Assessing Circular Economy Transitions

This document is for providing background materials for discussion on the CE 'benchmarking tool' for the final conference of H2020 REPAiR project.

The core objective of REPAiR was to provide local and regional authorities with an innovative transdisciplinary open source geodesign decision support environment (GDSE) developed and implemented in living labs in six metropolitan areas (Amsterdam (The Netherlands), Naples (Italy), Ghent (Belgium), Hamburg (Germany), Łódź (Poland), Pécs (Hungary) in order to help decision and policy makers shift their regions towards a circular economy. Besides, among many research questions of the project one was that where are our case study regions on the way towards circularity?

We know, that there are many indicators for measuring the state of a given (in most of the case) country on the way towards circularity (e.g. EASAC's suggestion, among others), however, our aim was to approach this assessment from qualitative perspective, from the point of view of policy making and partly using the tools of REPAiR, on subregional/city level. Hence, we have created four main indicators/axles that can refer the stage of circularity,

Each axis contains 3-4 indicators, with which we will be able to assess the state of play using a four-stage scale (from ambition to move beyond the linear economy to mainstreamed CE). Here are the four axles:

1. **Governance axis**: arenas, agendas, experiments
2. **Awareness axis**: corporate awareness, awareness towards wastescapes, awareness towards policies, everyday practices of citizens
3. **Tools axis:** flow, stock, co-creation
4. **Sustainability assessment axis:** data availability, stakeholder involvement, comprehensive sustainability assessment

The four levels/stages that describe the levels we used here (beyond the zero, where there is no any attempt towards circularity) are:

1. **Ambition** to go circular
2. **Niche** change
3. **Accelerating** change
4. **Mainstreamed** CE

The four stages represent a Likert Scale (1-4) that we use in the assessment along the above mentiond axles (indicators).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

After assessing each indicator, indicators are aggregated for visualizing the state of CE in a Region by axles. Figure 1 shows the output visualisation of the axes aggregating the scores of indicators.

	Region 1	Region 2
Awareness (flows, wastescape, policy, everyday practices)	2	4
Governance (arenas, agendas, experiments)	4	2
Tools (flow, stock, co-creation)	4	3
Sustainability assessment (data availability, stakeholder involvement, comprehensiveness)	1	4

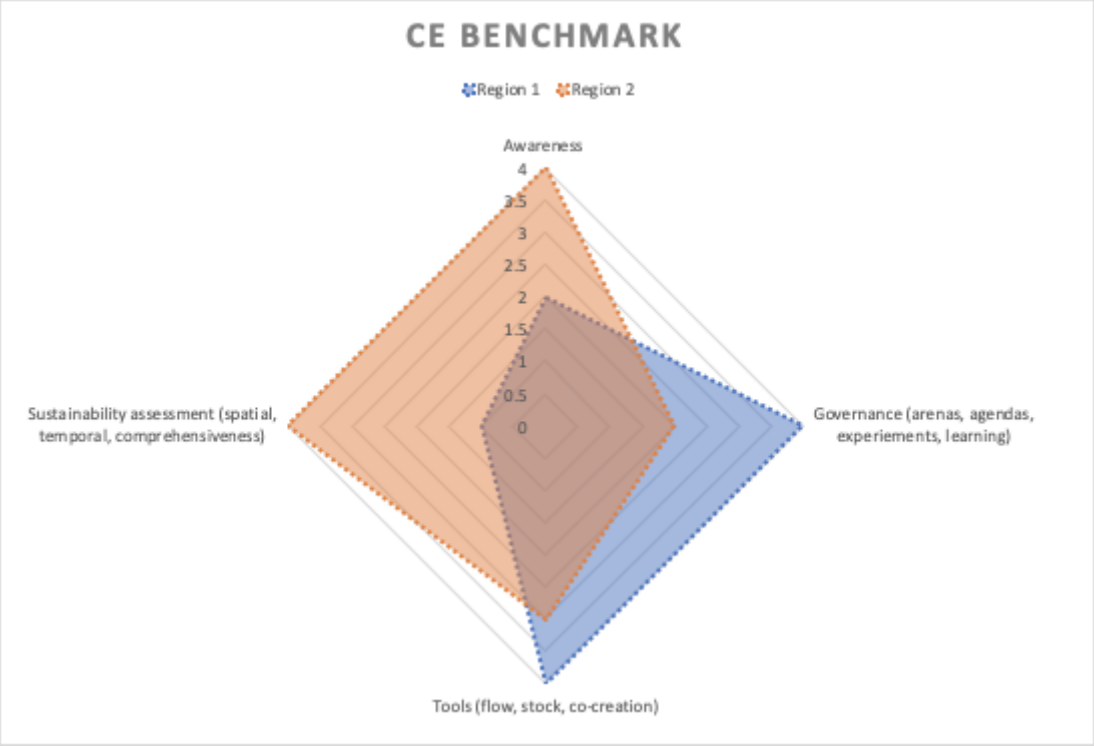

Figure 1: Aggregated indicators along the axes.

Below, for each of the axis you can find a **table** presenting the indicators of the axis across four stages of transition. Afterwards, **one extra page to explain the table and its theoretical underpinning.**

The idea is that once we have the scores for each of the indicators on an axis, we could calculate means (averages) and include them in the summary score as shown on Figure 1.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

1. GOVERNANCE

Level of CE	**Arenas** (long-term-oriented strategic activities and policies)	**Agendas** (medium-term tactical activities)	**Experiments in integration across flows and space** (niche innovation activities)
Ambition to move beyond linear economy	Strategies and policies for CE transition - are being **discussed** between small groups of stakeholders.	Regulations, support tools and incentives for CE are being **discussed** (emerging).	Eco-innovative solutions are **isolated**, most innovations are concerned with the improvement of **waste management.**
Niche change	Strategies and policies for CE transition: - Implementation starts at **some of the territorial levels** - and covers **only parts of the relevant territory**, - is **not yet integrated** vertically or horizontally, - is not yet integrated with spatial strategies.	Regulations, support tools and incentives for CE are in place at **some territorial levels** and **cover some of the relevant territory**, their impact remains limited to selected policy sectors.	Eco-innovative solutions are emerging based on the **R-strategies**, predominantly in the form of industrial symbiosis.
Accelerating change	Strategies and policies for CE transition: - Implementation present at **all territorial levels** - and **covers most of the relevant territory** (municipalities), - **integrated vertically** across those levels; **OR horizontally across administrative boundaries**; **OR across policy sectors** and in collaboration with knowledge and private sectors .	Regulations, support tools and incentives for CE are in place at **all territorial levels** and **cover most of the relevant territory**, but they cover only **some** of the relevant policy sectors.	Eco-innovative solutions are reaching a **'critical mass'**, , **circular urban and regional development initiatives** emerge (e.g. spatial planning integrating CE). like circular area development (e.g. business parks, circular neighbourhoods).
Mainstreamed CE	Strategies and policies for CE transition:	Regulations, support tools and incentives for CE are in place at **all territorial levels** and **cover all the relevant**	Spatially integrated eco-innovative solutions are considered as standard.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

	- are in place at **all territorial levels** - and **cover all the relevant territory, integrated vertically** across those levels - **AND horizontally across administrative boundaries** - **AND policy sectors** in collaboration not only with knowledge and private sectors, but also with citizens.	**territory**, creating an **enabling environment** for the transition and removing barriers for it.	

Table 1: Governance indicators

Governance axes - background

The transition framework distinguishes four transition levels and corresponding transition governance activities (see Loorbach 2007; 2010; Wittmayer & Loorbach, 2016, p.19). We adapted it for our CE focus:

- **Strategic-level activities:** Activities aimed at the long term through which the future is collectively debated and imagined; for example, visioning, long-term goal formulation, including collective goal setting and norm setting. **For this one we included the policy dimension more prominently as well as the territorial coverage and aspects of vertical and horizontal coordination (across boundaries, sectors of policy, societal sectors).**
- **Transition Agendas with Tactical-level activities:** Activities aimed at the midterm and long term, targeting changes in established structures, institutions, regulations, and physical or financial infrastructures. **Here we related this to the enabling environment for the transition and efforts to create it at different territorial levels and different degree of coverage of the territory.**
- Transition Experiments with Operational-level activities: Activities aimed at the short term, focussing on experiments and actions through which alternative ideas, practices, and social relations are practised, tried out, and showcased. For this one, **we added the degree of integration with spatial strategies and across flows.**
- This axis is not in the recent benchmark as several elements of it can be found in Tools and awareness axles. (*Transition Monitoring and Evaluation with Reflexive-level activities: Activities aimed at learning about the present state and dynamics in the system, and about possible future states as well as about the way from present to future: these include (collective) learning from ongoing operational, tactical, and strategic activities.* ***Here we added also territorial levels distinction as well as the notion of co-creation.*** **) -**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

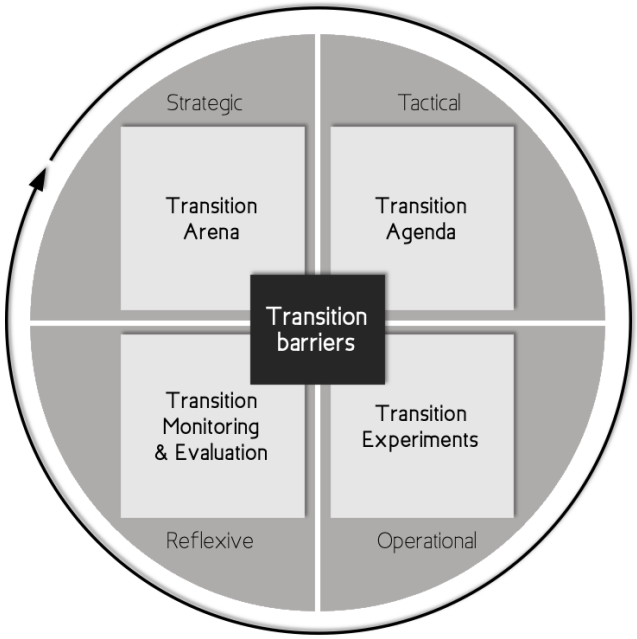

Fig 2. Conceptual framework: barriers for managing transition towards CE (Source: adapted from Wittmayer & Loorbach, 2016).
https://www.researchgate.net/publication/319314335_Circular_Economy_Measuring_innovation_in_the_product_chain

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

2. AWARENESS

	Corporate awareness	Towards Wastescapes	Towards Policy implementation	Ordinary life practices
Ambition to move beyond linear economy	Little own responsibility in separate waste collection can be found at corporate level (e.g. One or maximum two (plastic and paper) separation possibilities available for employees.)	Citizens are aware of discarded areas in their territories	Citizens are interested in CE rules and opportunities	People start thinking about potentials within discarded objects. Most of the people are satisfied with separate collection
Niche change	In most of the companies , separate collection is available for employees , and the most of the company has a voluntary "green strategy" and a related education program.	Citizens start to consider discarded areas as a potential	Citizens are partially able to be informed about and to experiment with CE opportunities	Experiments are made on the recycling of materials/objects and in the field of education. People are trying to reduce their packaging use.
Accelerating change	Most of the companies are working on reducing packaging in their production and commercial phases, and looking for low-waste technologies. Service provider companies mainly use paperless and distance services.	Groups of people start reappropriating discarded areas	Citizens start using policy implementation on CE	Groups of people start reusing disused materials/objects and also NGOs work in this field.
Mainstreamed CE	Most of the production companies are looking for solutions for integrating reused parts in production; working on the extension of life of their products. Services are paperless. Companies mainly use renewable sources in their	People are actively involved in the recovery of discarded areas	Citizens are able to use CE rules and solutions, and to suggest new challenges for policies	People are actively involved in CE practices and open to new challenges. People mostly buy durable consumer goods. Repair and refurbishment are priorities.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

	electricity, heating and transport consumptions.			

Table2: Awareness indicators

Awareness – background

Corporate awareness

'Corporate environmentalism' - awareness of a company towards green thinking/circularity - refers to the recognition and integration of environmental concerns - in our case of circularity concerns - into a firm's decision-making process, and it is one way how a business entity can address environmental issues (Banerjee, 2002), or circularity of flows in our case. Firms' awareness can be twofold. One of them is 'externally' regulated (by a meta-governmental, governmental, local governmental organisation), while the other one is self-regulatory mechanism (Lyon and Maxwell, 2004). The latter approach (self-regulatory mechanism) is usually manifested in the use of environmental management systems such as the EU's Eco-Management and Audit Scheme (EMAS) and the International Organization for Standardization's ISO 14001 quality management system (Hillarya and Thorsenb, 1999; Neugebauer, 2012).

Wastescapes

Awareness towards wastescapes is citizens' awareness about wastescape potential to become resources.

Circular Economy theories are quite developed and start to impact on the industrial world (McDonough, Braungart 3003, Mckinsey & Company 2016, Wijkman, Skanberg 2015). Considering waste as a resource, in fact, has become a useful argument in order to move from theory to practice. While experiences taking advantage of waste flows are underway, the transition to practice appears more difficult with respect to wastescapes, that are at the core of the REPAiR research. The first step in order to achieve this transition implies enhancing citizens' awareness of the presence of wastescapes in their urban region and then promoting their ecological sensitivity in order to change their perceptions about them. Such an accretive consciousness, when mainstreamed, could trigger shared visions of development useful to launch wastescape regeneration processes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

Towards Policy implementation

Awareness towards policy implementation is citizens' awareness of what the policy framework on CE makes possible for them.

In the framework of CE, a "gap between policies and the city" (Balducci, Leonardi, Fedeli 2018) can be observed, that points out, on the one hand, how traces of innovation, coming from local contexts, are often ignored by institutions, on the other, how institutional measures and tools are often little-known and then not exploited by citizens. Such a gap, wider in some urban regions in Southern Europe, can be adopted as a lens to interpret CE awareness in European regions in general. Raising awareness is the base to promote local transitions (Ellen MacArthur Foundation 2019): social and behavioural aspects of the transition are under-investigated and constitute a barrier to circular processes (Jonker and Montenegro Navarro 2018) .

If, in a first stage, citizens simply are interested in the framework of CE rules and measures made possible by public policies, then some of them become informed and skilled in testing how to catch CE opportunities within policy-making. Consolidated awareness can modify customs and habits and, when mainstreamed, promote shared circular processes, in which the gap between policies and the city is bridged and each actor has its proper role.

Towards Ordinary life practices

A significant part of the environmental problems can be traced back to human behaviour. Hence, most research is targeted at the discovery of motivations and background of environmental/circular related **actions**. The attitude and the awareness is a "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour" (Eagly & Chaiken, 1993) or the list of action has taken (cf. Varjú et al. 2018). For the "measurement" of the (environmental) awareness both interviews (e.g. Vicente Molina et al., 2018) and questionnaires are used (e.g. Buta et al., 2014).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

Tools

Level of CE/tool	Flow	Stock	Co-creation processes implemented in Living Labs
Ambition to move beyond linear economy	A material flow analysis for a city/region on input output level is available for most materials and energy flows.	The development of urban mining models is being discussed.	Only limited participatory processes are established, like focus groups, consultation processes aimed at finding out people's expectations and their needs.
Niche change	A more detailed material flow analysis , either spatially or concerning qualities of materials and treatment of specific flows are available regularly.	A general Urban mining model for the whole city has been developed once for a selection of materials.	Pilot projects that include co-creational aspects are running (user-centric ensemble) are established.
Accelerating change	A Comprehensive and detailed material flow analysis is done regularly and used for policy assessment.	A more detailed model (either spatially or concerning qualities of materials and specific stocks) is available regularly.	Many experiments are established that are based on user-centred environments with results conveyed by actual users.
Mainstreamed CE	A real-time material flow information system is available that provides sufficient information to establish a secondary raw material market.	Comprehensive and detailed urban mining model (supported by material passports for example) is done regularly and used for policy assessment.	Co-creational decision development of CE related policies are widely spread in management/planning processes and policy regulations.

Table3 : Indicators of Tool

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

Tools – background

Urban Metabolism Flows and Stocks

Urban Metabolism is a framework based on a metaphor that conceptualises cities as living organisms (Lucertini & Musco, 2020). With the aim of understanding resources processes of a hypothetical town, Wolman (1965) pioneered the UM concept. Only recently, Kennedy et al. (2007:44) aptly broadened UM definition to *"the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste"*. Consequently, UM describes the continuous **flows** of resources *in* (e.g. energy, materials, water), *out* (e.g. waste, pollutants, materials) of and *within* (**stocks**) a given system boundary (city, territory).

The assessment of **flows** and **stocks** of materials within a chosen geographical boundary and temporally defined system is conventionally defined as **Material Flows Analysis (MFA)** (Brunner and Rechberger, 2004; Broto et al., 2012). The fundamental principle of MFA is the conservation of matter (Allesch and Brunner, 2015). Since the system has defined boundaries, the principle of mass conservation aids in the accounting exercise that follows: inflows equals to the outflows plus changes in stocks and depletion (Allesch and Brunner, 2015).

We understand **urban mining** as the process of reclaiming raw materials from products, buildings and waste within a city. These secondary raw materials that can be used in manufacturing processes instead of or alongside virgin raw materials. **Urban mining models** allow to predict, at which time, where in a city in which quantities and qualities specific secondary raw materials become available.

Co-creation processes

Living labs are a real-life testing environment, where Public-Private-People Partnerships (and among them researchers and experts) interact. One of the specific innovations, in comparison to other forms of participatory processes, is to put these PPPP into real contexts, and giving them space to co-production/co-creation activities. Whereas other forms of collaborative planning stop at the turning point of public consultation. Co-creation, in particular, refers to a paradigm of mutual help and competences sharing, where anyone can be the conveyor of its own knowledge, its own experiences (they are the users). The innovation of the methodology starts from this user-centric ensemble, putting together expectations (as in past participatory processes), but also turning the users themselves in future co-creators" (Source: Deliverable D5.1)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

Sustainability assessment

IT SHOULD BE MADE CLEAR THAT PERFORMING A COMPREHENSIVE SUSTAINABILITY ASSESSMENT BASED ON DATA OF GOOD QUALITY NOT ALWAYS IMPLIES THAT YOU ARE INVESTIGATING THE LEVEL OF CIRCULARITY; CIRCULAR SYSTEMS AR NOT ALWAYS SUSTAINABLE AND SUSTAINABLE SYSTEMS ARE NOT ALWAYS CIRCULAR;

Level of CE	Data availability	Stakeholder involvement	Comprehensive sustainability assessment
Ambition to move beyond linear economy	Data (material, emissions, land use, etc.) related to the **waste management system** under study is not directly available (<20% primary data, from companies, institutions, ...). Data gaps (>80%) are filled with data from literature, databases etc. and many approximations have been made. There are many problems with confidentiality of data.	Stakeholders were not involved in the data collection.	A sustainability assessment has been done for the **waste management system** under study for 1 pillar (either social, economic or environmental) **AND** for one spatial scale (either global, regional or local).
Niche change	Data (material, emissions, land use, etc.) related to the waste management system under study is limited available (<50% primary data, from companies, institutions, ..). Data gaps (>50%) are filled with data from literature, databases etc. and a few approximations have been made. Confidentiality issues of data might appear.	Stakeholders were involved in the data collection , as well as to contribute to the definition of the goals and scope of the sustainability study	A sustainability assessment has been done for the **waste management system** system under study for : (*) 2 pillars (either social/economic , social/environmental, environmental/economic) **OR** (*) 1 pillar but covering multiple spatial scales (local, global, regional)
Accelerating change	Data (material, emissions, land use, etc.) related to the waste management system under study is available (>50% primary data, from companies, institutions, ..). Data gaps (<50%) are filled with data from literature, databases etc. and a few approximations have been made. Many data is open access.	Stakeholders were involved in the data collection brainstorm about the goal and scope of the sustainability study and were engaged in the impact assessment step (e.g. developing/selecting indicators)	A sustainability assessment has been done for the system under study for: (*) all three pillars (social, economic and environmental) OR (*) 2 pillars but covering multiple spatial scales (local, global, regional)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

Mainstreamed CE	Data (material, emissions, land use, etc.) from the waste management system under study is extensively available (>80% primary data, from companies, institutions, ...). Data gaps (<20%) are filled with data from literature, databases etc. and almost no approximations have been made. Data is open access and /or fully available.	Stakeholders (including governance) were involved in multiple steps of a sustainability assessment studie (collection of data, goal and scope definition, impact assessment and interpretation/communication of results)	Model and framework in place to aggregate sustainability results (covering three pillars and multiple spatial scales)and eventually towards a single score, providing clear and simplified way of decision support to e.g. policy makers .

(*) spatial scale: local, regional or global impacts

Table 4: Indicators of Sustainability Assessment

Sustainability assessment - background

A circular economy strategy aims at creating value for the economy, society and/or business while minimizing resource use through reducing, re-using and recycling. CE is based on a systems-thinking approach and tries to find opportunities to close loops, either biological or technical cycles, to keep components and material as long as possible and preferably in a highly qualitative way in the market.

However, closing the loops is not always enough. The potential environmental impact associated with these 'closing-the-loop' processes need to be considered. Examples are high energy use and recycling stations, more transport needed for collection of reusable products, etc. Very often CE strategies go hand in hand with improved (environmental) sustainability, however, we need to be aware this is not always the case. Multiple options need to be evaluated and therefore, life cycle assessment (LCA) is often used as it is a robust and science-based tool to quantify the environmental impacts of products, services and business models throughout their life cycles — from the extraction of raw materials to manufacturing, distribution, use, and disposal. It follows the ISO 14040/44 standards (International Organization for Standardization, 2006). (https://pre-sustainability.com/articles/why-circular-economy-business-models-need-lca/)

It is crucial to evaluate CE strategies with LCA to measure its environmental performance. Data availability is often an important challenge within an LCA study and to reduce the uncertainty on the results, it is crucial to get access to good qualitative primary data. On top, stakeholder involvement is key, either to help in data collection, to co-decide on the goal and scope of the analysis or even during the identification, selection and development of LCA indicators. Another important aspect: to provide even a more holistic overview of potential impacts related to waste management and/or circular economy strategies, also other approaches than LCA need to be combined, such as the integration of social and economic indicators and the differentiation between local, regional and global scales. *(Taelman et al. 2018; 2020)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.

References:

Allesch, A., & Brunner, P. H. (2015). Material flow analysis as a decision support tool for waste management: A literature review. *Journal of Industrial Ecology*, *19*(5), 753-764.

Broto, V. C., Allen, A., & Rapoport, E. (2012). Interdisciplinary perspectives on urban metabolism. *Journal of Industrial Ecology*, *16*(6), 851-861.

Brunner, P. H., & Rechberger, H. (2004). Methodology of MFA. *Practical Handbook of Material Flow Analysis. Lewis Publishers©, Boca Raton London New York Washington, DC*, 34-166.

Kennedy, C., Pincetl, S., Bunje, P., (2011).'The Study of Urban Metabolism and Its Applications to Urban Planning and Design', Environmental Pollution 159/8, 1965-1973: 1967.

Wolman, A., 1965. The metabolism of cities. Scientific American 213, 179-190.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 688920.