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## “Circular models for the city’s complexity”

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### Introduction

The Circular Economy (CE) approach has been conceptualized in 114 definitions collected and analyzed by Kirchherr, Reike and Hekkert (Kirchherr et alii, 2017) and has been massively used for promoting productive initiatives based on sustainable supply chains and cooperative logistics (Ghisellini et alii, 2016). In several scientific papers the CE has been described as a “regenerative” model based on the reduction of wastes and the optimization in the use (and reuse) of natural resources. The experiences of early CE applications show that cooperative models are key to success, since they are able to create the necessary linkages and synergies to “close loops” and create new value from economic, social, cultural and environmental resources.

In the last two decades literature in the field addresses circular economy as a new business model able to encourage a transition toward a more sustainable development and a more wise and harmonious society. It has been seen as a strategy for achieving the sustainability objectives by integrating its environmental, social and economic dimensions (Pierce and Turner, 1989; Ellen MacArthur Foundation, 2013). Nevertheless, despite the flourishing of literature, industrial practices and policy-making processes in which the circular and sustainable models are intermingled, the similarities and differences between both concepts remain ambiguous (Geissdoerfer et alii, 2017).

The UN Agencies Reports, the EU documents as well as several researches developed by international bodies and foundations – since the UN Agenda 21 subscribed in Rio in 1992 – encourage to cope with environmental problems such as biodiversity loss, pollutions, resources depletions, land abuse and excessive waste production. The activities that are increasingly jeopardizing the environmental equilibria of the planet are progressively depriving the majority of the

world’s population – not only in the Global South – in terms of cultural, economic and social imbalances between the few rich and the most under the poverty threshold. Dealing with these inequalities represents one of the main societal challenges. According to literature and policies worldwide, one of the most accredited answers to this challenge is the circular economy model which dates back to the early 90s as reaction to the linear and open-ended characteristics of the production-consumption economic model (Pierce and Turner, 1989).

The origins of the model are mainly rooted in ecological and environmental economics and industrial ecology, aimed at implementing greener economy and regenerative eco-industrial development (Ghisellini et alii, 2016: 12). This loop economy with an industrial matrix oriented at waste prevention, regional job creation, resources efficiency, dematerialization as well as selling instead of ownership of services and goods for production aims at reducing environmental externalities and social risks without additional costs (Geissdoerfer et alii, 2017). Since the dawn of the new millennium, the understanding of the CE model evolved to incorporate different concepts, such as cradle-to-cradle closed loop (McDonough and Braungart, 2002), regenerative design (Lyle, 1994), industrial ecology (Graedel and Allenby, 1995) and the most popular definition by the Ellen MacArthur Foundation: “an industrial economy that is restorative or regenerative by intention and design” (2013: 14).

This means that the new model requires not only the implementation of green technologies and innovative employment solutions but mainly it refers to the re-design of the entire life cycle of the productive processes in which waste and resources are strictly intermingled. The core of this model is the circular (closed) flow of raw materials and energy managed by “slowing, closing, and narrowing resource loops” (Bocken et alii, 2016: 309). This approach has been consolidated in the sectors of waste management policies, industrial symbiosis, eco-industrial systems, zero-waste clusters and other networks of collaborative consumption (Geissdoerfer et alii, 2017). The new frontier of this model is to transfer the closed loop of materials and energy flows to territorial systems as a whole, at micro, meso and macro

scales. Cooperating and sharing resources, raw materials and strategies for reducing waste and dispersals need to be developed not only within industrial clusters, but referring to the regeneration of the built environment and the community empowerment.

Within this framework, the CLIC project - Circular models Leveraging Investments in Cultural Heritage adaptive re-use, funded within the European Research and Innovation programme Horizon 2020 and led by CNR IRISS, aims at developing and testing innovative circular governance models for the adaptive reuse of abandoned and underused cultural heritage.

This paper investigates “circular models” to be adapted to the city in order to connect the complexity of the city with its several dimensions (social, human, cultural, political and entrepreneurial) – an issue still open to the international debate.

### **Circular economy implementation at territorial level**

What is a circular city? Can urban planning and management implement a CE model? In which way a circular city model can be conceptualized? What is the role played by the CE model within an urban regeneration process? The above open questions have guided the first phase of the ongoing research project CLIC we are reporting in this paper.

The term CE has both a linguistic – as antonym of a linear economy – and a descriptive meaning which relates to the concepts of biochemical cycles and to the idea of recycling and regenerating (Murray et alii, 2017). The research focuses on both the meanings: defining a circular business model as well as slowing and managing cycles in order to stimulate the re-generation.

The climate change and its impacts on the environmental vulnerabilities, the increasing inequalities, the gentrification and its discontents are the challenges of the urban contradictions (Florida, 2017) and the recent urban Agendas, depicting the city of the future, try to merge the sustainable development goals and the CE principia. Given these issues, the CE more suitable definition could be “an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed as both process and output, to maximize ecosystem functioning and human well-being”

(Murray et alii, 2017: 377). In this way, CE can be considered a “workable socio-technical approach” for attaining economic, social and environmental transition to sustainability (de Jesus, Mendonca, 2018). Nevertheless it remains a rather underspecified notion to be investigated at governance level in order to assess driver and barriers.

The UN 2030 Agenda for Sustainable Development and Sustainable Development Goals (2015) encourages the developing of national-level urban policies for dealing with the challenges of the rapid urbanization and the climate change issues. The New Urban Agenda, adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016, promotes measures for cleaner, green, safe and equal cities by encouraging the transition to a circular economy (§71) while facilitating “ecosystem conservation, regeneration, restoration and resilience in the face of new and emerging challenges”. While in China the Circular Economy Promotion Law has been “formulated for the purpose of facilitating circular economy, raising resources utilization efficiency, protecting and improving the environment and realizing sustainable development” (CCICED, 2008: art. 1) in order to deal with the increasing environmental issues related to the industrial growth, in Europe CE is considered mainly the toolbox for creating job opportunities and pushing economic development.

At EU level, the Circular Economy Partnership aims to stimulate the re-use, repair, refurbishment and recycling of existing materials and products to promote new growth and job opportunities, by focusing on waste management (turning waste into resources), sharing economy and resource efficiency, in order to develop an Urban Agenda for the EU (EEA, 2016; Partnership Circular Economy, 2018). The main aim of the European Commission is “the transition to a more CE, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized” (European Commission, 2015).

In line with the transfer of this production approach to the planning and management of urban areas, the European Green Capital Award has been established. In this context, the selection of a city awarded with the title of European Green Capital is assessed on the

basis of twelve environmental indicators: Climate Change: Mitigation, Climate Change: Adaptation, Sustainable Urban Mobility, Sustainable Land Use, Nature and Biodiversity, Air Quality, Noise, Waste, Water, Green Growth and Eco-innovation, Energy Performance, Governance.

Following a similar approach, based on concrete local and regional examples, ESPON, Interact, Interreg Europe and URBACT have produced a policy brief outlining pathways to a CE in cities and regions. The policy brief has been presented at the joint workshop “Pathways to a circular economy in cities and regions” during the European Week of Regions and Cities in Brussels on 12 October 2016 (ESPON, Interact, Interreg Europe and URBACT, 2016). The document states that “moving from a linear to a more circular economy calls for new business models, new modes of consumer behavior and new solutions for turning waste into resources”. According to this, cities and regions are encouraged to work with other stakeholders to promote sustainable sourcing of raw materials and different modes of resource circulation, such as industrial symbiosis, chemical leasing or remanufacturing. They are also involved in influencing consumption patterns of households, businesses and organizations, enhancing education and awareness campaigns, promoting sharing economy approaches, as well as encouraging reuse and repair. Maximizing the benefits of a CE at urban level is challenging, since the process involves players from the private sectors, everyday consumers and cities and regions.

As introduced in the first section, in the last two decades, the concept of CE has been associated to multiple models such as: the closed-loop economy, the industrial symbiosis, the industrial synergies, the industrial eco-parks, the natural capitalism, the cradle-to-cradle, the zero waste movement, the functional service economy (Murray et alii, 2017). It has also been included within experiences of smart specialization strategies (S3) developed throughout Europe involving high tech industries, innovative supply chains, community-led initiatives and rural-urban linkages. While applying the model at macro level, in cities, metropolitan areas and regions, CE development involves the re-design and integration of four systems: the industrial system, the infrastructure system delivering

services, the cultural framework and the social system (Ghisellini et alii, 2016). In order to understand how these systems are related and in which way these relationships could generate a circular city model, a qualitative fieldwork is needed:

- at macro-level – by addressing urban and regional policies and financial resources within regional and metropolitan strategic plans as well as rural-urban linkages
  - at meso-level – by understanding relationships between public and private players and local planning trends
  - at micro-level – by focusing on built environment, cultural heritage and place-based civic initiatives and social economics.
- Considering these premises, the urban-regional circularity can be seen as result of the combination of the following actions: reduction of land consumption; reusing the built environment; sharing spaces and places by combining function; ensuring longer life to the existing assets; retrofitting the built environment; re-creating shared tangible and intangible values; and activating a durable and self-maintained regeneration process. Nevertheless, prevailing discourses in literature, policies and practices are business oriented and the spatial and social aspects need to be further investigated. When it comes to the definition of circular city-region, substantial confusion emerges.

### Circular city experiences

The lack of conceptualizations regarding the notion of urban circularity, as well as of comparable circularity interpretations by cities, invites at collecting, interpreting and categorizing experiences of circular city. Khan and Zaman (2018), trying to shape future cities by critically examining the existing urban notions, include within the circular city model categories such as Age-friendly city, Compact city, Creative city, Eco-city, Global city, Liveable city, Low-to-Zero Carbon city, Regenerative city, Resilient city, Sharing city, Smart city, Zero Waste city. In this section, the paper focuses on different experiences included in two main categories: the self-defined circular city and the spontaneous circular city. Within the first group are included experiences in which policies, strategies and planning have been officially oriented at achieving a circular dimension of the city or the region. The second group includes ex-

periences in which the drivers of a circular approach have been performed in an indirect way, without explicitly referring to CE.

#### *Examples of circular regions and cities*

The Basque Government has integrated the CE in its strategic documents, including the Basque Country Energy Strategy 2030, the Environmental Framework Programme 2020, the EcoEuskadi Strategy 2020, the Eco-efficiency Programme, as well as the Waste Prevention and Management Plan 2020. The transition towards a green resource-efficient economy have been listed as key priorities under Priority Axis 6 of the Basque Country Operational Programme, with the following measures planned: Partnerships leading to the integration of more environmentally efficient processes in the strategies of companies; Support in the development of projects focusing on the development and demonstration of new, more efficient technologies, methods and processes; Investment support to companies and industries for more efficient industrial approaches. The S3 strategy of the Basque Country which identifies three spearhead sectors (Advanced Manufacturing, Biosciences and Energy) also shows close links to the CE (EVE, 2016).

A similar approach has been followed within the Brussels Regional Programme for a CE (BPRCE, 2016). The BPRCE is an integrated strategy started as bottom-up initiative involving several public and private stakeholders (multi-stakeholder programme) through an innovative co-creation process. After several seminars, working groups and public meetings, the BRPCE was adopted in March 2016. Currently 74 measures have already started, while 37 have begun the first discussions for developing action plans. A revision mechanism will take place every 18 months, to challenge the results, amend some measures and involve more public and private stakeholders. The players involved are 3 regional ministries, 15 public administrations, regional advisory committees and almost 60 NGOs and private businesses. In order to achieve the three general goals: to transform environmental objectives into economic opportunities; to anchor economic activities within Brussels' borders, maximizing resource circularity and boosting entrepreneurship; to create new employment opportunities, four areas of action have been

established. The first one is cross-functional: creating a favorable regulatory framework; the second is sector-based: dedicated to construction, resources and waste logistics, trade and food; the third one is territorial (integrate the CE at the local level), and the last one is related to the governance framework: support the programme by strengthening coordination between authorities.

The London Waste and Recycling Board (LWARB, 2007) is the lead facilitator of CE activity in London, not just through collaboration but by developing and investing in CE business in London. In June 2017, LWARB published the Circular Economy route map for London, which was created with stakeholders from across different sectors, to set a pathway for London to accelerate its transition towards a CE. It is based on analysis of economic impacts and residual waste streams within the city within five key sectors: the built environment, food, electricals, textiles and plastics. Besides the cooperation between stakeholders, other areas where London needs to focus were identified through eight crosscutting themes highlighted in the route map – communications, collaboration, finance, demonstration, innovation, policy, procurement and business support. One of the challenges facing London is to provide access to the housing, business premises and infrastructure that the capital's residents and workers require – but in an efficient and sustainable way. This can be substantially helped by adopting a CE approach to the built environment in London.

In 2015 Amsterdam commissioned an in-depth study on the potential of a CE. In Amsterdam, two value chains are very important: the building and construction sector and the organic and biomass industry. Amsterdam is perceived as a front-runner. This attracts companies and start-ups, which consider the city as a living lab to experiment and expand their business. Amsterdam is trying to adapt to a CE by forging new business models shifting from products to services and creating new legal and financial instruments. The city had to overcome traditional barriers in administration and think about new forms of cooperation, such as cross-sector thinking and multidisciplinary working.

It was crucial for Amsterdam to involve citizens in this transition. As consumers, they

are drivers of change, along with the private sector. One of the city's main challenges has been to translate the concept of CE into the daily lives of citizens.

The General Assembly on the Circular Economy of Greater Paris was launched in 2015 co-organized by local governments. Its purpose was to bring together a wide spectrum of players (government authorities, business, associations, NGOs, academia, research, etc.) to work on tackling the CE's challenges for the Greater Paris Metropolis. A model that is based on sharing rather than profit, collective intelligence rather than individual competition, recovery rather than waste: this is what Paris seeks in the CE. The drivers are multi-stakeholder approach, political vision and leadership, stakeholders commitment and pro-active role and the perspective is the implementation of the 65 proposals of the White Paper on the Circular Economy of Greater Paris.

An interesting indirect experience is the Sustainable public procurement for cradle-to-cradle design in Venlo City Hall (The Netherlands). The Cradle-to-Cradle (C2C) framework seeks to create production techniques that are not just efficient, but are essentially waste-free. In cradle-to-cradle production, all material inputs and outputs are seen either as technical or biological nutrients. Technical nutrients can be recycled or reused with no loss of quality and biological nutrients composted or consumed. The Municipality of Venlo used C2C principles in the design and procurement of the new Venlo City Hall. The bidders were requested to take into account the use of appropriate, safe and healthy materials that can be recycled

after their lifetime, the enhancement of air and climate quality, the production and use of only renewable energy and the enhancement of water quality (INTERREG IVC Cradle to Cradle Network project).

A quite different experience is represented by the United Arab Emirates Masdar City construction, which was the world's first "zero waste, zero carbon and fossil fuel free" city, started in 2008. Abu Dhabi's renewable energy company developed Masdar City aiming to diversify its economy beyond oil. Masdar, meaning 'resource' in Arab, is located in the desert at about 17km from Abu Dhabi. As reported by Marin and De Meulder (2018), "the city design reflects the precepts of the CE, in which industrial networks are designed to mimic the cyclical behavior of natural ecosystems (Veolia, 2008)". The city is designed by the architects' team, led by Norman Foster, as a pedestrian area, and the energy efficiency is obtained through a combination of high-end technology and vernacular building methods. The design is inspired by traditional settlement typologies, working with natural ventilation towers, shade, water features, and green spaces for cooling. "Masdar desalitates sea water and reuses waste materials and resources maximally, such as wastewater for the landscape maintenance". "At Masdar City's core lies a knowledge institute for sustainability, with a special economic zone to attract green companies and clean tech businesses". "Today, the aims of Masdar City as a model of sustainable living have been partially abandoned. Only 300 people effectively live in the city that has only been completed for 5% of the original plan. The autonomous vehicle system was abandoned

after two of the planned hundred stops were built because new automotive technologies made it obsolete. Bike sharing systems were put in place, but are underused because of the absence of bicycle paths between Masdar City and Abu Dhabi" (Marin, De Meulder, 2018).

## Conclusions and ways forward

Circular economy principia may have a different aspect in cities and regions, depending on geographic, environmental, economic or social factors. The industrial profile of a city or region, service and resource-intensive sectors, accessibility, sharing economy, large concentrations of inhabitants could play a role in facilitating or challenging circularity goals. The diversity of territorial contexts translates into different needs and opportunities to be addressed by circular economic approaches. Regarding this aspect, "the transition towards a CE can take valuable lessons from the efforts made by regions and cities to make the economy greener" (ESPON, Interact, Interreg Europe and URBACT, 2016). The green economic performance of a region could provide more insight on what a shift towards a CE might imply as well as of the needs for encouraging the transition to a CE. "Since a CE may look different in every region depending on local needs and resources, copy-pasting solutions from elsewhere will not be effective. Every city or region should start with their own challenges to determine what the transition towards CE could look like. A good way to start is with small, experimental projects that can then be scaled up and translated into policy" (ESPON, Interact, Interreg Europe and URBACT, 2016).



Figura 1 – Circular action plans in London, Brussels and Paris

Nevertheless, going through literature, policies and practices, is possible to undertake drivers to be tested during the research fieldwork. Among the others, is possible to recognize as driver the possibility of:

- working closely together with the private sector and research institutes;
- involving the entire city administration from the very beginning;
- using existing strategies, such as green procurements;
- developing multi-stakeholder approach with pro-active role;
- encouraging bottom-up approach and co-creative and iterative process;
- sharing knowledge, resources, costs and opportunities;
- building community awareness and empowerment;
- cooperating for social innovation and social economics;
- closing the loops.

In this context, the reuse of abandoned historic buildings and areas as proposed in the Horizon 2020 CLIC project can be seen as a strategic area of interest for next “circular cities”, turning “urban wastes” into resources for sustainable, safe, inclusive and resilient cities (Fusco Girard and Gravagnuolo, 2017).

## Note

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