssystems.

Anderes Wirtschaftswachstum, andere Basis für unseren Wohlstand nötig.

#### Break-out room 4

Lorsqu'on habite derrière la frontière Belge dans un hameau, qui est encore plus petit qu'un village, il faut miser pour l'instant sur le covoiturage et plus tard sur plus de transports en commun quand les infrastructures le permettront.

Un problème est que la plupart des résidents luxembourgeois dès qu'ils ont les moyens préfèrent habiter dans une grande maison à la campagne et que la ville n'est pas du tout attractive pour eux. Par contre il y a énormément d'étrangers qui habitent à Luxembourg ville et Esch. C'est justement là qu'on peut bien développer les transports en commun et développer la ville du quart d'heure. Ce qui est beaucoup plus difficile dans des hameaux ou des villages. Pour rendre les villes plus attractives il faudrait rendre les logements plus attractifs et pas avoir que des gros blocs comme on les construit actuellement et sans espaces extérieurs. Et avec la situation sanitaire les gens ont encore plus envie de jardin et de se retrouver à l'air libre, donc d'avoir plus d'espaces verts en ville.

Pour restructurer ce pays il faudrait investir massivement justement dans les villes où la ville des 15 minutes devient possible. Cependant l'électorat justement ne vit pas dans les villes, ni à Luxembourg ni à Esch. Mais c'est dans les villes que réside l'avenir de ce pays. Il faut donc les restructurer pour que aussi les gens qui ont les moyens ont envie de revenir.

Très probablement le meilleur moyen de réduire le CO2 c'est de réduire la richesse, car c'est avec cette richesse qu'on s'habitue à des grands espaces.

Notre économie est complètement surdimensionnée par rapport à la taille de notre pays et elle inclut donc d'autres territoires et une autre main d'œuvre qui n'habite pas au Luxembourg. Alors comme recentrer cette économie sur le niveau qu'elle devrait avoir par rapport au territoire ?

Il faut travailler sur l'urbanité, que le Luxembourg invite les gens non seulement à venir travailler au Luxembourg mais aussi à y vivre et d'y développer une qualité urbaine, avec des espaces publics de qualité et des espaces de rencontre, de vie de quartier.

Je ne comprends pas et j'étais étonné quand je suis arrivé au Luxembourg qu'un pays dont son agriculture est basée sur la production de

lait déjà ne faisait aucun fromage et au-delà de ça ne soit pas plus diversifiée et avec une chaîne qui suit derrière.

Il y a besoin de rendre la ville plus humaine et plus agréable à vivre. La place que prend la voiture ne laisse plus de place à d'autres modes de mobilité comme le vélo. Il faudrait réduire la vitesse de la voiture en ville, p.ex. mettre des zones 30 partout dans la ville.

Les résidents luxembourgeois ont un certain pouvoir d'achat et auraient donc plus de capacités à s'adapter et en même temps il y a toute une partie de la population qui est amenée à déménager au-delà des frontières et en même temps c'est une population qui est plus vulnérable.

#### Notes taken during the session:

Idées territoire décarbonisé/résilient: revoir consommation, utilisation transport en communs (si infrastructures présentes), revoir l'idée d'habiter une maison à la campagne, revoir la qualité de vie dans la/les ville(s), ville des 15 minutes, donner un caractère de ville aux villes, l'électorat n'habite pas en ville, réduire la richesse pour réduire le CO2, économie surdimensionnée au Luxembourg-dépasse de loin les frontières du pays-revoir l'économie par rapport au territoire du Luxembourg, manque qualité de vie urbaine, rapprocher travail du lieu de travail, plus de vie de quartier, diversifier l'agriculture (beaucoup trop axée lait/viande), revoir aussi les chaînes d'alimentation, créer des activités économiques pour créer de nouveaux emplois (durables), réduire la place de la voiture en ville, réduire la vitesse de circulation (de toute façon bloqués dans des embouteillages), plus de vélo/transports publics, croissance vs. comportement des résident.e.s du Luxembourg (pouvoir d'achats élevé par rapport aux pays voisins)

#### Break-out room 5

Concernant la transformation des friches il y a besoin des acteurs du secteur public mais aussi du secteur privé pour amener des solutions créatives car tout ne peut pas dépendre du secteur public ou du secteur privé non entrepreneurial parce que sinon c'est la société qui supporte l'entièreté du coût de cette transformation.

L'évolution du comportement implique aussi la dimension collective qui est au cœur de l'exercice de Transition que nous sommes en train de faire. Ceci est à approfondir non seulement au niveau des contraintes mais surtout au niveau du dynamisme, de la joie et de comment rendre cela souhaitable.

La crise actuelle est aussi une opportunité à réinventer le lieu de travail et l'espace géographique dans lequel il s'exerce. Alors que le télétravail peut ne pas être adapté quand on est isolé mais il y a moyen de développer des espaces de coworking décentralisé qui peut favoriser une réduction du besoin e mobilité.

Activer ce changement on pense que c'est impossible mais la pandémie nous a montré que beaucoup de choses qu'on imaginait impossibles sont très vite devenues possibles. Il y a des exemples un peu partout, dont par exemple paradoxalement au niveau du commerce local : quand les librairies ont recouvertes elle sont attirés pas mal de monde alors qu'on pensait que tout était parti vers le commerce en ligne. Ces paradoxes sont à explorer. Par exemple la livraison à domicile pourrait aider les petits commerces et retomber sur leurs pieds. Cela permettrait aux gens de ne pas avoir à se déplacer et en même temps éviterait de passer via des grandes plateformes.

La promotion de la biodiversité est importante. Mais si les villes et villages grandissent, il faudra veiller à ce qu'il y ait suffisamment d'espace verts.

Il est nécessaire de travailler sur la solidarité dans l'espace public, notamment sur un équilibre entre les intérêts individuels et communs au sein d'espaces communs, notamment sur l'exemple des jardins partagés.

#### Break-out room 6

Notes taken during the session:

Die Zahlen haben mich beeindruckt. Viele Bürger wissen womöglich nicht, wie ernst die Lage ist. Vielleicht brauchen wir ein anderes Narrativ, um noch mehr Bürger dafür zu interessieren.

Ich bin erstaunt, dass, wenn man einen neuen Stadtteil entwickelt, man keine regenerativen Energieanteile herstellen muss.

Kein Politiker wird den Mut haben, diese Dinge an die Leute zu bringen.

Ich haue in die gleiche Kerbe. Die Vorstellung von weniger Fleisch wird immer als persönliche Vorliebe abgetan. Es wird immer dargestellt, dass das politisch nicht umsetzbar sei.

Positives Narrativ, wie man unsere Kinder in die Zukunft gehen lassen kann.

#### Break-out room 7

Notes taken during the session:

Création de densité suffisante pour avoir commerce à proximité, moins dépendant voiture, voisinage et activités quotidiennes = qualité de vie à offrir aux pers., liberté où gestes naturels possible, pas de voiture.

Changement de consommation (moins de viande). Culture du jardin, maraîcher... dans quartier dense, bat de 5 à 7 niveaux jardin en copropriété devient support pour jardinier maraîcher qui pourrait cultiver (contrat avec copro qui pourront récolter et recevoir une partie de ces

récoltes).

Collectif de citoyens. Changement de comportement et mentalité doit passer par une prise de conscience en 3 axes. 2 grands types d'actions: informer les citoyens (il est possible d'habiter autrement), participer aux actions, associer les citoyens aux luttes (pour les territoires par exemple cf ZAD d'Arlon)

Les pays moins développés sont en train de suivre le chemin des pays développés actuels alors que les pays "riches" sont en train de réfléchir à réduire.

Beaucoup de sensibilisation à faire. Beaucoup font attention à leur consommation, style de vie pour réduire leur impact sur l'environnement. Mais les médias encouragent la consommation ce qui fait qu'une grande partie de la population consomme beaucoup.

Conclusion: l'axe le plus important pour nous: PROXIMITÉ et CHEMIN LE PLUS COURT POUR TOUT, réduire la consommation, planification: ville des chemins courts, less is more.

#### Break-out group 8

Notes taken during the session:

Réutilisation des friches industrielles, commerciales, etc..(vallée de la Fench, Thionville). Pas d'intervention privée à cause des coûts, de la pollution, des infrastructures. Question politique et financière. Impliquer plus le secteur privé. Tout ne peut pas être pris en charge par le secteur public.

Mobilité: Pas toujours de transports en commun pour les zones isolées et éloignées des centres d'activité professionnelle. Adapter les moyens (télétravail) et l'espace (co-working décentralisé).

Logement: Comportement individuel: Évolution dans la logique de la joie dans l'adhésion aux usages sobres. Coopératives, initiatives de groupe. Depuis la crise du Covid, prise de conscience que l'impossible est devenu possible. Rôle des librairies et des petits commerces de proximité.

Extension des villes et villages. Pas assez d'espaces verts. Comment prendre cet aspect dans les métriques? Aménagement urbain dépend des PAG des communes. Tendance vers les espaces non sellés et espaces verts. Aspect de régulation. Constructions sans parkings. Tendance vers la mobilité douce.

Culture et solidarité dans l'espace commun. Risques de conflits possibles. Trouver le bon équilibre entre intérêt collectif et intérêt individuel.

Roundtable:

Éric Maronchini:

Salut le travail qui a été fait dans le cadre de LiT. Le territoire de la GR et celui du Luxembourg sont particuliers. C'est bien beau de vouloir évoluer les choses à l'échelle d'un espace si autour on ne va pas dans le même sens ou on n'a pas les mêmes orientations. Si ça ne collabore pas, ce n'est pas forcément toujours facile. De ce point de vue j'ai toujours été choqué sur les différences de gouvernance selon les territoires, en particulier du côté français où on trouve une organisation de la commande publique sur le territoire toujours très compliquée, c'est vrai aussi du côté Belge et du côté Allemand, mais ce qui est remarquable au Luxembourg c'est la rapidité d'action.

Il faudra voir comment les résultats de l'exercice Luxembourg in Transition vont se retrouver au niveau des territoires. En France il y a très peu d'outils opérationnels pour la transition (décarbonation des territoires) comme p.ex. le Plan climat, air énergie et territoire (PCET), mais il est difficile d'influer le comportement des gens. Ces dimensions dans le rapport LiT1 de l'Unilux. 80% de réduction c'est considérable ! Le Luxembourg, étant un petit pays, importe un problème environnemental qui finalement le dépasse un peu. Mais on sent cette volonté de travailler en synergie avec les territoires de part et d'autre des frontières.

Harald Kreutzer:

Die Diskussion rund um das Thema Flächenversiegelung ist sehr relevant, auch im Saarland und die Arbeit die hier getan wird könnte vielleicht auch die Diskussion im Saarland inspirieren.

Verrückt ist, dass die Luxemburger noch autoverrückter sind als die Saarländer, wohle europaweit an der Spitze und das Saarland scheint in Deutschland das Bundesland mit den meisten Autos pro Kopf zu sein! Nachhaltige Zukunftsmobilität ist also ein großes Thema sowohl für Luxemburg als auch für Saarland. Der kostenlose öffentliche Nahverkehr könnte in punkto Expertise und Inspiration ebenfalls dem Saarland helfen.

Vermisst in diesem Bericht habe ich das Thema nachhaltige Finanzwirtschaft denn Luxemburg hat ja einen sehr sehr starken Finanzsektor. Die Expertise und die Akteure sind ja vorhanden, und da wären Ansätze wünschenswert, wie Geld anders angelegt werden kann, damit Menschen und Umwelt möglichst wenig zu Schaden kommen.

Das Thema Digitalisierung wirkt sich in allen Lebensbereichen aus und fehlt als Aussage in der Studie, wo kann sie Nachhaltigkeit unterstützen aber auch wo sie Nachhaltigkeit unterlaufen kann wegen einem hohen Ressourcenverbrauch.

Die Studie ist sehr gelungen aber es braucht den Druck von der Straße, es braucht Leute, die sich hinter diese Vision stellen, den der Bericht allein wird es nicht reißen z.B. wenn man diesen Pfad von 13 auf 1,6 Tonnen CO2 pro Kopf und Jahr bis 2050 anschaut. Es braucht auch

die Leute die's umsetzen. Alleine bei der Automobilität sieht man, dass es vielen Anstrengungen braucht um die Leute mitreißen und begeistern zu wollen. Es reicht nicht wenn wir in unserem akademischen Elfenbeinturm uns diese schöne Konstrukte ausdenken und dann die Leute in der Politik sagen „das ist sehr schön was Ihr sagt aber wenn wir das umsetzen, bin ich keine 3 Jahre mehr in der Politik. Von daher lasst uns auch aus der Zivilgesellschaft heraus unsere Arbeit machen damit tatsächlich sinnvolle Nachhaltigkeitsziele in sinnvolle Gesetze umgewandelt werden.

Olivier Thunus:

Ce qui est appréciable dans le rapport es notamment que les concepts présentés sont traduits en chiffres mais aussi parce qu'il y a des mesures placées à haut niveau, dont celle des taxes et d'accises sur le carburant et enfin des mesures très concrètes pour le citoyen en termes de voyages et d'alimentation. Il y a ce besoin de ne pas rester au niveau de l'étude mais de la rendre opérationnelle. Dans la question comment arriver à convaincre le plus grand nombre, déjà présenter cette étude publiquement permet d'en dégager un petit groupe de citoyens intéressés, parce que le citoyen a un rôle au niveau du comportement mais aussi au niveau politique à être un acteur actif. Au Luxembourg il est plus facile d'avoir accès directement aux instances dirigeantes du pays que p.ex. dans la Province du Luxembourg en Wallonie, où Bruxelles est très loin. Toutefois le citoyen peut agir au niveau local et avoir accès à ses élus, à qui on peut demander à prendre des mesures. Au Luxembourg il y a le Pacte climat, en Wallonie il y a la Convention des Maires pour l'action locale en matière de climat et d'énergie, avec des objectifs similaires.

Deux thématiques intéressantes concernant les régions frontalières sont le développement de la mobilité et du logement, qui en région Wallonne se font essentiellement à partir du développement du Grand-Duché du Luxembourg. Par exemple le nombre de logements qui est planifié dans la commune d'Arlon est basé sur la croissance du Luxembourg, le nombre de frontaliers qui vont pouvoir aller travailler au Luxembourg – c'est comme ça qu'on fait les calculs : ce n'est pas sur base du développement de la Ville d'Arlon mais sur base du développement du Grand-Duché ! Un autre exemple est l'autoroute vers la France qu'on élargit pour accueillir les français qui viennent travailler sur Luxembourg ville. Il faut donc organiser une coopération entre ce qui se fait au Luxembourg et dans les régions limitrophes.

En termes de coopération il faut mettre en œuvre la maxime « penser global, agir local » et de fédérer des collectifs citoyens qui sont basés dans leur territoire, localement, et qui connaissent les problématiques. Mais souvent ces citoyens sont désarmés parce qu'ils ne savent pas comment mener des actions pour faire évoluer leur ville ou leur région. Il faut donc créer des réseaux entre ces collectifs pour initier un mouvement qui sera plus large. Il faut aider ces collectifs qui sont pionniers sur leur territoire à acquérir de l'expérience et de l'expertise, notamment dans les relations avec le domaine de la recherche et des universités. Il

faut donc mettre en lien la recherche et les citoyens. Un exemple est à Arlon où on est en train de débattre le développement de la place principale Léopold, piétonnier mais avec parking ou non. Pour les citoyens il est très difficile de discuter cela sans l'expertise en aménagement, patrimoine etc.

Question posée dans le chat: Que répondre à qn résistant à tout changement vers la suffisance avec l'argument de ne pas être convaincu qu'il y aura des changements structurels,, que l'Etat ne bougera pas?

Éric Marronchini:

Le sujet politique et citoyeneté: il existe la Commission inter-gouvernementale (CIG) franco-luxembourgeoise pour parler d'État à État, mais en intégrant les collectivités locales. On y discutait des grands sujets des coopérations entre les deux pays. Mais il a quelques années on n'a jamais parlé de décarbonation et de transition écologique mais tout le temps d'autoroutes et des parkings et de voitures ou de possibilités foncières. Ce qui rend pessimiste concernant les politiques à enclencher des développements à long terme. On peut plus y croire au niveau citoyen. Donc la question est qui suit qui sur ces sujets. Et de comment on peut développer les réseaux citoyens.

Une grande question est celle du recyclage foncier, par exemple dans la transformation des friches. Le recyclage foncier est seulement traité par les instances publiques et le privé ne va pas sur ces sujets-là. On laisse au public donc les sujets compliqués et au privé les zones facilement exploitables.

Question des circuits courts par exemple sur les projets alimentaires territoriaux : ce serait bien de développer des coopérations sur ce sujet par-delà des frontières, en favorisant les circuits courts. Actuellement les zones d'importation sur nos territoires vont bien au-delà de nos régions. Ce serait une première pensée globale avec des actions plus locales.

Question du chat : le préfet du grand est peut-il décider d'un régime fiscal attractif pour une entreprise luxembourgeoise qui voudrait s'implanter sur Micheville. Faut-il passer par Paris ? la réponse est oui ! Et ce sera beaucoup plus long que d'aller au Luxembourg.

Harald Kreutzer :

Das Potential zur Zusammenarbeit ist sehr groß, unter anderem gibt es in Luxemburg viel Expertise, und auch sonst jenseits der Grenze. Leider kommt das im Alltag zu kurz denn alle sind mit den eigenen Projekten beschäftigt. Daher sollten wir die Chance der Digitalisierung stärker nutzen, zum Beispiel in der Kartierung der Initiativen. Da können Schnittstellen, Synergien zur Kooperation erörtert werden. Es gibt sehr viele Portale, im Saarland versucht man ein App aufzubauen die alle Initiativen zur Nachhaltigkeit zentralisiert und die Leute zusammenringen. Da gibt es Tools, da muss man das Rad nicht neu erfinden. Man sollte auch die Leute identifizieren die sich hinter uns stellen können. Das könne

beispielsweise Leute in Repair Cafés sein die ja Nachhaltigkeit „machen“. Da müssen wir noch mehr auf die Menschen zugehen. Wir müssen schauen dass in der Grenzregion die die Kommunikation offenbleibt aber wir müssen diese Austausch auch institutionalisieren, wir müssen es uns einfach machen damit wir gut gemeinsam Ideen gemeinsam ausarbeiten können.

Participants Transition Day:

Christian Bauer, Biergerkomitee 2050  
 Myriam Bentz, Ministère de l'Énergie et de l'Aménagement du territoire  
 Muriel Chadelon, CELL  
 Véronique Degbomont, Arpeggio  
 Tiffen Eyraud, ECAU  
 Nicolas Fauquet  
 Julien Gannard, Ouni  
 Benoît Geisen, Ministère de l'Énergie et de l'Aménagement du territoire  
 Coline Grimée, Biergerkomitee 2050  
 Francis Hengen, Mouvement Ecologique  
 Marguy Kohnen, Ministère de l'Environnement, du Climat et du Développement Durable  
 Yolande Koster, Biergerkomitee 2050  
 Bernard Lahure, EcoTransFaire  
 Françoise Lavabre-Bertrand, Stoldt Associés  
 Karinne Madron, étudiante  
 Denis Marco, Biergerkomitee 2050  
 Estelle Paquay, IDELUX  
 John Park, Bee Together  
 Serge Raucq, Observatoire de l'Environnement  
 Peter Reijnders, Biergerkomitee 2050  
 Melissa Roller, student  
 Estelle Rotondano, commune de Mondercange  
 Ekkehart Schmidt, etika asbl / Transition Town Saarbrücken  
 Paul Schosseler, Ministère de l'Énergie et de l'Aménagement du territoire  
 Jeannot Schroeder, +ImpaKT  
 Glenn Schwaller, Luxemburger Wort  
 Josée-Anne Siebenaler-Thill, Gemeng Käerjeng  
 Nico Steinmetz, Steinmetzdemeyer  
 Jürgen Stoldt, Stoldt Associés  
 Claude Wagner, Ministère du Logement  
 Bob Wetzel, BoB Marketing & Projects  
 Ann-Kathrin Wirth, Ministère de l'Énergie et de l'Aménagement du territoire



**Speakers:**

Éric Marronchini, Communauté de communes du Saulnois / Université de Lorraine  
Harald Kreutzer, coordinator of Weltveränderer e.V. Saarbrücken  
Olivier Thunus, Observatoire de l'Environnement. Arlon

**Team :**

Tom Becker, University of Luxembourg  
Delphine Dethier, CELL  
Estelle Evrard, University of Luxembourg  
Thomas Gibon, LIST  
Jean-Régis Hadji-Minaglou, University of Luxembourg  
Marine Henry, CELL  
Florian Hertweck, University of Luxembourg  
Claudia Hitaj, LIST  
Markus Hesse, University of Luxembourg  
Sabine Kessler, Institut für Biologische Landwirtschaft und Agrarkultur (IBLA)  
Marija Maric, University of Luxembourg  
Markus Miessen, University of Luxembourg  
Markus Molz, CELL  
Karine Paris, CELL  
Rachel Reckinger, University of Luxembourg  
Norry Schneider, CELL  
Christian Schulz, University of Luxembourg  
Eric Weirich, CELL  
Sophie Zuang, CELL

## Documentation of the Cross-border Workshops (27th April 2021, 5th May 2021, 6th May 2021)

Invitation and programme of the cross-border workshops:

The cross-border region is a space of intense flows and strong interdependencies. However, each of the three neighbouring countries is engaged in its own way in the ecological transition, certainly in accordance with international and European agreements, but within the framework of national mechanisms and priorities concerning decarbonization, biodiversity and resilience.

As far as spatial planning is concerned, there are tentative beginnings of cross-border cooperation in the Greater Region. But what about the municipalities, citizens or companies directly impacted on one side or the other of the borders, what is their scope of action to contribute and benefit from the ecological transition, together?

**Introductions**

Presentation of key elements of the foresight being developed

First round of exchange stimulated by the questions:

What supporting and impeding dynamics of the ecological transition in the cross-border region do you perceive?

What are the needs and visions of the actors at grassroots level, their scope of action, their limits?

Second round of exchange stimulate by the questions:

What are key opportunities and barriers for cooperation across the borders?

What avenues are there for participatory governance of the cross-border ecological transition?

Conclusions

**First cross-border workshop**

Eviter les technologies énergivores, qu'en est-il de la mobilisation citoyenne? - identifier les besoins des citoyens, éducation populaire, conscientisation, participation / montage de projets citoyens. Déséquilibres économiques dans la Grande Région à prendre en compte.

Dans nos projets nous disons également stop au smart qui consomment beaucoup de matières premières en partie rares. Zones commerciales. Rénovation de l'habitat urbain, promouvoir une rénovation de l'existant lelong les artères au lieu de raser et reconstruire neuf. Déséquilibres du territoire est important mais difficile à dépasser à cause de ramifications législatives.

Sans double adhésion citoyenne et politique il ne sera pas possible d'avancer la transition. Heureux de voir traiter la région fonctionnelle. Gouvernance de la transition un vrai sujet pour aborder les déséquilibres

économiques et de justice spatiale. L'aménagement du territoire à avancer au niveau de la Grande Région. C'est capital. Travail de confrontation de l'utopie à un collectif citoyen, un panel d'élus. Prolongement du tram à travers des frontières devrait être rendu possible.

Lorsqu'on évoque les questions environnementales on est amené à s'interroger sur certains développements au Luxembourg. Ainsi, on ne peut pas discuter de la question de la mobilité avant de parler de la question de l'urbanisme et de l'organisation spatiale. En effet, on ne peut pas manquer de constater qu'on construit énormément de centres commerciaux à la périphérie des villes. Certaines équipes de LIT ont évoqué l'idée de contraindre les particuliers à utiliser les transports publics. On ne peut pas contraindre les gens à renoncer à leur voiture personnelle alors qu'on a une séparation entre le monde du travail, le lieu d'habitation, etc. Il faut d'abord parler de ces questions-là. De ce point de vue votre présentation était très intéressante, mais je m'interroge sur l'idée, p.ex. de développer la ligne de tram au-delà de nos frontières : Est-ce que là on ne risque pas de renforcer encore une fois la concentration économique dans la région ? Pour moi, la première question à se poser est : comment est-ce qu'on en est arrivé là? Parce que si on veut avancer on doit d'abord comprendre comment on en est arrivé là et il faut se poser des questions sur le modèle de développement économique. Vous soulevez la question de la construction des centres commerciaux qui contribuent à l'artificialisation des sols. La même question se pose pour les réseaux routiers qui consomment énormément d'espaces. Si on veut libérer cet espace on sera confronté à la question des titres de propriété. Ici, au Luxembourg, il y a une tendance à vouloir limiter l'intervention de l'État qui compte sur les forces économiques pour résoudre les problèmes y compris la question du logement. On est dans un modèle néo-libéral où l'État laisse faire les forces privées. A mon avis, il faut toucher ces questions-là. L'idée de ne pas concentrer toutes les activités en un seul endroit est bonne, mais la tendance générale est de concentrer les populations dans les villes. Dès lors se pose la question des utopies : Quelle serait votre utopie pour le développement du territoire ? Quelles activités doivent être développées, ceci aussi en partant du constat que le développement d'un autre type d'activités telles que notamment l'artisanat et le maraîchage est très difficile notamment en raison du prix du foncier. Ainsi, il devient de plus en plus difficile de trouver de la main d'œuvre car les salaires pratiqués dans ces secteurs ne permettent plus de se loger au Luxembourg. D'où ma question, quelle est votre utopie et votre vision à long-terme qui sont également important pour gagner l'appui de la population.

Comment vendre une telle vision au grand public, aux politiciens qui ne font ce que la majorité réclame ? Qu'est-ce qui fait un "bon citoyen", l'adhésion citoyenne est la grande question que l'on se pose depuis longtemps.

Justice spatiale, distribution des ressources équitable, question épineuse de la fiscalité, capacité d'action des décideurs politiques et des citoyens, distribution des opportunités dans l'espace, appropriation de la

transition par les citoyens, capacitation, comités des citoyens mais faut plus de temps pour les mettre en place.

Il y a beaucoup d'initiatives citoyennes mais peu visibles, aussi différentes cultures/langues, quels sont les obstacles concernant plus de collaboration à travers les frontières ?

On travaille en transfrontalier depuis 2013, création de réseaux, développement d'écosystème, l'usage du territoire, pas la même vision, pas les mêmes mots même si on parle la même langue, Lorraine-Wallonie, travail de tous les jours, c'est de l'humain, souvent plus informel que formel, il ne faut pas tout formaliser, on a beau mobiliser les citoyens (comme p.ex. le Groupe d'Achat Solidaire des Pays Lorrains) mais il faut aussi des leviers politiques - malgré tout le travail qu'on fait au niveau transfrontalier on n'a pas trouvé d'accélérateur, il faut continuer. On ne peut pas résoudre le temps humain nécessaire par exemple par plus de financements. Côté français il faut être attentif, c'est devenu un discours, une stratégie de relance économique, risque d'être un brouillage. Chaque territoire doit avoir son programme de transition et relance économique en 2022. Donc, tension entre vision nationale et vision locale de la transition qui demande une attention supplémentaire.

La photo de Foetz représente un changement radical. Quelle est l'adhésion de la population à un tel changement radical? Actuellement, on échange des voitures à essence contre voitures électriques et on pense qu'on peut continuer notre modèle économique comme avant. Ce n'est pas que l'individu qui produit des émissions, c'est aussi l'industrie, les camions. Moins de mobilité c'est très bien, mais je verrais plutôt la mobilité comme service comme perspective d'avenir.

Notre communauté de communes est la deuxième plus grande en France (128 communes), on a beaucoup de programmes qui se mettent en place, des coopératives d'énergies, cybercafés etc. C'est très positif. Mais il suffit une initiative négative comme les déchets pour faire de l'ombre sur tout ça. Coûts fonciers tellement différents. Nos collectivités sont désormais contractualisées sur la transition écologique et la relance économique. On manque d'ingénierie du territoire. C'est un outil de recentralisation.

On est intervenu au pavillon Luxembourgeois à Venise en 2017 avec l'expo "Tracing Transitions" sur les friches etc., on a fait un catalogue mais qui n'a jamais été publié. Les indépendants vivent encore une autre réalité. La question de la nourriture, de la viande est aussi une question importante. On travaille avec un maximum de récup mais on se heurte au manque d'espace, en tant que petit collectif on n'arrive pas, même s'il y a beaucoup de halls et de hangars vides, mais il faudrait d'abord exproprier avant de pouvoir les accéder. Dans notre projet DKollage on explore des utopies possibles, au pluriel, des lieux qui évoluent, pas des lieux finis. Ce n'est guère dans la culture luxembourgeoise.

Justice spatiale n'existe absolument pas, la frontière existe même s'il y a 200.000 personnes qui la traversent tous les jours. Le Luxembourg n'a pas trop d'intérêt de travailler avec les communes. Le Luxembourg

profite de la Grande Région côté ressources humaines. D'ici 2050 il faut promouvoir la Grande Région pour bien plus d'équité spatiale. Il y a beaucoup à travailler. Mais si on ne fait rien on n'arrivera pas à régler les problèmes de mobilité et de vivre ensemble au Luxembourg. Réduire les déplacements n'est pas la même chose que réduire la mobilité. Dans mon coin tout est accessible, travail, culture, nature. Éviter les erreurs. Un tram jusqu'à Steinfort ne fait pas de sens pour moi. Chaque maire dans la périphérie veut maintenant un arrêt de tram. Il faut une masse critique de voyageurs. Les scientifiques ont leur mode de travail très analytique, bien soutenu, mais il faut garder l'utopie zéro carbone en tête. Il y a aussi le problème des différences des procédures administratives des 2 côtés des frontières... et de toute autre réglementation.

Dans le sud du Luxembourg il n'y a aucun espace de coopération transfrontalière, aucun financement, aucune structure. On voulait faire une monnaie locale et partager avec nos amis français, mais comment ? Si les alternatives économiques demandent de travailler quatre fois plus pour deux fois moins de revenus et sans trouver des espaces, cela restera utopique.

#### Second cross-border workshop

La mobilité n'est pas un objectif en soi. C'est un moyen. Ce qui est important c'est de savoir pourquoi est-ce qu'on a besoin d'autant de mobilité à l'échelle de l'aire fonctionnelle. On a besoin d'autant de mobilité justement parce qu'il y a des problèmes de déséquilibres territoriaux. Il est primordial qu'on se pose réellement la bonne question par rapport à la mobilité, qu'on ne se dise pas simplement oui il faut de la mobilité durable, il faut faire des pistes cyclables, il faut faire un tram qui passe la frontière, je veux bien, mais cela ne règlera pas vraiment le besoin de la mobilité, cela rendra la mobilité peut-être plus acceptable, mais cela ne répondra pas au véritable problème qui est la localisation des pôles d'attraction que ce soit lié à l'emploi, que ce soit lié aux services, que ce soit lié au commerce.

Si on regarde aujourd'hui le comportement de l'ensemble de la population, quand on va au supermarché on remplit pratiquement son coffre de voiture avec des caddies qui débordent parce que souvent les commerces de proximité dans les villages et dans les villes disparaissent, malheureusement. Ces 20, 30 ans passés on a vu disparaître les boulangeries, les cafés dans les villages. Les gens sont amenés à se déplacer. Ils n'ont pas toujours la mobilité des transports en commun de porte à porte jusqu'aux supermarchés.

La gratuité des transports en commun introduit par le Luxembourg ne s'étend pas au-delà des frontières. On voit des parkings payants apparaître autour de Thionville. On se pose des questions concernant la communication entre les gouvernements pour faire des choix de mobilité cohérents dans la Grande Région, des choix plus larges que la frontière

luxembourgeoise.

La Grande Région est un espace de coopération institutionnelle qui comporte toute la Wallonie. En Wallonie il y a des villes, Liège, Namur, Charleroi, qui pour le dire très clairement qui ont leur propre politique de transport, leur propre vision de l'aménagement du territoire. Elles n'ont pas besoin d'une vision du Grand-Duché, de la Rhénanie ou de la Sarre, pour mettre à bien leur politiques publiques. Pour la gratuité des transports publics, qu'on n'y réfléchisse pas au niveau de la Grande Région, qu'on y réfléchisse au niveau de l'aire métropolitaine du Luxembourg. Du coup, ce n'est plus le même débat, plus les mêmes acteurs, plus les mêmes compétences. Cela concerne tous les utilisateurs, les riverains, les gens qui y travaillent. L'état luxembourgeois et les territoires voisins. Cela ne concerne pas l'ensemble de la Wallonie, cela concerne 22 communes, le fameux Grand Luxembourg, l'espace fonctionnel. Ce n'est pas toute la région lorraine, ce n'est pas le Grand Est,, c'est les 8, 9 ou 10 communautés de communes côté français, ou le pôle métropolitain nord lorrain, qui doit arriver à discuter avec l'état luxembourgeois sur ces questions-là. C'est en en débattant à une mauvaise échelle qu'on crée l'inéquilibre territorial. A l'heure actuelle il faut arriver à avoir une structure, un territoire avec un outil de gouvernance, à l'instar ce qui se passe sur d'autres territoires transfrontaliers métropolitains, comme il y en a en Suisse et ailleurs, qu'on arrivera à résoudre toute une série de problèmes liés à la frontière, à se mettre d'accord sur les questions de mobilité, de l'aménagement du territoire, de localisation des pôles économiques qui sont des sites qui génèrent des flux. Il est important qu'on arrive à pointer à la fois les bons acteurs, les bons enjeux, les bons problèmes et les bons territoires.

Arrêtons de réfléchir au niveau administratif, partons des enjeux sur lesquels nous avons décidé de travailler et essayons de voir le périmètre adéquat pour répondre à ces enjeux.

J'aurais un petit complément. Au niveau de la Grande Région il y a trois échelles de coopération qui ont été définies en janvier 2020, lors de l'adoption de la vision prospective pour la Grande Région par les ministres et responsables de l'aménagement du territoire. En janvier 2021 la stratégie opérationnelle transfrontalière pour la Grande Région a été adoptée. Chacun des axes stratégiques y est décliné selon les trois échelles de coopération c'est à dire selon que l'on se situe à l'échelle de proximité, à l'échelle du Grand Luxembourg ou à l'échelle de la Grande Région. En terme de gouvernance, il y a une évolution par rapport à une déclinaison des actions à ces trois échelles territoriales. C'est tout récent.

Historiquement, il y a un lien qui existe entre le Grand-Duché et la province de Luxembourg. Il y des interactions qui sont quotidiennes. Si le Luxembourg se donne une ambition de transition c'est profitable de toute façon pour les territoires voisins. Comme quand la Wallonie se dote d'une politique de l'économie circulaire cela doit être bénéfique pour les voisins. Donc il n'y a pas de perception de colonisation.

Je pense qu'on peut comparer la démarche du Luxembourg avec la démarche qui a été menée à Bâle avec l'agglomération trinationale avec la France et l'Allemagne. La ville principale lance la dynamique. C'est dans la logique des choses. C'était Bâle qui au début a porté la dynamique. Les territoires autour ont pu en bénéficier et se sont développés au fur et à mesure. Quand on voit qu'aujourd'hui qu'il y a un tram qui va de Bâle jusqu'à la gare de la commune française de Saint-Louis et que de là une navette a été mise en place pour rejoindre l'EuroAirport (aussi appelé localement aéroport Bâle-Mulhouse et situé sur le territoire de la ville transfrontalière de Saint-Louis en France), que l'industrie pharmaceutique présente s'est développée avec l'accueil de chercheurs et ingénieurs internationaux, qu'une passerelle traversant le Rhin entre une commune française et allemande et à une centaine de mètres de la Suisse a été créée. Il y a toute une dynamique qui se crée. Une IBA pour le développement de l'agglomération trinationale de Bâle a été lancée par la suite.

Les territoires voisins sont demandeurs.

Je pense depuis très longtemps il n'y a plus de frontières. J'ai connu l'abandon des frontières. Cela va au-delà du Luxembourg.

C'est vrai que nous quand on parle Grande Région dans les projets dans lesquels on est, la Grande Région on ne la voit jamais jusqu'à Namur ou Charleroi, c'est d'office avec la Lorraine, le Luxembourg et un petit peu l'Allemagne. Je ne sais pas quel autre mot qu'on pourrait trouver que le Grand Luxembourg.

Quand on réfléchit en termes de projets concrets, déplacements, biodiversité, parc naturel, tout ce qui est travail quotidien c'est plus le Grand Luxembourg. Les réflexions qui touchent un public beaucoup plus large, en termes juridiques, p.ex. Le télétravail, la santé, les systèmes de sécurité sociale, sont des domaines où une réflexion entre nations est obligatoire. Selon les problématiques il y a forcément des échelles différentes. Il y a forcément des choses que l'on ne peut pas régler qu'au niveau local si elles ne sont pas prises en compte à un niveau supérieur.

On parle beaucoup de télétravail en ce moment. Le télétravail a ses limites et ses avantages. Il faut pas voir non plus le télétravail comme solution à tous les problèmes parce que de toute façon à l'échelle transfrontalière cela ne résoudra pas tout. Une fois le cadre Covid sauté le télétravail ne sera plus autorisé de la même manière. On va rebasculer dans la mouvance qu'on a connu avant, càd 2h pour faire les 26 kms entre Arlon et Luxembourg. Les règles fiscales et de sécurité sociale vont réapparaître. Il faut être intellectuellement honnête aussi dans ce débat-là en disant qu'un des plus grands problèmes du Grand-Duché et ses territoires périphériques est lié notamment à la surconcentration des activités économiques. Tant qu'on n'aura pas trouvé un modèle bis, une alternative à ça malheureusement je pense qu'on ne pourra avoir que des solutions rustines, notamment autour de la mobilité propre. Cela n'empêchera pas les gens à aller travailler à Luxembourg. En province du Luxembourg on voit ce qui se passe, ce que certains appellent la tâche d'huile. La dispersion du nombre des frontaliers ne cesse de croître. Avant les frontaliers

était principalement sur l'arrondissement d'Arlon, notamment à Aubange. Aujourd'hui on trouve une masse de frontaliers jusqu'à Libramont ce qui n'était pas le cas il y a 20 ans. Qu'on le veuille ou non, cela va continuer car l'attractivité économique du Luxembourg est telle que les entreprises qui sont implantées en province de Luxembourg vont avoir tendance de plus en plus de s'implanter au Grand-Duché ce qui va générer des nouveaux flux. C'est ce qu'on voit au quotidien.

Si on part du concept que je rejoins philosophiquement à 100% que tant que faire se peut on essaie que les gens restent à un quart d'heure de chez eux, leur vie sociale, sportive, culturelle, économique, professionnelle, il faut aussi favoriser à ce que la vie professionnelle reste sur place aussi, soit en maintenant l'activité économique soit en la soutenant. Les flux côté français sont encore plus importants et cela va aussi de plus en plus loin. Cela se pose moins en Allemagne parce que la tendance démographique est complètement inverse à ce qui se passe en Wallonie. Pour rester encore là-dessus il faut savoir qu'en province de Luxembourg on voit de plus en plus de Wallons qui ont leur point de départ dans le Namurois, le Liègeois, voir dans le Hainaut et le Brabant wallon, qui migrent dans le sud de la province de Luxembourg pour aller travailler au Grand-Duché et ça c'est un flux qui est très important. Ça montre bien pourquoi il y a tant de création de logements à Arlon parce qu'il y a une telle croissance de la population grâce ou à cause du dynamisme de Luxembourg ville, Esch, la Nordstad.

Certains chercheurs wallons ont le point de vue que si on augmente le seuil de télétravail pour des Wallons qui travaillent au Luxembourg, historiquement c'était 24 jours, on imagine que ce soit 48 voir 55 jours par an, si on augmente ce seuil on augmente l'attractivité du marché de travail du Grand-Duché. Les entreprises qui sont actuellement implantées en Wallonie et qui ne sont pas encore entièrement attirées par le marché du Grand-Duché, vont l'être d'autant plus... on va encore renforcer les flux. Le télétravail apporte énormément de bien-être, donc c'est très important, mais il faut vraiment étudier tout ces impacts...

J'ai une expérience de 30 ans de route transfrontalière porte à porte de mon domicile à mon travail. J'avais l'avantage de parkings de mon entreprise qui existaient en centre-ville. Mais à l'avenir ces parkings risquent de disparaître. Même pour rejoindre les transports en commun le stationnement est toujours le problème. J'ai fait 5 aller et retour par semaine que j'ai réduit à 1 ou 2 en période de pandémie. Le télétravail permet aux gens de travailler finalement au Luxembourg de beaucoup plus loin. Il y a dans mes connaissances des gens qui ont déménagé qui se sont dit que tiens le télétravail me permet de m'éloigner et aller dans une zone que j'enviais. Pour aller au Luxembourg ils feront plus de kilomètres.

Le logement et des services à la population est une problématique soulevée quotidiennement.

Pour répondre à l'augmentation de la population dans la préphérie du Grand-Duché, p.ex. à Arlon, il y a une explosion des appar-

tements construits par des promoteurs privés. On densifie l'habitat ce qui est souhaité par beaucoup de personnes. Mais on urbanise aussi en excès dans certains villages ce qui pose la question du devenir de ces villages et du cadre de ces villages, mais cela pose aussi la question du logement public, des logements sociaux. Les gens qui ne savent plus se loger au Grand-Duché tentent de se loger en Wallonie. Ils ont davantage de moyens, soyons clairs, et on se rend compte du coup qu'il manque du logement public pour loger les "autochtones". Dans la commune d'Aubange il y a des réelles problèmes de logement public, on ne sait plus où loger des gens qui habitaient là initialement parce qu'il y a une trop forte augmentation du marché foncier et ça c'est entièrement dû à la proximité au Grand-Duché.

Le Grand-Duché est gagnant si les villes de l'autre côté de la frontière se développent correctement.

Ce qui manque aussi c'est les ceintures vertes, la biodiversité, les espaces ouverts, la continuité végétale, la dynamique des parcs naturels, sont des éléments de nos jours qui avec la crise du Corona ont été renforcés. Il y a la ville avec les espaces verts. La tendance actuelle est de réfléchir sur la qualité de vie. Cette qualité de vie ne se réfléchit plus en terme de barrières entre espaces construits et non-construits mais plutôt en terme de qualité de vie où que l'on soit, finalement, et sans non plus trop consommer d'espace supplémentaire. Il y a des espaces publics, il y a des espaces verts, ce sont des dimensions importantes.

Il y a des freins administratifs, p.ex. une station d'épuration qui pourrait peut-être plus facilement être installée côté luxembourgeois mais en profitant des résidents wallons, non cela ne peut pas se faire ou il faut passer par un projet européen qui peut le financer. C'est dommage qu'il y ait encore des freins administratifs qui font qu'il faut rester au niveau du pays. Un autre exemple: on a été contacté pour que l'Attert intègre LEADER Rédange alors que s'il s'agit de fonds européens, cela nous a été refusé.

J'ai peur que toutes les bonnes intentions de tous les groupes de travail ne soient pas suivies par les politiques. La suite, toutes les lois qui devraient sortir pour le climat, on voit des exemples comme celui de la France que les groupes de travail du comité citoyen n'a pas été suivi.

Je trouve que c'est très positif de créer des débats entre différentes parties du territoire de la Grande Région. On sent qu'il y a toujours ce défaut de communication. Les préoccupations se déclinent effectivement aux trois échelles de coopération. Il y a des attentes plus prégnantes à l'échelle de proximité et à l'échelle du Grand Luxembourg pour les citoyens, mais la dynamique à l'échelle de la Grande Région est très positive et mérite tout à fait d'être renforcée.

Les citoyens sont très pro-actifs, les petites choses s'additionnent, plus il y a d'exemples d'initiatives positives partagées plus cela va se développer, à mon sens cela va s'accroître, les gens sont assez autonomes, on n'attend plus tout des Etats.

Je vous remercie de nous questionner puisque toutes les équipes ne le font pas, je trouve que votre démarche est très positive. J'espère vraiment que la démarche qui est portée par le Grand-Duché va permettre d'avoir une réelle réflexion en terme gouvernance transfrontalière. Ça c'est vraiment mon souhait en tant que riverain et aussi en tant qu'insituation. Au niveau local on fait face à des murs administratifs qui nous empêchent de créer des projets cohérents pour le territoire alors que c'est les états et les régions qui ont les clés en main pour résoudre les problèmes administratifs. Ça montre qu'il faut une coordination entre le niveau local et le niveau régional et les autorités et cela pourrait se faire à travers un outil de gouvernance pour le périmètre métropolitain transfrontalier.

#### Third cross-border workshop

L'idée centrale de réduire l'étalement urbain et la consommation de l'espace, c'est là-dessus qu'il faut travailler par rapport à l'imperméabilisation des sols, par rapport à la consommation des ressources, par rapport à la préservation de la biodiversité.

Il semblerait que cette équipe veut mettre en place une bio-région dans un contexte transfrontalier. Il y a aussi l'idée d'être moins dépendant de l'extérieur et de recentrer les activités de production et de consommation au sein de cet espace-là (pour l'énergie, le travail, alimentation, la mobilité etc.). Dans le phasage à un nouveau modèle socioéconomique de post-croissance il y a besoin d'un nouveau récit, mais derrière il faut chercher l'adhésion des acteurs et des populations, sinon le récit restera une légende. Il faut que ce récit se concrétise dans des faits et ça passe par un changement des comportements et d'état d'esprit / de conscience. Pour cela le travail d'information et de sensibilisation est primordial. Et il y aura des actions à mener par des acteurs économiques, des acteurs politiques, des citoyens – il y aura des succès mais on va aussi se planter et on devra insérer dans ce processus de transition le droit à l'erreur et c'est là qu'on va faire d'autres innovations et réajuster les expériences faites, c'est un processus d'apprentissage. Malheureusement cela est difficile à faire accepter politiquement. Une partie de la population en a marre et il y a un besoin d'authenticité pour faire adhérer les gens, or actuellement on n'y est pas, on est dans la représentation.

Dans la transition il n'y a pas ce modèle mais il y en a plusieurs qui peuvent fonctionner. P.ex. Hopkins a le modèle des Villes en Transition pour faire changer les choses. Mais certains modèles ne peuvent pas fonctionner sur certains territoires p.ex. pour des grandes métropoles c'est compliqué, ça marche bien pour des zones rurales ou des villes de petite taille. La culture a aussi un rôle important à jouer, notamment dans le domaine de l'alimentation.

La transition va demander un autre modèle de la production de l'espace. Pour l'instant on est dans une logique de spécialisation fonc-

tionnelle sur l'emploi (forte concentration au Luxembourg), les zones résidentielles dont beaucoup derrière la frontière) - on est dans du mono-fonctionnel. Arriver à la transition et à une société décarbonisée et résiliente, à une société du 15 minutes et à une réduction de la mobilité cela va vouloir dire redistribuer les activités sur le territoire. Et ça politiquement du pont de vue du Luxembourg cela va être compliqué d'expliquer aux électeurs qu'une partie des activités devraient être transférées de l'autre côté de la frontière. Parce que c'est ça que cela veut dire si on va jusqu'au bout. Il y a des outils pour cela, dont p.ex. l'ECBM (European Cross-Border Mechanism), qui a été développée en 2015 sous présidence de l'UE par le Luxembourg. Il s'agit d'un mécanisme de coopération transfrontalière, d'un outil juridique qui permet de transcender les réglementations d'une souveraineté nationale de l'autre côté de la frontière sans que les souverainetés des deux pays se confrontent, p.ex. dans la création de zones d'activités économiques en France avec une base fiscale Luxembourgeoise. Cela permet aux pays voisins de profiter de l'attractivité d'un territoire comme Luxembourg ou Genève. Cela peut être un outil gagnant-gagnant qui ressort les liens entre les territoires parce que ces territoires frontaliers sont tous dans des situations d'interdépendances, mais actuellement avec des inégalités et un tel outil pourrait rééquilibrer les choses.

Sur les obstacles que rencontrer les acteurs dans l'espace transfrontalier le LISER (Establishing Cross-Border Spatial Planning par Frédéric Durand & Antoine Decoville, Liser 2018) avait fait une étude et un tableau synthétique (obstacles institutionnels, légaux, techniques, culturels, politiques, fiscaux, relationnels – ce dernier ayant été identifié comme pratiquement les plus importants).

Le projet « Luxembourg in Transition » fait modèle et fait parler de l'autre côté de la frontière et suscite l'intérêt notamment des gens qui sont dans les institutions, même au-delà de la Grande-Région.

Ce qui serait intéressant dans ce travail, ce serait d'aller voir au-delà de 2050 aussi, car c'est une étape mais il y a aussi l'après et de réfléchir comment le processus de Transition se développerait après 2050 : est-ce qu'on va plus loin dans cet aspect régénératif ? La question de la post-croissance est passionnant mais difficile à aborder de manière concrète et opérationnelle. Une question concrète à approfondir serait comment au Luxembourg et ses alentours on pourrait tendre vers l'autosuffisance alimentaire ? Parce que là on part de loin et il y a de gros efforts à faire.

#### Participants in the cross-border workshops:

Marco Denis, Biergerkomitee Lëtzebuerg 2050

Frédéric Durand, LISER

Serge Ecker, independent artiste and membre of DKollektiv

Pascale Fouchs, Administration wallonne, aménagement du territoire

Sylvie Hubert, director of Parc naturel Vallée de l'Attert

Albert Kalmes, 1er échevin of Schifflange and president of TM EnerCoop

Bernard Lahure, director EcoTransFaire

Eric Lavillunière, coordinator REconomy, CELL and Transition Minett

Eric Marronchini, director of the Communauté de communes du Saulnois and researcher at the Université de Lorraine

Alexandre Petit, Idelux

Caroline Schmit, Conseillère Pacte Climat, Syndicat Intercommunal Canton de Redange

Jürgen Stoldt, coordinator of the Biergerkomitee Lëtzebuerg 2050 (observer)

Karin Waringo, Biergerkomitee Lëtzebuerg 2050

#### Team

Estelle Evrard, Université du Luxembourg

Thomas Gibon, LIST

Florian Hertweck, Université du Luxembourg

Markus Molz, CELL

Norry Schneider, CELL

Céline Zimmer, Université du Luxembourg

# Decarbonisation Assessment

## Population

One of the challenges the Functional Area faces is accommodating a rapidly growing population. Luxembourg had 626,000 residents in 2020, with official estimates projecting a 48% increase in population in 2050. Planning where this growth should occur is key to achieving resilient decarbonisation and spatial justice. Unmanaged growth leads to urban sprawl, making efficient public transportation more difficult. Housing is also increasingly unaffordable. In 2018, Luxembourgers spent on average 36% of their income on housing.

In our plan, the increased population would be spread more equally across the functional area, with Luxembourg still seeing the largest increase in population of 19%, which is still lower than the projected 48% (Figure 1). Nevertheless, the new population would be housed in existing population centres or former commercial or industrial sites. This kind of growth strategy would group population around existing and new public transportation in Luxembourg and across the border, instead of housing the new population in ever-growing villages in Luxembourg. As such, the population would be in better reach of the public transportation network—the travel mode of choice in 2050—and would also avoid the destruction of the natural landscape through increased soil sealing.

## Housing

Luxembourg's housing stock is less energy efficient than the housing stock of the rest of the functional area. In 2020, single-family homes in Luxembourg consumed on average 220 kWh per square meter per year, earning an energy passport score of F (Figure 2). Energy consumption in single-family homes in the rest of the functional area was half as high at 101 kWh per square meter per year. In our scenario, we reduce per-capita GHG emissions by 83%, eutrophication by 69%, air pollution (particulate matter emissions) by 70%, and material use by 41% from 2020 to 2050 (Table 1).

## Mobility

The mobility sector will decarbonise thanks to an overall reduction in demand for transportation and a shift in mode of transportation from car to public transportation and soft mobility. In addition, cars and buses will become increasingly electrified, shifting away from fossil fuels. Figure 3 shows this shift for cars in the functional area. The result is a gradual decrease in GHG emissions per person-km (Table 2), which is a way of measuring the impact of a person traveling one km, taking into account the different occupancy rates of trains, trams, buses, cars, and bikes. In our scenario, we reduce GHG emissions by 81%, eutrophication by 71%, particulate matter emissions by 59%, and material use by 32% from 2020 to 2050 (Table 3).

## Cross-border mobility model

In order to complete our assessment of the functional area's demand for mobility on GHG emissions, we relied on a model on cross-border mobility alongside the population-weighted average mobility demand of the functional area according to the EU REFERENCE scenario, to which we applied our strategies to yield our scenario. Figure 4 and Figure 5 show the traffic volume in vehicles per day for the road transportation network in 2021 and 2050. The public transportation system is expanded with new tramlines in 2050 (Figure 6). Figure 7 shows a close-up of the tramline network around Luxembourg City in 2050, including the volume of tramline users.

## Agricultural production and food consumption

The transition to agro-ecological food production, fewer and pasture-raised cattle, arable land used for food rather than feed production, and agrivoltaics change the type and amount of food and feed that is produced in the functional area. Table 4 presents crop production in kilo-tonnes, taking into account the reduction in field size through hedgerows, yields for organic production, and the 20% yield decline for the share of cropland with agrivoltaics—a share that increases gradually from 0% in 2020 to 5% in 2050.

In terms of food consumption, for the average diet of the functional area, we reduce meat in a flexitarian diet that is part omnivore (1 day per week) and part vegetarian (6 days per week) to achieve a 40% reduction in GHG emissions relative to the omnivore diet (Figure 8). This flexitarian diet is within the parameters of national dietary guidelines (France and Germany), and an omnivore diet that follows the dietary guidelines of the FA countries also reduces GHG emissions by 30%. Eating healthier thus comes with benefits in terms of climate change mitigation. Vegetarian and vegan diets reduce GHG emissions the most by 53% and 49%.

## Carbon sequestration

GHG emissions from land use, land use change, and forestry (LULCF) depend on a variety of factors. Our basis is the EU REFERENCE scenario, which we adjust to create our scenario. Notably, our scenario foresees no new soil sealing, such that the category of land use change into settlements (“new settlements”) is set to zero after 2020, which reduces GHG emissions by 200 kt CO<sub>2</sub>eq/year (Table 5). The same applies to “new cropland” and “new grassland”. Our afforestation measures are listed separately, so “new forest” is also set to zero. Existing forest area continues to function as a carbon sink (with negative emissions). Our new measures include hedgerows, green roofs, riparian buffers, trees on meadows (silvopasture), as well as agro-ecological management

of cropland and grassland. Table 6 presents the carbon sequestration calculations for each of our new strategies. Green roofs provide relatively little benefit in terms of carbon sequestration, and instead serve mainly as an adaptation measure to reduce the urban heat island effect and to increase biodiversity in urban areas.

## Carbon footprint accounting

The carbon footprint presented in our proposal is consumption-based, i.e. it includes GHGs emitted anywhere in the world and embodied in the goods and services we consume in the functional area. Figure 9 presents GHG emissions embodied in trade for Luxembourg and the remaining part of the functional area, the remainder of Belgium, Germany, and France, as well as the remaining EU28, and the rest of the world. On the diagonal are the GHG emissions that take place within the borders of each region for the final consumption of their residents. In Luxembourg, this value (2.5 Mt CO<sub>2</sub>eq) is very low compared to its total footprint. Luxembourg imported 9.3 Mt of embodied emissions from non-EU products (e.g. Russian oil for heating) and 0.6 Mt from Germany (e.g. automobiles), while it exported 2.3 Mt of embodied emissions to the EU28 (e.g. steel). Worldwide emissions in 2018 were 51.4 Gt. The column on the right shows the production-based carbon footprint, including the 10.6 Mt for Luxembourg or  $10.6 + 12.3 = 22.9$  Mt for the entire functional area. The bottom row shows the consumption-based footprint for Luxembourg at 15.5 Mt or  $15.5 + 16.6 = 32.1$  Mt for the entire functional area. Figure 10 shows a further breakdown of Luxembourg's consumption- and production-based carbon footprint.

To complete our decarbonisation analysis, we calculated the overall impact of our decarbonisation measures on the production-based carbon footprint of Luxembourg—this time excluding the rest of the functional area (Figure 11). This scenario was developed in less detail than our main decarbonisation path for the consumption-based carbon footprint. Nevertheless, it highlights again that, while there is some overlap, a different set of measures would be needed to decarbonise the production-based carbon footprint. Notably, the measures to decarbonise mobility, align fuel taxes, and decarbonise the building and public sectors remain the same. In the agriculture sector, we focus entirely on reducing the environmental impacts of production in Luxembourg, rather than on reducing impacts of production anywhere in the world due to food consumed in Luxembourg. Finally, we require a new set of measures to decarbonise the manufacturing sector. For this decarbonisation path, citizens play a smaller role, since they are not called upon to reduce consumption as required by our consumption-based decarbonisation path.

### Mitigation measures in the area of urban planning (e.g. case study Esch)

Cities are responsible for around 70% of the world's CO<sub>2</sub> emissions caused by urban transport and industry, as well as impractical waste management, and harmful building practices. Today, cities are facing several climate-related problems including impacts on urban services, city infrastructure, employment, housing, and urban public health. One of the most pressing issues facing metropolitan areas is the Urban Heat Island Effect. This term describes urbanized areas that show higher air temperatures than surrounding areas. Buildings, roads, and other urban infrastructure absorb and re-emit short- and long-wave radiation more than natural materials like forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become “islands” of higher temperatures relative to outlying areas with negative health effects. Therefore, the ultimate goal of urban planning—especially in the light of global warming—should be the reduction of the urban heat island effect through tailored measures.

### Urban green and blue elements

As far as possible, the proportion of greenery in the urban area should be increased, especially in areas under high thermal stress levels (→ M01, → M02, Table 7). Water-supplied structurally rich green areas as well as urban water bodies will have positive effects on the ambient climate due to their evaporation (→ M03). Compared to e.g. concrete or other building materials with high heat storage capabilities, green areas cool down much faster at night and can act as cold air formation areas. In addition, they fulfil many other functions, such as the possibility of recovery or increasing biodiversity, and have synergy effects for precipitation management (infiltration) and air pollution control (filtration and deposition of air pollutants).

In addition to the great potential of urban green to reduce thermal stress during the day and at night, trees and shrubs in street canyons take over the function of filtering of air pollutants, thereby improving air quality. When planting new trees, the vertical air exchange/mixing must be secured to ensure no accumulation of air pollutants. Closed crown roofs should be especially avoided in small streets with high amounts of traffic, while in multi-lane roads the middle lane could be used for tree planting. For the selection of new trees, species with low emissions of volatile organic compounds (VOC) should be avoided, because VOCs contribute to the formation of near-surface ozone. Furthermore, those species of trees and shrubs should be preferred, that show a high tolerance towards heat and drought stress.

### Shading measures

Shading measures reduce the thermal stress caused by direct sunlight during the day. Shaded roads, footpaths, bicycle paths or parking lots store less heat than the sealed open spaces exposed to sunlight (→ M06). With large-scale shading, the nocturnal heat island effect and thus the thermal load of adjacent residential quarters can be substantially reduced.

### Climate-adapted construction

Climate-adapted construction contains many of the measures already discussed so far and could be implemented easily for new buildings, but those measures could also be applied for already existing building or in the case of re-densification. During the construction of new buildings, there is the opportunity to optimize the building orientation and thus reduce the direct heat input. Considering the exposure of the sun and wind, buildings should be aligned in such a way that in sensitive rooms such as bedrooms the summer heat input is minimized (→ M07, Table 8). This is especially important for sensitive buildings such as hospitals or nursing homes. In addition, a suitable building orientation can maintain or achieve good ventilation with cooling effect (orientation parallel to the cold air flow, sufficient (green and blue) open spaces between the buildings (→ M08).

The use of suitable building materials should be realized for new buildings but also during renovation. Special emphasis must be paid to thermal properties of construction material—natural building materials such as wood have a lower heat turnover and emit less energy to the ambient air at night-time compared to e.g. steel or glass. The specific albedo of surfaces influences the radiation budget of buildings so that the appropriate choice of building materials is even more important. The reflection of solar irradiation on bright surfaces is greater, so that they heat up less strongly (→ M09). Moreover, structural measures to improve the indoor climate such as roof and facade greening, shading elements or energy refurbishment can also be implemented in the existing building structure and often offer synergy effects on the energy consumption of the buildings (→ M10, M11, M12, M13).

### Mitigation measures in the area of regional planning

Local wind systems either induced by topography or by thermal conditions are of great importance for urban planning in general and particularly to reduce thermal stress levels in densely populated urban areas. Larger settlements act as a flow obstacle due to their high aerodynamic roughness, so that the ventilation of the city bodies is reduced. The dilution—or ideally—the removal of overheated and polluted air masses (emissions from traffic, industry and house heating) in the road

canyons can be significantly limited depending on the type and density of the building. Especially during weather situations characterized by low wind speeds, low cloud cover and thermal inversion, these factors lead to unfavourable bioclimatic effect with negative health impacts.

Therefore, the above-mentioned local wind systems can provide a significant ecological compensation (reduction of thermal stress and pollutant levels) for polluted areas by the supply of cool and ideally unpolluted fresh air (Table 9). Flow obstacles such as buildings, road or train dams or even vegetation belts can cause cold air accumulation on the luv side. If the obstacles are overflowing in the lee side, substantial reductions of the speed of the cold air flow will occur. The penetration depth of cold air into built-up areas therefore depends on the size of the settlement and the density of buildings, as well as on the anthropogenic heat release and the amount of cold air flowing in (depending on the size and characteristics of the cold air production area).

### What would it take for you to sell your car and switch to public transportation (with a bit of car sharing)?

I'm already car-free – 16%  
More bike paths – 8%  
Increase bus/train frequency – 12%  
More bike paths AND increase bus/train frequency – 38%  
Completely overhaul the current public transportation system – 24%

### Which decarbonisation action would be most difficult/unpleasant for you?

Reducing consumption goods by 90 percent – 55%  
Reducing air travel – 23%  
Living in a smaller house/apartment – 16%  
Reducing beef and dairy consumption – 3%  
Switch to electric vehicles and car sharing – 3%

### How much do you think we need to reduce our carbon footprint in order to meet the Paris objective?

By 60 percent – 5%  
By 70 percent – 30%  
By 80 percent – 33%  
By 90 percent – 33% [This is the correct answer]

### How much longer is your commute by public transportation than by car?

About the same – 18%  
Up to 50% longer – 16%  
Up to twice as long – 41%  
Up to three times as long – 10%  
More than three times as long – 6%  
No public transportation option within walking distance – 8%

Figures

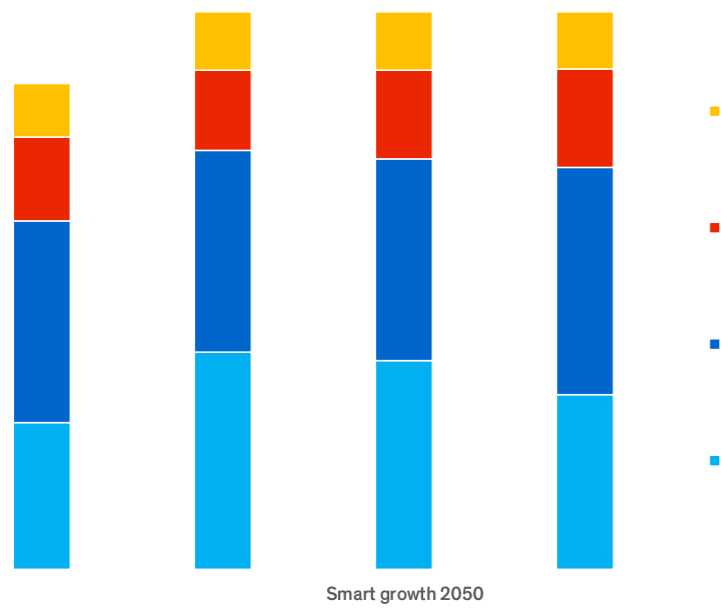


Figure 1: Population in 2020 and 2050 (thousands) for different scenarios

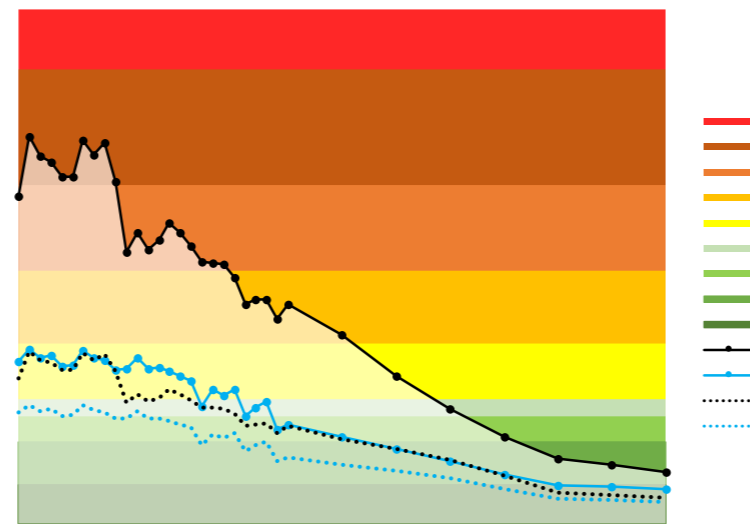


Figure 2: Building energy consumption (kWh/m2 per year)

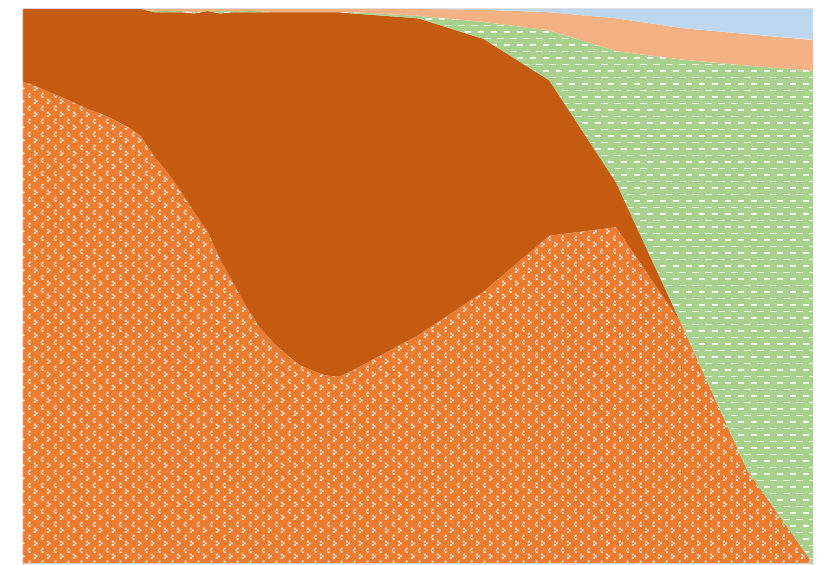


Figure 3 Cars in the functional area will become increasingly electric

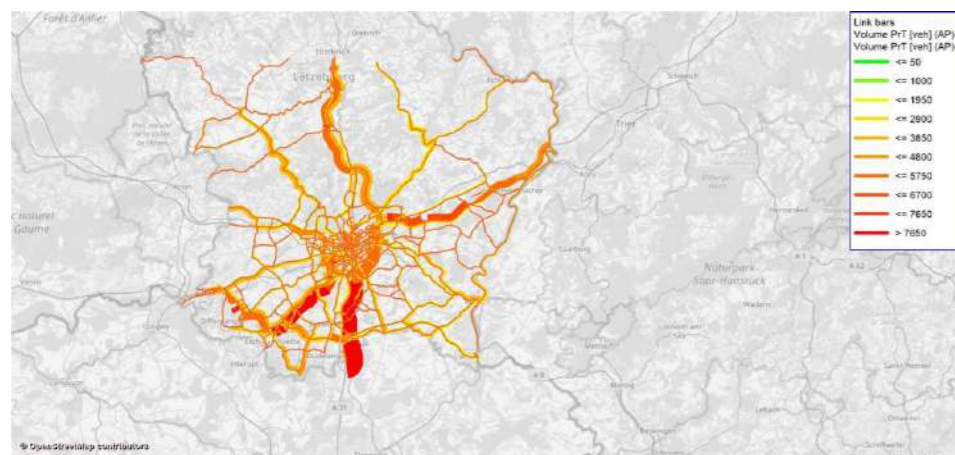


Figure 4: Car travel volume in vehicles per day in 2021

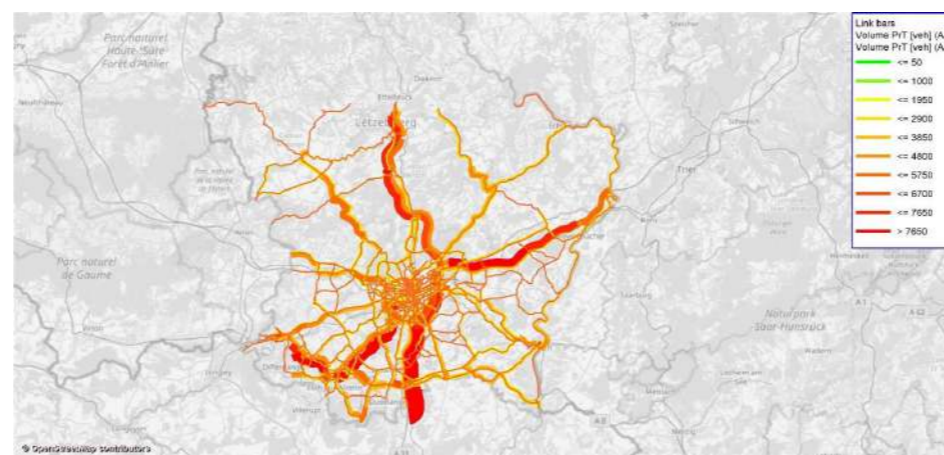


Figure 5: Car travel volume in vehicles per day in 2050 in the business-as-usual scenario

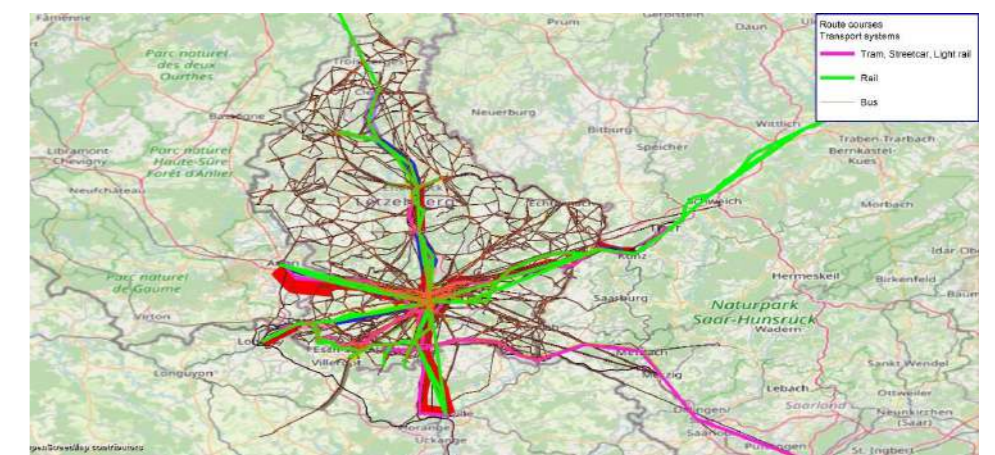


Figure 6: Public transportation network in 2050 with new tramlines

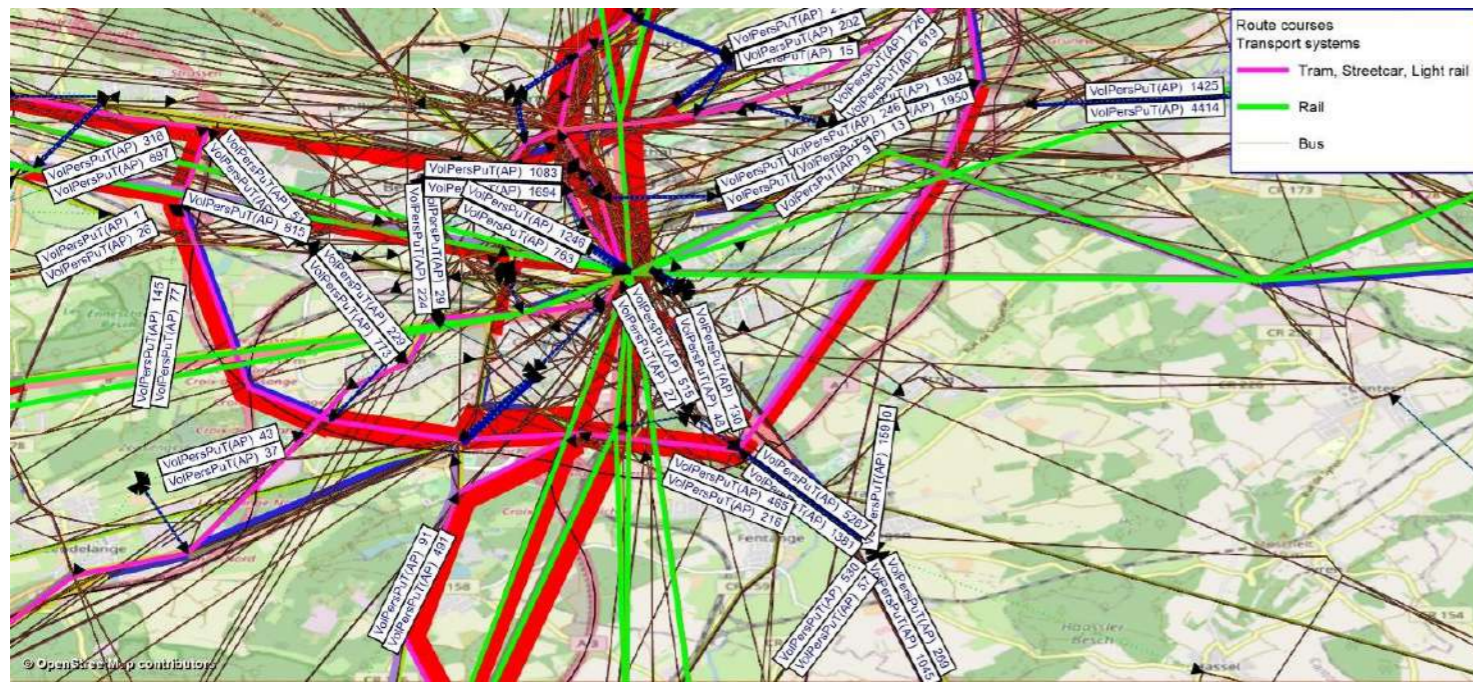


Figure 7: Public transportation system in 2050 with new tramlines, showing tramline user volume

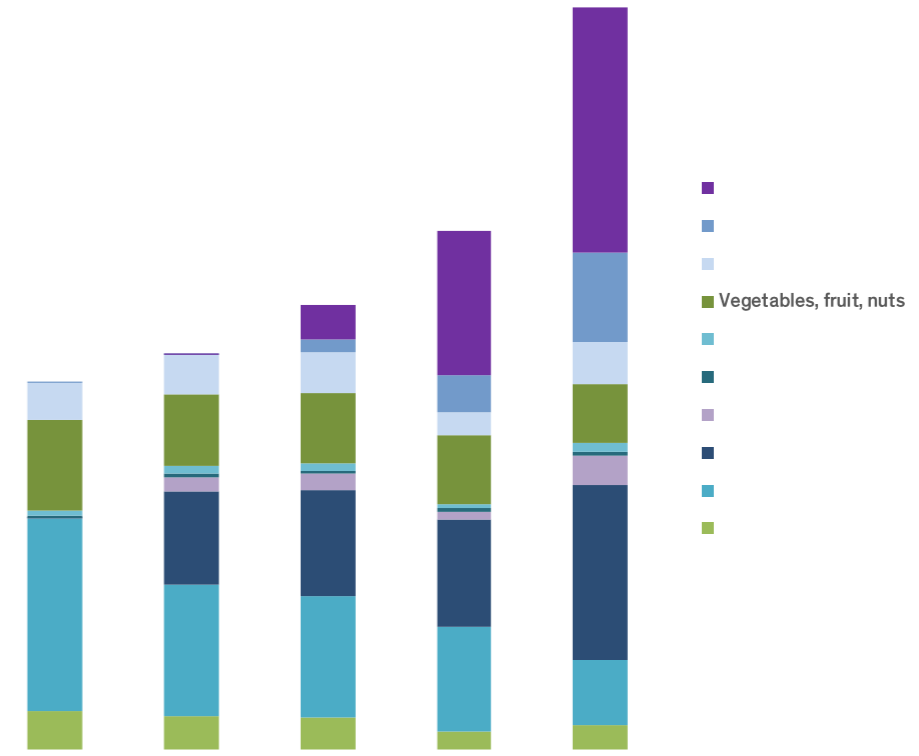


Figure 8: GHG emissions embodied in diets (kg CO2eq/cap/yr)

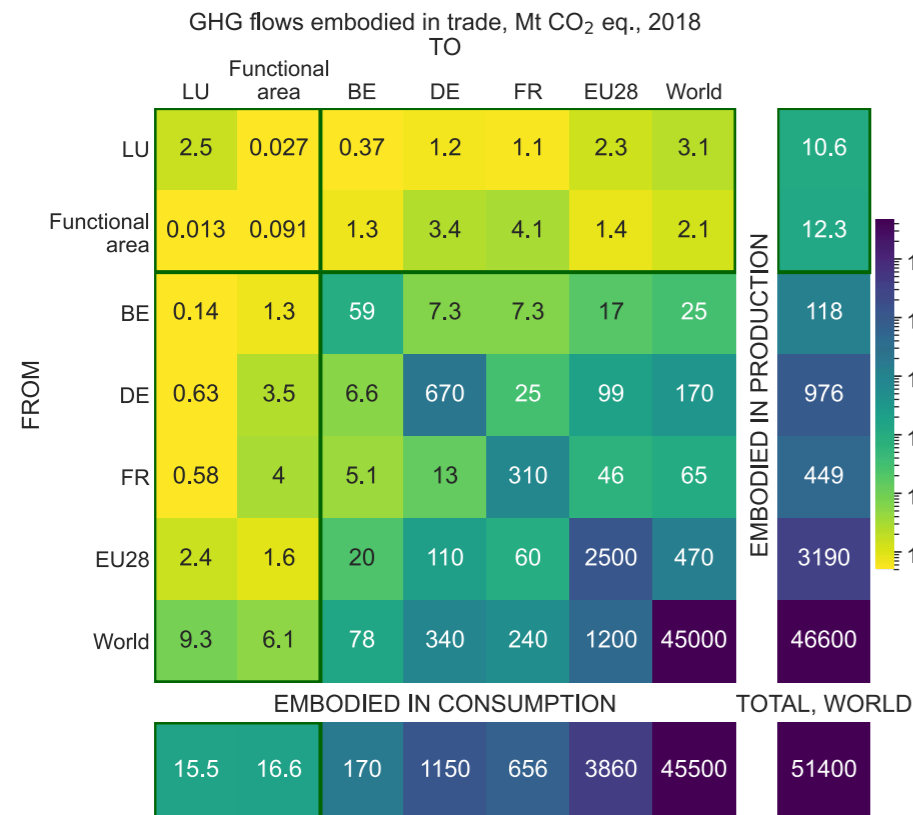


Figure 9: GHG emissions embodied in trade, Mt CO2eq, 2018

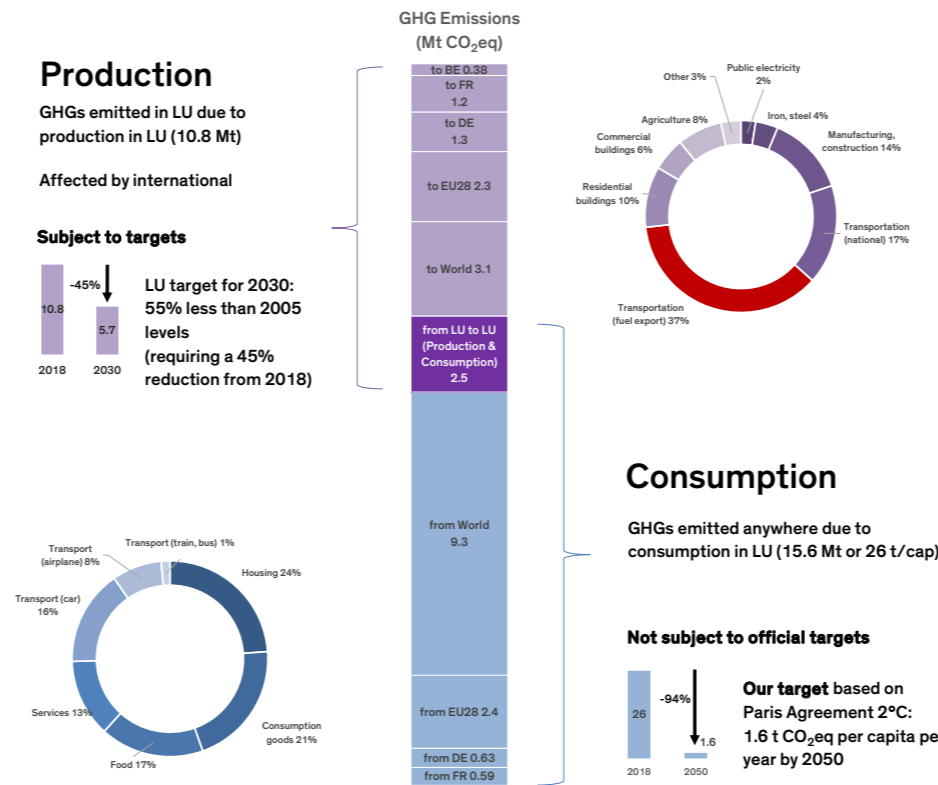


Figure 10: Production- and consumption-based carbon footprint of Luxembourg, 2018

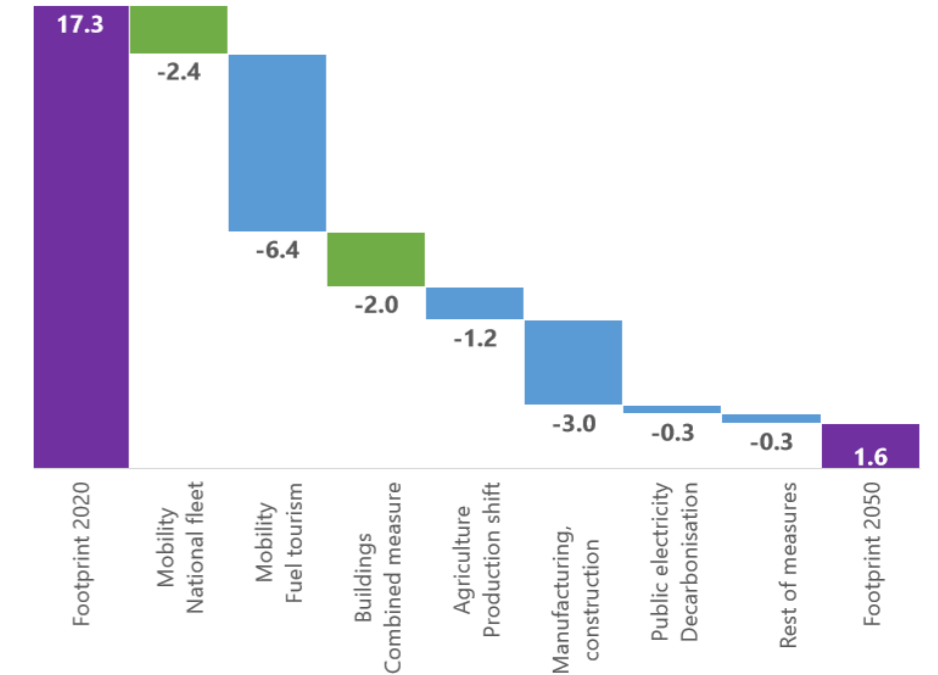


Figure 11: Decarbonisation of the production-based carbon footprint of Luxembourg (t CO2 eq./cap)



## Tables

### Eutrophication

Table 1: Housing environmental impacts in the functional area in our scenario

Table 2: Life-cycle GHG emission factor by mode of transport (g CO<sub>2</sub>eq/pkm)

Table 3: Mobility environmental impacts in the functional area in our scenario

Feed production

odder cereals  
odder legumes

Food production

rain legumes

Oleaginous crops (e.g. sunflow)  
Other cultures

New forest  
Cropland  
New cropland  
Grassland  
New grassland  
Settlement  
New settl  
  
New wetland  
Hedgerows  
Green roof  
Cropland  
Grassland  
Riparian buffer  
Trees on meadows

of green roof determined by excluding Penman et al. 2003  
Gradual shift to sustainable grassland management. In 15.5 kg C/ha/year for grassland ha grassland in the FA  
Gradual shift to sustainable/organic production on 2050, 250 kg C/ha/year for arable land under organic production (Sanders and Hess 2019)  
  
arbon sequestration of 0.16 silvopasture in France)  
0.32 t C/ha/yr on 33 and assume that 50% of the  
Field edge assumption: 4m (2m on each side of a field edge), for all field edges in cropland that border streets or forest  
4.9 t C/ha/year for part managed and part unmanaged hedgerows (Organic Research Centre 2015).  
Riparian buffer area of 762 km in the FA, conservatively same CO<sub>2</sub> uptake as hedgerows

Table 4: Food production in the Funcational Area (kt/year)

Table 5: Land use, land use change, forestry (LULCF) emissions in the functional area (Mt CO<sub>2</sub>eq)

Table 6: Carbon sequestration estimates of our strategies (kt CO<sub>2</sub>eq/year)

Tables

	Spatial effects	Implementation
gardens in the inner city areas that also	Reduction of heat pollution during	
	Synergies for precipitation water management and biodiversity	
	Reduction of heat load during the	Building gaps, larger
	Networking of green spaces	
Microclimatic diversity of green areas (open meadows, trees, water	Synergies on precipitation management and biodiversity	
	Reduction of heat load during the	
Protection of parks, green and forest areas for the urban climate	Synergies on biodiversity	streets, paths, places,
	Importance for the cold air balance	
of larger flowing and still waters bodies and	Key functions for recovery, biodiversity and precipitation water management	
	During the summer months and especially heat periods, waters have a cooling effect on their vicinity during the day	Water bodies, green
ventilation corridors, through which cold and fresh air is transported into the city centres		
	measures (awnings,	
	Reduction of heat load during the	spaces, buildings in the

Table 7: Measures for urban green and blue elements, shading

	Spatial effects	Implementation
	Optimization of the building orientation and the use of interiors, i.e. if possible, not to align sensitive rooms to the south /to the warm sleeping, working or rooms used	Improvement of the
	Building arrangements the cold air flow and, sufficient green and blue open spaces between the buildings	Improvement of cold air
	Bright colours (especially roofs) and building materials that store	Reduction of heat load during the day and at
Extensive or intensive roof greening (up to gardens and urban agriculture on roofs; with preference for native plants), green roofs (plants standing in the water)		Improving the indoor
		implementation an roof height improvement of the adjacent outdoor
greening (preferential treatment		precipitation water
		biodiversity and climate
	Improvement of the indoor climate and the immediately adjacent	
	Synergies on air pollution and biodiversity as well as on noise and building	
Facade greening, trees, balcony design, structural measures such as external sun protection elements (blinds, awnings, etc.), reflective sun protection glass or		Effect during the day and
		Improvement of the
Insulation of buildings, bright colouring (increase in albedo value), suitable room ventilation		Synergies for climate
		protection measures
	Improvement of the indoor climate during the	

Table 8: Measures for climate-adapted construction

	Spatial effects	Implementation
characterized by flat vegetation such as meadows, extensive grassland, fields, allotments and park landscapes should be kept	Protection against excessive overheating and deterioration of	
	Synergies on biodiversity	
Small parks as steppingstones		
buildings) or natural obstacles (tree groups, but retention of existing trees) in the area of influence of cold air flows or adapt building orientation	cold/fresh air exchange	commercial areas,
Protection of cold air formation areas and upgrading of areas with lower cold air production	Reduction of heat load, especially at night, but	
Establishment of evaporative irrigation measures, greening and unsealing	precipitation water	

Table 9: Mitigation measures for regional planning

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