

# Guimarães: Circular Economy Towards a Sustainable City

By Carlos Ribeiro<sup>1</sup>, Dalila Sepúlveda<sup>2</sup>, Joana Carvalho<sup>3,4</sup>, Candida Vilarinho<sup>4</sup>, Jorge Cristino<sup>2</sup>, Isabel Loureiro<sup>5</sup>

## Abstract

Guimarães, is a medium size city located in the North of Portugal. Since 2015 a program was launched challenging the city to establish a roadmap for the sustainable development of the Territory. One of the goals was to develop a concept for Circular Economy based in our own city context and vision. A set of projects were established from waste valorization. Also to projects focused on promoting social affairs issues were developed having impact on citizens' quality of life. This paper aims to present the concept under the framework of Guimarães Circular Economy program presenting social, economic and environmental impacts.

*Keywords:* Circular Economy, Sustainability, holistic approach.

## 1. Introduction

In 2015, the European Commission established the Circular Economy Action Plan addressing issues on production, consumption and repair and manufacturing, waste management and secondary raw materials that are fed back into the economy. The framework under Circular Economy concept brought great opportunities for Research and Development projects as well as to other fields of our society. If the concept of Circular Economy is cross linked to Sustainability concept we easily understand that not only economy and environment are under analysis but also the social aspect should be taken into consideration.

Sustainability is about permanence depending on historical, cultural, environmental or religious attributes of a given city (Segheo, 2009). Also, “Smart” or innovative initiatives for improving cities’ energy efficiency, human living and environment, economy and governance can be included on this concept (Insch and Florek, 2008). When a city is establishing a roadmap towards sustainability, People should be the focus. Quality of life improvement and Health&Wellbeing normally are the goals to be achieved. Sustainability in its classic vision is a triangle based on Social, Environmental and Economic aspects of a given context (Zink, 2014). The way that this relation coevolves is dependent of several issues such as, people acceptance, governance, and innovation. Furthermore, sustainability requires a holistic approach meaning that planning should consider all the possible levels of the society its impacts and outcomes.

Circular economy model can be defined as “restructuring the industrial systems to support ecosystems through the adoption of methods to maximize the efficient use of resources by recycling and minimizing emissions and waste” (Ezzat, 2016). Furthermore,

<sup>1</sup>Laboratório da Paisagem, Guimarães

<sup>2</sup>Guimarães City Hall

<sup>3</sup>CVR- Centro para Valorização de Resíduos

<sup>4</sup>CT2M of University of Minho

<sup>5</sup>ALGORITMI Centre of University of Minho

circular economy is worldwide presented as a concept focused on material (Aeleneia et al., 2016). In order to respond to some issues and to overcome the technical difficulties identified in the implementation of a correct and comprehensive waste management, the European Commission recently outlined the new EU action plan for the circular economy and also the proposal to amend the Directive 2008/98/EC on waste management. It should also be noted that the proposed amendment to this Directive, forms an integral part of the circular economy action plan, as well as proposals for amendments to Directive 94/62/EC on packaging and packaging waste, Directive 1999/31/EC on the landfill of waste, Directive 2000/53/EC on end-of-life vehicles, Directive 2006/66/EC on batteries and accumulators and related waste and Directive 2012/19/EU on waste electrical and electronic equipment. The various proposals for amendments to Directives incorporated in the new EU action plan for the circular economy demonstrate their key and crucial role in defining a new global strategy to promote sustainable development, the adoption of sustainable consumption and production standards and the efficiency of resources, which can translate into economic, environmental and social benefits. Regarding to waste management, this new action plan clearly indicates that the transformation of waste into resources is crucial to increasing the efficiency of resources in order to close the cycle in a circular economy. Therefore, promoting innovation actions in recycling and reuse, limiting landfill and encouraging consumer behavior change will directly contribute to achieving significant benefits in terms of sustainable growth, job creation, greenhouse gases emission reductions, direct savings associated with better waste management practices and a better environment (McDougall et. al, 2008; ISWA, 2016).

The Report from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Region on the implementation of the Circular Economy Action Plan identifies several main Key deliveries developed in 2016. This main key deliveries includes recommendations for “Food Waste” prevention, that proposes guidelines for the developing of EU methodology to measure food waste and also EU guidelines to facilitate food donations and the use former foodstuff as feed. The Action Plan also proposes “legislation for fertilizers” made from secondary raw materials (in particular recovered nutrients), thereby turning waste management problems into economic opportunities. Proposed rules can make the fertilizers sector less dependent on imports of critical, primary raw materials such as phosphate, which can also be recovered from domestic waste. Circular Economy Action Plan also launch “Innovation Deals” aim at bringing together innovators, national/regional/local authorities, and Commission services to clarify perceived regulatory barriers to innovation in EU regulation or Member State implementing measures. “Ecodesign” is also recommended through the repair or recycle of a product. Following political discussions on ecodesign, the Commission confirmed the importance of smart product design and decided to focus efforts on the product groups with the highest potential in terms of energy and resource savings and further reinforce the evidence base for regulatory action. Ecodesign can also have an important contribution in creating a more circular economy. While ecodesign measures have so far mainly focused on energy efficiency, in this working plan, the Commission undertook to also explore more systematically the possibility to establish product requirements

relevant for the circular economy such as durability, reparability, upgradeability, design for disassembly, information, and ease of reuse and recycling. This will be undertaken both for new product groups and for reviews of existing product-specific measures, and will bring benefits throughout the value chain. “Waste-to-Energy” is also another topic included in the Circular Economy Action Plan and the main objective of this deliver is to ensure that the recovery of energy from waste supports the goals of Circular Economy. Also, the plan suggests directives on the restriction of the use of certain hazardous substances in electrical and electronic equipments, through the substitution of certain hazardous substances in electrical and electronic equipment, enhances the possibility and economic profitability of recycling waste of that equipment. The plan described also designates a platform to support the financing of circular economy. This deliver aims to promote the coordination and awareness raising pillar by sharing best practices amongst potential project promoters and other stakeholders. Particular financing needs, advice on improving their bankability, as well as coordinate activities regarding financing of the circular economy will be analyzed by a dedicated expert group. The reports also makes reference to other initiatives delivered such as; Guidance on circular economy into Best Available Techniques Reference Documents for several industrial sectors, Green Public Procurement. This paper aims to analyze the concept of Circular Economy using the framework of Sustainability using a holist approach.

## 2. Methodology

The methodology under this study, used Guimarães as a context city. The first step of the methodology was to gather information of the city regarding 1) context: geographic reference, population and administrative organization 2) brief description on the sustainable roadmap of the city 3) gathering of information about City’ Waste management plan and projects on circular economy using an holist approach, meaning not only focused on the waste valorization or product design but also considering the social part of the sustainable triangle.

## 3. Results

Guimarães is a city located in the north of Portugal. It is a middle size city with 158,000 inhabitants distributed in a diffuse territory. Notice that 1/3 of the population is located on the urban area where most of the services and equipment’s are implemented while 2/3 is outside the central agglomeration between Industries’ activities and Natural land. The historic center is UNESCO World Heritage since 2001 and the city was European Cultural Capital by 2012 and in 2013 European City of Sports. Currently, is running for the European Green Capital 2020 award. This award is given by the European Commission aiming to recognize local efforts to improve the environment, the economy and the quality of life in cities. Also, the European Green Capital Award (EGCA) provides a range of European Environmental Action Plans and Policy Instruments to support European cities and communities to become more sustainable. Twelve Indicator areas are assessed by a panel of internationally recognized experts,

between past performance, present situation and future plans for a given timeline: 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 and Governance. When the municipality decided to follow the roadmap to sustainability, in 2014, an invitation was addressed to the University of Minho, who was the first University on Portugal to publish a Sustainability Report and is recognized as a leader in this area. A so called Mission Unit was defined comprising several experts on the 12 Indicators Areas. Waste Production and Management is one of the 12 areas. In this particular area, results from the systematic review on circular economy concept are presented in Table 1.

According to the results presented we are able to identify several key deliveries implemented by the Circular Economy Action Plan proposed by the Commission. “Guimarães for Circular Economy” (G4CE) program presents several initiatives that answers to the main concerns and also to the challenges appointed by the commission. Through the valorization of forestry and green residues G4CE program found a new economic opportunity according to “waste-to-energy” described by the Commission (see table 1) through the use of waste for heating several municipal buildings. Besides that, green residues can be used as fertilizers for municipal gardens’ application, according to the legislative proposal on fertilizers described in table 1. With the Bubble Gums and Cigarettes Butts valorization we are also able to include eco-design concept, according to the Commission Directives, not only in the conception of the new urban furniture but also in the design of the new products generated by this valorization. Also, the project also developed an important role in education for sustainability in schools through the involvement of students in the creation of promotional teasers about the project.

“Agrowaste” and “Soil Remediation”, are also innovative projects developed in Guimarães that contributes to circular economy, using residues from agriculture and industry, for the production of bioplastics and improve soil’s quality, promoting the reduction of heavy metals and other toxic compounds, corresponding to the EU Directives that proposes legislation to produce fertilizers made from secondary raw materials.

Finally, “Refood”, answers to another important concern from Circular Economy Action Plan, promoting the reduction of food waste and also contributing to social programs, and “Paper4food”, also addresses the social concern, promoting the improvement of recycle paper and its exchange for food destined for solidarity institutions.

**Table 1:** G4CE projects

Area	Project	Summary
<b>Waste Valorisation</b>	Forestry & Green Residues	Forestry and green residues are produced during the garden and green areas maintenance operations. The valorization process will be evaluated in two main areas depending on the waste potential (properties and amount). It can be used as raw material for producing an organic substrate for apply in the communal municipal garden, a successful City Hall initiative. On the other hand this residues can be used in the production of solid biofuels and apply in biomass boilers located in many municipal buildings as: schools, swimming pools, nursing homes.
	Bubble Gum & Cigarette Butts	The City Hall of Guimarães presented the "Papa-Chicletes" and the "EcoPontas", two new structures of urban furniture that intend to contribute to the reduction of chewing gum and cigarette butts thrown to the ground, two of the most found residues in the squares and streets of the city. The recycling process to which they will be further subjected, will allow their conversion and scientific valorization, transforming them into new products available to the community, from the formation of new plastics or paper, through energy or agriculture.
	Agrowaste	Agrowastes are among the most produced biowaste in Guimarães. Therefore, it is an interesting source for the production of second generation bioplastics. For this purpose, different techniques for extraction and modification of target compounds will be tested, which will lead for the production of a bioplastic granulate, a product which has higher value, especially in European market.
	Soil Remediation	The region of Guimarães is known by its strong industrial background, namely textile and tannery industries, which may have created an environmental burden in some agriculture soils. For this reason the soil remediation study involves the reduction of the concentration of heavy metals and/or other toxic compounds of soils, allowing their use for agricultural purposes. In a first stage real soil samples will be subject to a physico-chemical methodology using eggshells developed for this purpose in an existing prototype. This will allow the definition of the operating conditions for the soil in situ remediation.
	Re-Food	Refood is an independent, non-profit organization run by volunteer citizens who collect food left over from restaurants, supermarkets, bakeries, hotels, etc. distributing this food by those who need it. Besides the social concerns, the project aims to reduce food waste, trying to improve waste management in cities.
<b>Social Affairs</b>	“CONSIGO” “PAPER4FOOD”	In order to increase the life time of many medical equipments, Guimarães found within the framework of the CONSIGO project, a way to promote a reduction of waste and at the same time allow a reuse of various equipment such as the crutches, wanderers, wheelchairs and articulated beds, eg. These equipments are restored and delivered to families identified by the Social Division of the City Hall. Guimarães promotes an initiative of the Food Bank: "Paper for Food" campaign. The citizens are asked to collect and recycle the paper that will be exchanged for food destined for solidarity institutions. The idea is simple but meaningful with the citizens playing an important role in contributing to help social institutions provide alimentary help to families and citizens who are proven to be needy.

## Conclusion

The importance of waste has been recognized in EU legislation for more than 40 years from the 1975 Waste Framework Directive. In Guimarães, this theme is attracted particular attention last years with several projects that are in line with the main concerns of Circular Economy Action Plan. Environmental, social and economy concerns are included in all of these projects described in G4CE program and is in line with the sustainable roadmap established for the city of Guimarães that aims to be Green Capital in 2020.

## Acknowledgements

This work has been supported by COMPETE: POCI-01-0145-FEDER-007043 and FCT – Fundação para a Ciência e Tecnologia within the Project Scope: UID/CEC/00319/2013.

## References

- Seghezze, L.: The five dimensions of sustainability, *Environmental Politics*.18 (4), 539--556 (2009)
- Insch, A. and Florek, M. (2008) "A great place to live, work and play: Conceptualising place satisfaction in the case of a city's residents". *Journal of Place Management and Development*, 1 (2), pp.138-149.
- Ezzat, A.M. (2016). Sustainable Development of Seaport Cities through Circular Economy: A Comparative Study with Implications to Suez Canal Corridor Project. *European Journal of Sustainable Development* (2016), 5, 4, 509-522.
- Aelenei, L., Ferreira, A., Monteiro, C.S., Gomes, R. Gonçalves, H., Camelo, S., Silva, C. (2016). Smart City: A Systematic Approach towards a Sustainable Urban Transformation, *ENRGY PROCED.* 91, 970--979
- Zink, K. (2014). Designing sustainable work systems: The need for a systems approach. *Applied Ergonomics*, 44 (1), pp. 126-132. Zink 2014
- European Commission, 2017. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Plan
- McDougall, F.R.; White, P.R.; Franke, M.; Hindle, P., 2008. *Integrated Solid Waste Management: A Life Cycle Inventory*. John Wiley & Sons.
- ISWA – International Solid Waste Association, 2016. *Circular economy: Energy and Fuels*, 48 pp.