Policy|brief

State of the Art:
Circularity Assessment Methods

18.06.2019

Executive Summary

With the Circular Economy Package release in December 2015[1], the European Commission has shown its commitment to the transformation towards Circular Economy (CE). CE aims to improve resilience and maintain competitiveness against other markets, especially considering the increasing difficulties of accessing natural resources to develop products and services within the current linear model.

The Circular Economy Action Plan is promoting the transformation of waste into resources through the Producer's Extended Responsibility (PER) concept. Much of the change in regulation links producers with either the prevention or the management of waste at the end of the products life. This concept is already included in European Directives for WEEE's, batteries and accumulators.

The OceanWise (OW) project aims to jointly develop a set of long-term measures to reduce the impact of expanded and extruded polystyrene (EPS/XPS) products in the North-East Atlantic Ocean. Based on resource-efficiency participatory methods and circular economy principles, OW will generate new methods and highlight best practice within sectors considering the use, manufacturing, recycling and uptake of EPS/XPS.

This brief has been generated from a first assessment report by OW partner SUSTAINN that reviews the current state-of-the-art regulations, standards, guidelines, methodologies and tools to perform circularity assessments for generic products. This brief summarizes recommendations to perform a circularity assessment of alternative solutions for EPS/XPS products and applications.

Definitions

Circularity Assessment: A structured procedure to assess a company, product or service in terms of circularity and sustainability, identifying the environmental, social, and economic impact all along its life cycle. It is focused on maximizing the efficiency in the use and exploitation of materials and resources, putting a value on perceived waste as well as to minimize generated waste. In essence, it strives to obtain economic, social and environmentally sustainable products and services.

Circular Economy: A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life[2].

Life Cycle: Consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal[3].

Life Cycle Costing: Life cycle costing is the process of economic analysis to assess the total cost of acquisition, ownership and disposal of a product[4].

The OceanWise project is co-financed by the European Regional Development Fund through the Interreg Atlantic Area Programme

Introduction

The Circular Economy package includes revised legislative proposals on waste, setting clear targets for the reduction of municipal and packaging waste by 2030, focused predominantly on boosting recycling and reducing landfill. It further promotes turning waste into resources through general requirements for Extender Producer Responsibility (mainly electrical and electronic waste, vehicles, batteries and accumulators).

The rate of waste generation on the planet is much higher than the speed at which we can turn waste into resources. Society needs to go beyond improving waste management, exploring possibilities of recirculation and promoting recycling to solve this global problem.

As a general approach, the 3 dimensions of sustainable development (economic, environmental and social) are to be considered to analyse circularity and sustainability. The Life Cycle Sustainability Assessment (LCSA) approach should be the main reference to follow, to combine environmental impact (Life Cycle Analysis - LCA), cost impact (Life Cycle Cost - LCC) and social impact (Social Life Cycle Analysis - SLCA).

> *"We need to think about methodologies to avoid generating waste from the early conceptual design stages."*

We need to think about methodologies to avoid generating waste from the early conceptual design stages. Methodologies and tools are needed to help the product developer and designer to think about the waste generated during commercialisation process and also at the end of the product lifecycle, by considering the impact of waste management costs within Life Cycle Cost assessments of products.

Approach and Results

The aim of the research behind this policy brief was to provide an in depth overview of the state of the art on circularity assessment methodologies for different objects, regions, systems, products, and components, as defined by available references.

Document type:

A total of 59 relevant references were found worldwide with more than 40 articles and research papers directly relating to circularity assessments. The results show a wide ranging diversity of methodologies concerning the implementation of a circular economy in different regions, cities, organizations, companies and products.

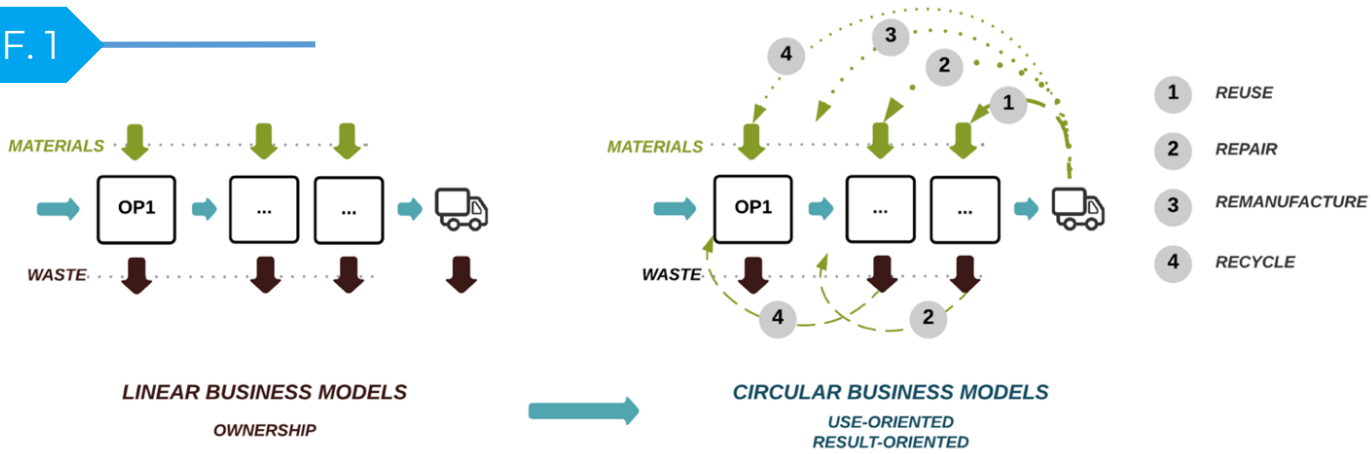
In contrast only 10 of these references concern standards, guidelines or methodologies developed by established and recognized bodies, organisations and institutions, demonstrating clearly that transition to a circular economy is just at the beginning in relation to legislation and regulations.

Applicability Scope:

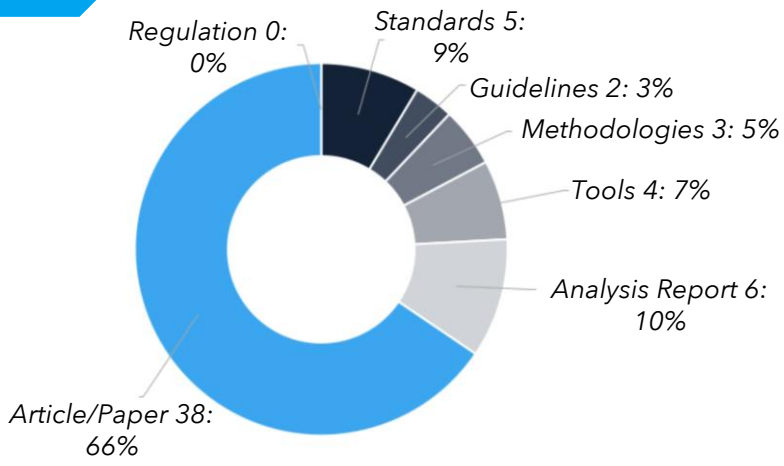
A range of applicability scales and subscales were found between all the studied references that analyse different aspects of implementation of circular economy for regions, cities, organizations and products.

The review focused on existing circularity assessment standards, guidelines, methodologies and tools at a nano-scale. This was applied at company and product level because the OW project is focused on EPS/XPS products and applications, which are predominantly used as primary packaging.

F. 1



F. 2



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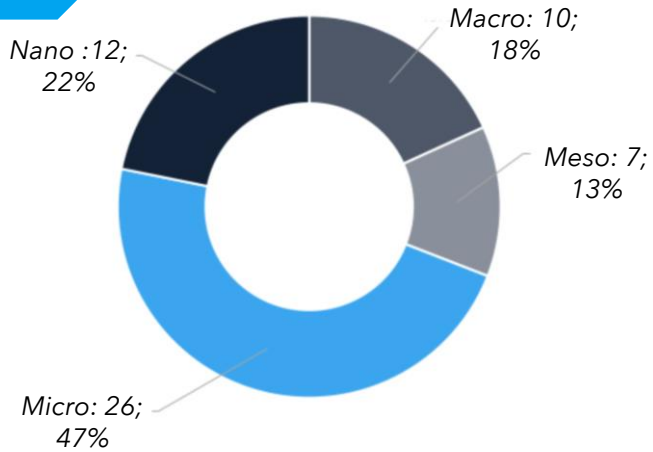

Figure 1. Circular Economy Transition

Scheme of the transition from linear to circular economy production models.

OW aims to define methodologies, models and indicators for the transition of Linear to Circular Business Models to:

- Assess and improve Circularity of current EPS/XPS Products & Applications (fish boxes and seafood eps, food packaging, consumer goods packaging)
- Design, develop and select sustainable and circular alternatives
- Circularity Assessment Database of current EPS/XPS Products & Applications and alternatives

Figure 2. Document Type

This figure shows the distribution of the document type of the references that have been found.

No specific regulations to perform circularity assessments of products have been developed yet.

Figure 3. Applicability Scale

Macro: cities, countries and international agencies

Meso: inter-industries, eco-industrial parks and inter-firm networks.

Micro: administration, companies, business models.

Nano: lowest level of analysis possible at which stand products and components.

Conclusion

Extensive research activity and analyses is being undertaken in the wider field of circular economy and associated circularity assessment for regions, organizations, business models and products.

To date, no specific references are directly applicable for a circularity assessment of EPS/XPS products and applications. However, many relevant aspects from existing research activities and analyses in the field of circular economy can be used to further develop specific methodologies and tools for EPS/XPS products.

References

[**1**] European Commission - Press release. Closing the loop: Commission adopts ambitious new Circular Economy Package to boost competitiveness, create jobs and generate sustainable growth (http://europa.eu/rapid/press-release_IP-15-6203_en.htm)
[**2**] The Waste and Resources Action Programme (WRAP) (http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy)
[**3**] ISO 14040: Environmental Management – Life Cycle Assessment – Principles and Framework. Second Edition 2006
[**4**] IEC 60300-3-3 2005: Dependability management. Application guide – Life cycle costing
[**5**] Sustainn. (2019) *State of the Art Report on Circularity Assessment Methodologies*. (Work Package 6, Action 6.1). Pamplona, Navarre. OceanWise.
[**6**] Icons retrieved from: https://thenounproject.com/

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Recommendations

As a general approach, the three dimensions of sustainable development (economic, environmental and social) are to be considered to analyze circularity and sustainability. A Life Cycle Sustainability Assessment (LCSA) approach should be the main focal point in order to combine environmental impact (Life Cycle Analysis - LCA), cost impact (Life Cycle Cost - LCC) and social impact (Social Life Cycle Analysis - SLCA).

Regarding an **environmental impact** analysis, following aspects should be considered:

- **Resource-use oriented**: aspects related to the materials selection and resources (water, energy) consumption and efficiency

- **Waste generation**: aspects related to the different kind of waste generated (hazardous, non-hazardous, wastewater, solids, etc)

- **Circularity**: where all the recirculation loops of the product, its components and materials (repair, reutilization, refurbishing, remanufacturing and recycling) are to be considered.

- **Impacts:** land, water, soil and atmosphere should be considered within environmental impact indicators.

In order to analyse **costs impacts** all along the value chain, the life cycle cost of the product or application should be undertaken by including all its life cycle phases and considering international standard[4] with specific reference to IEC 60300-3-3.

To analyse the **social impact** of different alternative solutions, a wider analysis has to be undertaken that takes into account internal social aspects and external aspects to a company responsible for the design and development of any potential alternatives.

Finally, combining the environmental, cost and social impacts analyses, a global quantitative index can be calculated to measure circularity and assess sustainability of potential alternative solutions for EPS/XPS products and applications.