

Circular Cities: Challenges and Opportunities Towards Their Transition to a Green, Smart and Circular Economy

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Abstract: Cities cover 3% of the land on Earth, however with more than 70% of the population expected to live in urban areas by 2050 they drive almost three-quarters of GHG emissions. They account for two-thirds of global energy demand, consume 60-80% of natural resources and generate 50% of waste.

Urban metabolism is becoming the most important indicator of measuring the sustainability of cities.

Cities are on the front lines combatting major challenges, notably climate change, pandemics, integration of refugees, decarbonisation, air pollution, food security, energy poverty, waste/water management and putting in place circular economy. Cities are hubs of sustainable economic activity, community engagement, innovation.

The policy choices local governments make today will determine the successful transition to greener, cleaner, smarter way of living and will offer new economic opportunities. Cities and regions can act as enablers of the transition, providing the conditions for the circular economy to happen in practice.

This paper/presentation explores major urban challenges driven by climate change. It observes new human-centric urban trends and technologies shaping circular urban planning. It draws the main axes of integrated policies, collaborative governance and technology-powered solutions that cities can deploy to speed-up their transition to a green, smart and circular economy.

Keywords: governance; innovation; sustainability; technology; urban-metabolism

1. Introduction

Our land use is the most underestimated factor in the environmental crisis. It is a key element to address environmental challenges. Land use is driven by a limited set of vectors: agriculture and economy (production and consumption) and the space needed for housing and other buildings, for infrastructure, roads, leisure, public transport, etc. One of the deeper underlying questions is: what are the paradigms that steer our economic model? The use of space (land use) for agriculture and for the extraction of raw materials together account for 50% of all emissions and for 90% of all vanished natural areas. Perpetual economic growth is an absurd concept on a finite planet.

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Today, both architecture and urban development are an integral part of the economic model described above. More than that, they play a prominent role in it. Land use planning is a lever for sustainable environmental transitions. The fact that the sector of spatial planning has fulfilled a problematic role for so long, can also be turned into an opportunity: it can be reinvented and turned into the last line of defense of nature and open space. To shrink our land-use and give space back to nature we must be willing to choose in favor of a new economy, in favor of densification, in favor of doing more on less land. Architects are pre-eminently systems thinkers who can shape and design densification and spatial shrinkage attractively. However, they are powerless if society and politics keep on giving them the wrong assignments. Moreover, their sector alone cannot solve this crisis. Civil society and economic stakeholders have a role to play. One factor of degradation is the area of soil that is sealed or artificialized¹: The net land taken per year in the period 2012-2018 can be seen as a measure of one important pressure on nature and biodiversity - land use change - which constitutes at the same time an environmental pressure on people living in urbanised areas. Despite a reduction in the last decade, (land take was over 1000 km²/year between 2000-2006), land take in EU28 still amounted to 539 km²/year between 2012-2018 (Table 1).

Table 1. Yearly Land Take in EU-28² (km²/year)

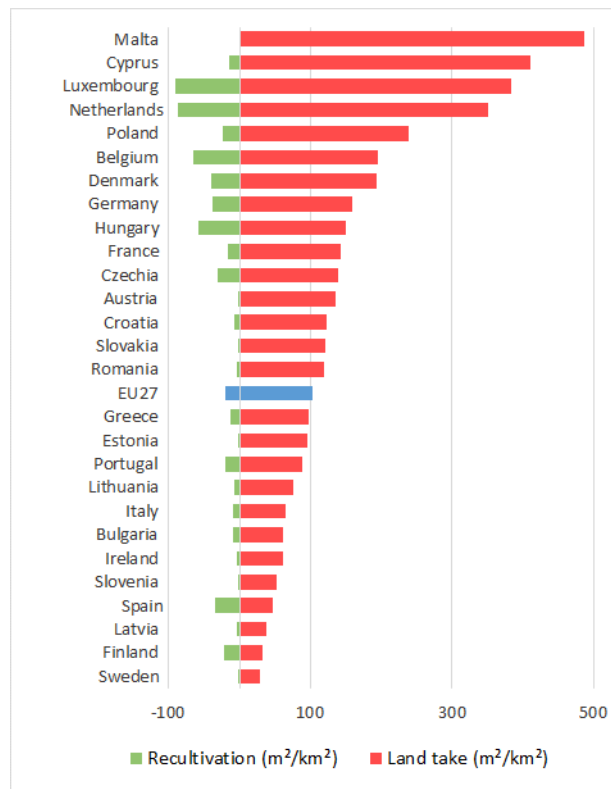
Years	Land Take EU-28
2000-2006	1,021.71
2006-2012	860.14
2012-2018	539.33
2000-2018	780.49

The net land take concept combines land take with land return to non-artificial land categories (re-cultivation). While some land was re-cultivated in the EU-28 in the period 2000-2018, 11 times more land was taken.

¹ Artificial land cover is defined as the total of roofed built-up areas (including buildings and greenhouses), artificial non built-up areas (including sealed area features, such as yards, farmyards, cemeteries, car parking areas etc. and linear features, such as streets, roads, railways, runways, bridges) and other artificial areas (including bridges and viaducts, mobile homes, solar panels, power plants, electrical substations, pipelines, water sewage plants, and open dump sites).

² [Land take in Europe — European Environment Agency \(europa.eu\)](https://europea.eu).

Figure 1: Land take & re-cultivation in EU27(2012-18)³



The ‘Weight of cities’ assessment report from the International Resource Panel (UNEP 2018)⁴, explores in detail the need of the circular transition through urban planning, investment in resource efficient infrastructure technologies and entrepreneurial governance.

According to the Circularity Gap Report 2023⁵, the quick build-up of cities without smart urban planning has also contributed to urban sprawl, leading to high car dependency, air and noise pollution and excessive material use. Where new builds are needed, be as efficient as possible with urban planning solutions that follow circular design principles so that buildings can be reused, repurposed or easily disassembled in the future. Insufficient urban planning also drives environmentally unsustainable and costly mobility patterns, especially personal vehicle dependency. The most impactful interventions for closing the Circularity Gap come from Housing, but also Nutrition.

On the other hand, land use is the most underestimated factor in the environmental crisis. Land use is driven by a limited set of vectors: agriculture and economy (production and consumption) and the space needed for housing and other buildings, for infrastructure, roads, leisure, public transport, etc.

To date, the industrial ecologists and economists have tended to dominate the circularity debate, focusing on closed-loop industrial systems and circular economy (circular businesses and systems of provision). The current state-of-the-art conceptualisation for circular economy (RESOLVE) is inadequate when applied to a city. Urban resource security issues are increasingly a problem, particularly for water, food and energy. Currently, half of the world’s cities with more than 100,000 inhabitants are situated in areas experiencing

³ [Environmental Implementation Review 2022-Belgium-p.16](#)

⁴ <https://www.resourcepanel.org/reports/>

⁵ [circularity-gap.world](#)

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water scarcity (Richter et al., 2013, as referred at Williams, J., 2019) and the number of water-stressed cities is growing rapidly. Asian and African cities are experiencing food security issues. The loss of agriculturally productive land surrounding cities is another key concern (Williams, J., 2019).

In addition, land-use directly relates to most urgent EU environmental policy priorities, as the following examples of relevance indicate:

- Mitigation of climate change (ecosystems provide natural carbon removal; soils hold important carbon stocks; large land taking sectors like housing and transport are also large GHG emitters);
- Adaptation of climate change (land use decisions critical to prevent the worst effects of more frequent floods and droughts e.g. building in development in flood-prone areas, or land management decisions impacting on water retention capacity of river basins);
- Zero-pollution (major land users are source of key persistent diffuse pollution pressures e.g. nitrogen through road transport and livestock farming, and pesticides in agri- and horticulture)

2. Global cities challenges

2.1. Opportunities for a circular economy

The United Nations–Human Settlements Program World Cities Report⁶ and the World Economic Forum in 2020⁷ discussed the opportunities for a circular economy as an alternative economic model, suggesting the following:

- a pay-for-service or sharing economy approach;
- self-sufficiency and local consumption to maintain food security;
- short supply chains and increased autonomy, focusing on the repair economy and local microindustries to supply products within reach;
- capping consumption based on capacity limitations and priority.

2.2. Cities transition to a green, circular economy

The transition to the green and circular economy is cutting across diverse policies and economic sectors, calling for increased attention across all government levels, industry, academia, and civil society for its realization⁸. A wide range of cities around the world have begun their journey toward a circular economy approach by putting in place innovative city models⁹ and collaborative governance:

- the 15-min city concept;
- the application of the doughnut economy in cities;
- local green deals;
- the Product-as-a-Service (PaaS) business model;
- green and circular public procurement;
- technology-powered solutions;
- green skilling and up-skilling initiatives;

⁶ World Cities Report 2020: The Value of Sustainable Urbanization. Nairobi, Kenya: UN-Habitat, 2020.

⁷ “Circular economy in cities: Evolving the model for a sustainable urban future” World Economic Forum, Cologne, Switzerland, White Paper, 2018. [Online]. Available: https://www3.weforum.org/docs/White_paper_Circular_Economy_in_Cities_report_2018.pdf

⁸ “The circular economy and green jobs in the EU and beyond” Foundation for European Progressive Studies, Feb. 2022. [Online] Available:

<https://feeps-europe.eu/publication/852-the-circular-economy-and-green-jobs-in-the-eu-andbeyond/>

⁹ Eleftheriadou D. et al. (2022).

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- sharing economy models;
- sustainable mobility models;
- sustainable production and consumption;
- governance, strengthening and active participation;
- innovation, creativity and research;
- local culture and identity;
- reuse and restoration of public properties/buildings;
- biodiversity and ecosystems restoration;
- restoration of contaminated soil;
- urban farming;
- water reuse of WWTP;
- biowaste treatment to biogas and fertilisers;

2.3. Bioclimatic city and urban planning

The geometry and location of buildings, city roads and public open space, the use of inappropriate materials on surfaces, the lack of greenery, human activities and land use, determine the energy behavior of an urban area and are responsible for the phenomenon of thermal islanding and reducing wind flow – reasons for rising temperatures within urban areas during the day and night and increasing energy consumption. A key policy objective is the implementation of bioclimatic planning (urban planning and architecture) with the aim of harmonizing building volumes, roads, public space and other areas of urban areas with the environment and the local climate with direct results in energy saving and at the same time in improving the urban environment and quality of life.

The accelerated and uncontrolled urbanization phenomena experienced in the past decades has often created fragmentation and deterioration of the quality of the urban environment. Cities are increasingly reconsidering the current settlement models in favour of solutions based on the re-use, recycling and development of innovative and creative communities. As the available land is often scarce in cities and the urban sprawl is burdensome and costly, re-using existing buildings emerges as an alternative. Promoting re-use practices will help to ensure more sustainable urbanisation, with multiple benefits not only for managing authorities, but also for all citizens. Most of the resources we use are still there, in our cities. Buildings, open spaces, parks and roads all represent a huge amount of used resources. As citizens, we are responsible for the best possible use of these resources. Experiences from cities all over Europe clearly show that there are alternatives to demolition and new construction. Re-use of existing properties is possible and, in many cases, better from both a resource and a human perspective. Circular re-use of spaces and buildings opens up scenarios and challenges for regeneration that need to be managed in an integrated manner by administrators, companies, associations, and citizens. Nowadays, many cities around the world grow in size and consume more and more natural and agricultural land. When the urban sprawl takes over, we are left with long commutes, pollution, poor access to services and a degrading sense of community. Sometimes, the space we need for these new developments is already there - in the city. Under-used urban land is a potential still to be explored in order to build more compact and liveable cities. But reusing abandoned buildings and spaces is not only about fighting urban sprawl. It is about re-thinking cities and mobilizing urban innovation, it is about inclusion, participation and co-creation of shared

urban space, and it is also about money.

Land is not infinite; thus, we must learn how to use this resource in a more responsible and sustainable way. Examples from this guidebook will hopefully contribute to adopting new approaches and finding new solutions by utilizing under-used spaces.

3. Land use planning as a lever for sustainable environmental transitions

Good land management is buttressed by a spectrum of commitments aimed to holistically address issues at the levels of environment, community, government, business, and economy. These interdependent spheres can collectively contribute to well-managed lands, in order to deal with: climate adaptation and mitigation; biodiversity; reconversion of contaminated land; water/drought; smart cities; resilience.

Three examples to be used as good practices:

3.1. Science-based environmental policies

Since November 2017, the partners of the Interreg 2 Seas [project PROWATER](#) have worked together on Nature-based Solutions targeted at increased infiltration and retention of rainwater in partner regions landscapes. Read more about the results of the projects in project's [Output Library](#). [Visit the demonstration sites](#) where showcased how regions can adapt to climate change through Ecosystem-based Adaptation measures¹⁰.

Figure 2. Interreg 2 Seas PROWATER project



¹⁰ Presented in the Conference 'Find your EU funding programme for the Environment', on 24 March 2023 (Module 2: Land use planning) organised by European Commission (DG Environment) in cooperation with the Belgium authorities from the Flanders Region Vlaanderen is ruimte;Ricardo,Trinomics OIR

3.2. Crop on Top Agrotopia (Flanders)¹¹.

Europe’s largest rooftop greenhouse, for research and demonstration. Total investment EUR 11 million, of which EUR 900,000 through ERDF. Other support from the Flemish Region, Province of West-Vlaanderen and private sector.

Figure 3. Top Agrotopia project (Flanders)



3.3 Sustainable & Circular Reuse of spaces & buildings Handbook¹²

The book intends to serve as a stimulus and an incentive for strategic planning at the urban level carried out by public authorities, but also supported by the regional and national level. With a wide review and analysis of good practices of urban re-use offered by the handbook, cities may learn about the different solutions that can be adopted, taking into account their specific urban features. The approach could be bottom-up or top-down, adopting different models of governance for the management of specific situations. More, involving the media in the communication and, in particular, in the storytelling of the regeneration process of unused spaces and buildings is the first step in making citizens an active part of change. Informing citizens on the decision-making process is crucial to sensitise them and to promote re-use and regeneration as keystones for urban development. The Urban Agenda partnerships on the Circular economy and on the Sustainable use of land and nature-based solutions decided to work together because the re-use of abandoned or underused

¹¹ Ibid.

¹² Published in 2019 ([Urban Agenda – Circular Economy Partnership](#))

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buildings and spaces emerged as a relevant topic for both partnerships. For this reason, they agreed in making joint efforts to develop a shared handbook merging the different perspectives.

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