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**The Circular Economy
Model: from the Building
Functional Reuse
to the Urban System
Regeneration**



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PLANNING THE CIRCULAR CITY: FOCUS ON BUILDINGS' ENVIRONMENTAL IMPACT

Gillian Foster

Abstract

Circular City initiatives to implement circular economy goals are expanding in Europe. This article provides the nascent Circular City movement with a rationale and motivation to target existing buildings and cultural heritage buildings. The article argues that Circular City initiatives should aim to achieve low-carbon development; less construction and demolition wastes; improving energy efficiency; and improving resource efficiency in the buildings sector in line with European Union policy goals.

Keywords: Circular City, buildings, historic buildings, environment, Europe

PIANIFICARE LA CITTÀ CIRCOLARE: UN APPROFONDIMENTO SULL'IMPATTO AMBIENTALE DEGLI EDIFICI

Sommario

Le iniziative per la città circolare si stanno espandendo in Europa per realizzare gli obiettivi dell'economia circolare in ambito urbano. Questo articolo esplora come e perché il nascente movimento per la città circolare dovrebbe includere in maniera centrale il patrimonio culturale e gli edifici esistenti. L'articolo sostiene che le iniziative per la città circolare dovrebbero mirare a raggiungere uno sviluppo a basse emissioni di carbonio, a ridurre i rifiuti di costruzione e demolizione, a migliorare l'efficienza energetica e a migliorare l'efficienza delle risorse nel settore edilizio, in linea con gli obiettivi delle politiche europee.

Parole chiave: Città Circolare, edifici, edifici storici, ambiente, Europa

1. Circular City initiatives in Europe

Circular City initiatives in Europe are becoming increasingly popular. For example, Amsterdam, Paris, Berlin, and Brussels region started their Circular City initiatives in the last five years. Other European cities, including Vienna, are planning Circular City initiatives. New York and Hong Kong are now using the Circular City concept as an organizing principle for policy and planning. Although the Circular City movement is certainly not limited to Europe, this article focuses on European cities. This focus is motivated by the broad policy support generated by the European Union's (EU) Circular Economy Strategy announced in 2015 and the EU Green Deal announced in 2019, which reiterated a circular economy direction. The EU recently announced its new "Circular Economy Action Plan for a cleaner and more competitive Europe" in March 2020. The new plan clarifies that the construction and buildings sector is a "key product value chain" that "requires urgent, comprehensive and coordinated actions" (European Commission, 2020). Further, the European Investment Bank provides new resources to support Circular City initiatives (European Investment Bank, 2020). EU policy and assistance has clearly turned towards implementing circular economy.

Given the prevailing policy encouragement, many European city managers are beginning to build Circular City initiatives. They are asking, "Where should we start?". Therefore, this article comments on this timely question by making the case that European Circular City initiatives should place buildings at the top of their Circular City agendas, particularly existing and cultural heritage buildings.

A circular economy approach to buildings is critically important to achieving the main goal of circularity, which is reducing the amount of natural resources and energy that humans use. The circular economy is not only about using less and recovering more, it also includes choosing sustainable low-carbon materials for construction, sharing spaces, and operating buildings in a low-carbon and resource efficient way. These are a few examples of how a circular perspective rethinks the ways in which we create buildings to provide shelter, health, and well-being today.

The rest of the article continues thusly. Section 2 justifies a Circular City focus on buildings' environmental impacts. Section 3 describes the opportunities for environmental improvements that a circular economy approach may attain from existing and cultural heritage buildings. Section 4 concludes.

2. Circular city initiatives: motivations to focus on buildings

Circular city initiatives should focus first on buildings because the circular economy model, urban development, and buildings are inextricably linked. The link is defined and driven by three simple facts of human settlements today: urbanization is increasing, resulting in intense unsustainable resource consumption; governance of urban environments reflects changing societal values toward the environment and sustainability; and buildings create urban form and function. A brief overview of these drivers follows.

1. Urbanization is increasing, resulting in intense unsustainable resource consumption. The majority of humanity, roughly 55%, primarily live in urban settings today (United Nations, 2018). Urbanization trends show that an increasing proportion of the human population will live in urban environments, two-thirds by 2050 (United Nations, 2018). Cities are centers of human consumption of natural resources and generators of wastes. The export and import (flows) of materials and energy between the outside and inside of

city boundaries is reminiscent of Europe's medieval walled settlements. The agricultural fields remained outside the walls, but the storehouses were inside where people traded and consumed them. For the most part, this pattern remains today. "Urban areas currently account for 60-80% of global energy consumption, 75% of carbon emissions, and more than 75% of the world's natural resource consumption" (UNEP, 2013). These statistics clearly show that the majority of consumption takes place in cities. If cities continue to grow in traditional ways in order to accommodate an increasing urbanized population, more resources, far beyond the earth's carrying capacity will be consumed;

2. Governance of urban environments reflects changing societal values toward the environment and sustainability. The urban environment is constructed by local communities through multiple governance structures ranging from individual building permits to master plans. Public governance tends to follow current political and policy discourse. Prevailing and changing social values are taken up in the discourse and implemented through public governance. The autumn 2019 Eurobarometer report states that European communities recognize climate change as a top issue (second place behind immigration) (European Commission, 2019a). Additionally, two other issues related to buildings, health and social security are ranked before environment, climate change and energy in the national level Eurobarometer results (European Commission, 2019a). Consequently, one may infer that European communities have an interest in their local governments pursuing environmental/sustainability outcomes, for example with Circular City initiatives.

The circular economy concept is often presented as a potential solution to some of Europeans' most pressing concerns, climate change, the environment, and energy issues, in general and specifically for cities. Notwithstanding relevant criticisms of the concept, (Korhonen *et al.*, 2018; Giampietro, 2019), the perspective of circular economy as a way to achieve sustainability has entered the political and policy discourse through research, advocacy, and funding. A few recent examples of this phenomenon are:

- The Ellen MacArthur Foundation's work to inspire circular economy policies in cities including the 2017 report *Cities in the Circular Economy: An initial exploration* (Ellen MacArthur Foundation, 2017).
- The European Union's (EU) Circular Economy Strategy announced in 2015, *Closing the loop – An EU action plan for the circular economy* (European Commission, 2015).

The action plan states, "The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy".

- The January 2020 launch of the European Investment Bank commissioned, *Circular City Funding Guide* (European Investment Bank, 2019).
- The new European Green Deal highlights building renovation. It states that the EU should "engage in a 'renovation wave' of public and private buildings" in order to improve energy and resource efficiency such that new and renovated buildings at all stages [are] in line with the needs of the circular economy" (European Commission, 2019b).

The Circular City movement is a new governance form that reflects today's European values and concerns. Namely, the desire to be sustainable by addressing climate change, and reduce natural resources and energy use. The concerted policy, advocacy, and funding

efforts have raised the profile of circular economy as a potentially effective governance strategy to achieve sustainability.

3. Buildings create urban form and function. Buildings are the defining feature of all urban communities. Their styles, placement, and cultural connection through design and use are what makes the city. Buildings concentrate human activity and human consumption. Buildings generate 30% of all greenhouse gases around the globe and the construction industry is the largest consumer of natural resources (World Economic Forum, 2016). In addition, the design of buildings for human shelter, health and well-being determine other critical urban infrastructure such as water supply, waste management, and public transportation.

In summary, each unique urban tapestry, created by buildings, is and will continue to be, a large share of the human ecological footprint. The Circular City challenge is to reduce the human ecological footprint; therefore, a focus on buildings is crucial.

3. European Circular City initiatives: opportunities in the buildings sector focusing on existing and cultural heritage buildings

Having established why European Circular City initiatives should focus on buildings above, this section discusses the opportunities in the buildings sector, focusing on existing and cultural heritage buildings. New construction is beyond the scope of the current article; however, the concepts discussed also apply to new construction. There are numerous circular economy strategies to reduce environmental impacts of individual existing building rehabilitations, including cultural heritage buildings (Foster, 2020). These occur at the micro-level and can mirror Circular City targets at the meso city-level. Certainly, opportunities span the range of sustainable community revitalization; but this article focuses only on the major environmental improvements possible due to rethinking buildings in a Circular City approach.

The four major environmental impacts of buildings that Circular City initiatives should target are:

- Low-carbon development;
- Less construction and demolition wastes;
- Improving energy efficiency; and
- Improving resource efficiency.

3.1. Low-carbon development

As noted, one of the biggest environmental impacts of buildings is greenhouse gas emissions. Therefore, decarbonization of the building sector is a core goal of national and city plans to meet policy goals such as the Paris Agreement to limit global warming to 1.5° above pre-industrial levels. Decarbonization starts with buildings' embodied carbon. Embodied carbon represents the energy used to provide for: the extraction and conversion of materials; transport to the building site; and construction into the building we see today. For example, according to the Inventory of Carbon and Energy Database, a standard Portland cement has average of Embodied Carbon (kgCO₂e/kg), a general concrete averages 0.103 (kgCO₂e/kg), and aluminium 6.67 (kgCO₂e/kg) (Circular Ecology, 2019). By reusing building components and parts, replacing the materials is not necessary; therefore, the embodied carbon is saved. One could think of this as the "replacement cost". Another way to look at embodied carbon savings is to examine the embodied carbon of

various building materials. Then chose the lowest embodied carbon materials that meet desired functions when designing a building. One could think of this as a “cost comparison” of materials. Retaining buildings and building materials and selecting low-carbon materials reduces the overall “carbon cost” of an adaptively reused building, thereby promoting low-carbon development in a Circular City framework.

3.2. Less construction and demolition (C&D) wastes

Reducing construction waste is a common goal of many cities. In Europe, C&D waste is the largest waste category. It is between 25 and 30 percent of all waste (European Commission, 2019c). Managing large quantities of heavy waste is expensive and many cities find landfilling it challenging. This is the reason why the EU targets reducing C&D wastes in its Circular Economy Strategy and the 2018 EU Construction and Demolition Waste Protocol and Guidelines. Recycling of materials is encouraged by promoting improvements to, for example: Waste identification/separation and collection; logistics; and processing (European Commission, 2018). A Circular City project can support the development of companies and jobs that make carrying out the mentioned improvements. In addition, a Circular City project can explicitly link the disposal & reuse phase of a buildings’ lifecycle to the materials sourcing and construction phases of other buildings.

3.3. Improving energy efficiency

An Adaptive Reuse of a Cultural Heritage building (ARCH) is an opportunity to upgrade the efficiency of windows, cooling and heating systems, insulation, roofing building envelopes, etc. These upgrades will make the building’s use of energy more efficient in its operations phase. Roughly two-thirds of residential energy consumption is for space and water heating/cooling. There is a dire need to increase building’s energy efficiency in general because there is currently an upward not downward trend in building’s energy use. According to the International Energy Agency (IEA), in 2018 buildings emitted 9.6 gigatons of CO₂, which is an increase of 1.9 Gigatons since 2000 (IEA, 2019). A Circular City perspective recognizes that increasing energy efficiency is not limited to new construction. By saving embodied energy of an ARCH and improving energy efficiency during use with upgrades to major systems mentioned above, the lifetime energy efficiency of an existing building may rival new construction. “Deep renovations” can reduce consumption by 30 – 50 percent (IEA and UNEP, 2019). Significant energy efficiency gains leading to reductions in energy consumption can be targeted by a Circular City approach through organizing financing for energy efficiency investments including credits to utility bills. In addition, a Circular City may implement municipal procurement focused on existing and cultural heritage buildings.

3.4. Improving resource efficiency

Stated simply, resource efficiency is “doing more with less”. Meeting the growing human need for shelter (“doing more”) with “less” construction materials and energy. For example, “Relevant materials for the construction sector are: the metals iron, aluminium, copper, nickel, zinc and lead; the construction materials clay, sand and gravel, limestone, wood, and building stone” (de Koning *et al.*, 2013). Additionally, reducing fresh water consumption is also important. In the building sector, circular economy strategies that influence resource efficiency are carried out at different stages of the building life cycle and at various scales.

For example, ARCH itself and the Design for Disassembly strategy at the design phase ultimately reduces material extraction (Foster, 2020). This can be done at the scale of a whole building and city. At the social / behavioural level, improving resource are achieved at a micro scale during the operation phase, including through multiple uses of space, reducing floor space for residences, reducing water consumption, or sharing communal services such as laundries or outdoor recreation areas. Circular Cities can promote structural changes that improve resource efficiency at the building and city scale and social / behavioural adaptations at the micro scale (UNEP, 2013).

4. Conclusions

In conclusion, existing and historic buildings must be at the top of Europe's Circular City agendas. This article describes the motivations and justification for cities implementing or considering Circular City initiatives to focus on buildings. Circular City initiatives are a new and growing form of municipal governance. As European cities plan to reduce their overall environmental footprints, emphasizing buildings is important because they are at the crossroads of urbanization, unsustainable resource consumption, and changing societal values towards sustainability.

Buildings, particularly cultural heritage buildings, define the spatial footprint, cultural footprint, and environmental footprint of the city. Fortunately, there are many opportunities for implementing circular strategies through municipal governance as noted in this article. Adaptively reusing cultural heritage buildings is an opportunity to showcase circular economy policies that must not be missed. Circular Cities should aim to achieve low-carbon development, less construction and demolition wastes, improving energy efficiency, and improving resource efficiency in the buildings sector in line with European Union policy goals. There simply is no chance of successfully planning and governing a European Circular City without addressing existing and historic buildings.

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References

- Circular Ecology (2019), *Embodied Carbon - The ICE Database*, <https://circularecology.com/embodied-carbon-footprint-database.html#.XnyluHsxmCg>.
- de Koning, A., Eisenmenger, N., van der Voet, E. (2013), *Topical Paper 1: Resource efficiency in the built environment-a broad-brushed, top-down assessment of priorities Scenarios and Options towards a Resource*, European Commission, Brussels.
- Ellen MacArthur Foundation (2017), *Cities in the Circular Economy: an initial exploration*, London, UK.
- European Commission (2015), *Closing the loop - An EU action plan for the Circular Economy*. COM(2015) 614 final. European Commission, Brussels.
- European Commission (2019a), *Standard Eurobarometer 92 Autumn 2019 First results: Public opinion in the European Union*, <https://ec.europa.eu/commfrontoffice/publicopinion>.

- European Commission (2019b), *A European Green Deal. Striving to be the first climate-neutral continent*, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.
- European Commission (2019c), *Construction and Demolition Waste (CDW)*, https://ec.europa.eu/environment/waste/construction_demolition.htm.
- European Commission (2020), *A new Circular Economy Action Plan for a cleaner and more competitive Europe*. COM(2020) 98 final. European Commission, Brussels.
- European Commission, (2018), *EU construction and demolition waste protocol and guidelines*, https://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en.
- European Investment Bank (2020), *The EIB Circular Economy Guide - Supporting the circular transition*, 32, European Investment Bank, Luxembourg.
- European Investment Bank (European Investment Bank) (2019), *Circular City Funding Guide*, <https://www.circularcityfundingguide.eu>.
- Foster, G. (2020), "Circular economy strategies for adaptive reuse of cultural heritage buildings to reduce environmental impacts", *Resources, Conservation and Recycling*, Vol. 152, n. 104507, pp. 1-14.
- Giampietro, M. (2019), "On the circular bioeconomy and decoupling: implications for sustainable growth", *Ecological economics*, Vol. 162, pp.143-156.
- IEA (2019), *Global Status Report for Buildings and Construction 2019. Towards a zero-emissions, efficient and resilient buildings and construction sector*, <https://www.iea.org>.
- IEA (International Energy Agency), UNEP (United Nations Environmental Program) (2019), *Global Status Report for Buildings and Construction: Towards a Zero-Emissions, Efficient and Resilient Buildings and Construction Sector*, Geneva, Switzerland.
- Korhonen, J., Honkasalo, A., Seppälä, J. (2018), "Circular Economy: The Concept and its Limitations", *Ecological Economics*, Vol. 143, pp. 37-46.
- UNEP (2013), *City-Level Decoupling: Urban resource flows and the governance of infrastructure transitions. A Report of the Working Group on Cities of the International Resource Panel*, Nairobi, Kenya.
- United Nations Population Division (2018), *World Urbanization Prospects: The 2018 Revision, Online Edition*, United Nations, Geneva, Switzerland.
- World Economic Forum (2016), *Shaping the Future of Construction A Breakthrough in Mindset and Technology*, Geneva, Switzerland.

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