In 2016, the UNECE and the International Telecommunication Union (ITU) launched the global initiative United for Smart Sustainable Cities (U4SSC).

One of the aims of the U4SSC is to develop guidance and training material for city leaders to facilitate the transition of cities to smarter and more sustainable ones and to support the implementation of international agreements such as the 2030 Agenda and the New Urban Agenda.

The “Guidelines on strategies for circular cities” document was developed in 2017 under the umbrella of the U4SSC’s programme of work. This document explains the concept and vision behind the circular economy, related positive impacts, and possible related policies and strategies for smart sustainable cities.

The Committee is invited to review this study and approve its online publication. The study is currently a draft unedited version.
Introduction

Traditionally, the era of industrial evolution has pursued a linear model of production and consumption in which goods are manufactured from raw materials, sold, used (consumed), and then disposed or eliminated as waste. Services have also utilized tangible goods (alongside intangible resources) during their provisioning in a similarly linear fashion.

This linear model has been successful in providing affordable goods, services and resources to consumers and material welfare to a large extent. The linear model is material and energy intensive; it relies on economies of scale, and typically builds on more complex and international supply chains. But at the same time, the current linear model of production and management of goods, services and resources that seeks to encourage short-term consumption is also leading the planet to a potentially unsustainable future. In this context, circular economy has recently emerged as an alternative to linear model of production and consumption for economic activities.

Definition of Circular Economy

The “Guidelines on strategies for circular cities” do NOT provide a new definition for the circular economy. Some existing definitions of circular economy are included in this document from other references to illustrate the concept.

In general, a circular economy is an economic system where products and services are traded in closed loops or ‘cycles’. A circular economy is characterized as an economy, which is regenerative by design, with the aim to retain as much value as possible of products, parts, materials and resources.
The below table highlights some of the previously well-known circular economy definitions and interpretations.

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition/interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sauvé et al. (2016)</td>
<td>Circular economy refers to the “production and consumption of goods through closed loop material flows that internalize environmental externalities linked to virgin resource extraction and the generation of waste (including pollution)”</td>
</tr>
<tr>
<td>Preston (2012)</td>
<td>Circular economy is an approach that would transform the function of resources in the economy. Waste from factories would become a valuable input to another process – and products could be repaired, reused or upgraded instead of thrown away”.</td>
</tr>
<tr>
<td>European Environment Agency (2014)</td>
<td>Circular economy “refers mainly to physical and material resource aspects of the economy – it focuses on recycling, limiting and re-using the physical inputs to the economy, and using waste as a resource leading to reduced primary resource consumption”.</td>
</tr>
<tr>
<td>Mitchell (2015)</td>
<td>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, extracting the maximum value from them whilst in use, then recovering and reusing products and materials.</td>
</tr>
<tr>
<td>Ellen MacArthur Foundation (2013a; 2013b; 2015a)</td>
<td>Circular economy is “an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models”. The overall objective is to “enable effective flows of</td>
</tr>
</tbody>
</table>

1 The reference to all these studies will be added later on.
materials, energy, labour and information so that natural and social capital can be rebuilt”.

European Commission (2015a) | The circular economy is an 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”.

Table 1: Circular Economy Definition Examples

Circular economy aims to create a sustainable system that allows for the long life, optimal reuse, refurbishment, remanufacturing and recycling of products and materials.

3- Challenges2 Faced by Cities

More than half the world’s population now lives in urban areas. Already in 2016, an estimated 54.5 percent of human population lived in urban settlements and the same figure is expected to rise to 60 percent by 2030. These urban areas consume 75 percent of natural resources, produce 60 to 80 percent of greenhouse gas emissions, and generate 50 percent of all waste. Cities contribute an estimated 80 percent of gross domestic product (GDP) globally.

There were 512 cities globally in 2016 with at least 1 million inhabitants and 662 cities are projected to reach this number by 2030. In the same year, there were 31 “megacities”, i.e. cities with more than 10 million inhabitants, and the same number is estimated to be reached by 41 cities by 2030. Similarly, in 2016, 45 cities had populations between 5 and 10 million and 63 cities are projected for 2030.3

Hence cities will play a crucial role economically in the future as well.

Cities, as relatively dense and highly congested physical spaces are also prone to significant challenges. More than 80 percent of cities in 2014 were located in areas that were vulnerable to high risk of mortality or economic losses associated with natural disasters and other environmental challenges.

Population increase, urban sprawl, climate change, environmental problems, and fiscal pressures are among the myriad challenges faced by cities.4 Additionally, demographic changes such as ageing populations, volatile economic growth, unemployment, low-wage low-skilled jobs, income inequality, social polarization and segregation present challenges for sustainable urban development. Furthermore, our current consumption levels in cities also pose challenges for the future.

Therefore, our social, economic and environmental challenges are mostly manifested in urban environments.

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2 Circularity related implications and ramifications will be included as a last conclusive paragraph in the next version of the document.
4 UNECE & ITU (2016). Striving for Sustainable Development Goals, United 4 Smart Sustainable Cities
Realistically, each city has its own particular characteristics and specific social and economic context and structure along with its own challenges. Hence, it is important for cities to identify their starting points, or current status, with respect to circularity. The gap between the current state and the intended future state for circularity creates an enormous innovation potential for cities and communities.

Stakeholders including public and private sector, NGOs, civil society and very importantly the city inhabitants themselves can collectively work as partners to close the gap. In this context, creating a public-private-people partnership (PPPP) through the involvement of the relevant stakeholders is critical for circularity.

Engaging and working with stakeholders through shared platforms to make the best use of cities’ collective capital and to ensure inclusivity are also important for success. Further, these partnerships can also enable innovative and alternative financing mechanisms for circular city initiatives.

4- Towards Circular Cities

Circular economy encompasses economic activities in its scope. On the other hand, this deliverable identifies a broader list of city assets and products and extends the circularity concept beyond the economy solely. Therefore, the scope of these guidelines entails a wider range of city assets and products within an urban context in addition to the economic ones; hence the broader term circular city. For example, public spaces in the city (which are not economic products but city assets) may be used for different social activities at different times (i.e. sharing public spaces as a city asset); similarly, household items may be shared among individuals and households or reused for different purposes. These examples transcend economic activities and enhance city assets’ utilization beyond economic ones.

The circularity approach adopted in this document is to increase city assets’ and products’ efficiency and effectiveness by extending either their and/or their constituents’ (components’) utilization and lifetimes. This increase is achieved by applying targeted action items (referred to as circular action items in this document) on city assets and products, such as sharing, recycling, refurbishing, reusing, replacing, digitizing and harvesting indirect benefits from them. Action items are a set of specific, discrete, outcome-orientated tasks that can be applied to the city assets and products to improve their utilization and lifetimes.5

5 The action items will be explained more in details in the sections below.

5- Circular City Implementation Framework - Components and their Definitions

The circular city implementation framework developed in these guidelines is broken down into four components which are utilized by a four-step implementation methodology. In this section, each of the four components is briefly defined and described. The next section will describe and clarify the four-step circular city implementation methodology.
City Assets and Products

Figure 1 presents various city assets and products classified in three categories, namely: city infrastructure, city resources and, city goods and services (as potential inputs to circular action items described in the next sub-section).

![City Assets and Products Categorization](image)

Figure 1: City Assets and Products Categorization

Brief Explanation of City Assets & Products

**City Infrastructure:** In these guidelines, city infrastructure refers to buildings, public spaces and infrastructure, and the digital infrastructure available in a city.

**Buildings:** Buildings are constructed structures which serve various urban needs such as living and working places, storage place for belongings, and as shelter from weather and provide security. Types of different buildings in a city include residential, commercial, and public buildings such as healthcare, educational, religious, heritage, government, military, and civic buildings belonging to the public sector.

**Public Space & Infrastructure:** Public space is an urban place that is generally open and accessible to people in a city\. Some examples are public squares, sports fields, and beaches. Infrastructures are connective structures that enable people in a city to get the resources they need (e.g. from the environment) and bring them to the city or that enable flows or cycles in a city\. Infrastructure types in this deliverable include communications, water, energy, mobility and green infrastructures.

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7 City Anatomy: A Framework to support City Governance, Evaluation and Transformation
Communications infrastructure includes telecommunications, radio, television, and Internet infrastructures (including analog and digital transmissions through various physical media such as copper, coaxial, fiber, etc.) in a city.

Water infrastructure includes supply, sanitation, and the management of clean, waste and surface waters including irrigation, drainage and collection in a city.

Energy infrastructure includes generation, transmission and distribution infrastructures for various available energy types (e.g. power plants, nuclear plants, hydroelectric dams, solar farms, wind farms, bio-energy systems, etc.) in a city.

Mobility infrastructure includes human and goods transportation and general mobility infrastructures (e.g. roads, airports, railways, ports, promenades, bridges, pavements, footpaths, bicycle paths, etc.) in a city.

Green infrastructure is composed of natural elements brought into the city in a structured manner (e.g. parks, trees, horticultural areas such as gardens, etc.) in a city.

**Digital Infrastructure:** Digital infrastructure includes foundational equipment and services needed for delivering digital services (excluding the communications infrastructure) in a city (e.g. data centers, information technology and data processing equipment and systems, cloud computing, etc.).

**City Resources:** Resource is defined as a source or supply from which a benefit is produced. It includes, in this deliverable, natural resources, human related and owned resources, private sector assets, and waste in a city.

Natural resources are derived from the environment and are consumed in a city (e.g. air, water, energy, land and soil, and biotic resources such as forests and fisheries).

Human related resources belong to individuals and are possessed by them inherently such as skills and knowledge. Human owned resources are various household items and other materials and goods owned and used by individuals.

Private sector assets are tangible assets owned by private sector organizations and they are used to produce products in the form of goods and services. Private sector assets include machinery, warehouse items, company cars and various other tangible assets owned and used by the private sector organizations.

Waste is everything that no longer has a use or purpose and needs to be collected, potentially transported and discarded or disposed of in a city. It includes municipal and industrial waste. Some examples of waste are household trash, wastewater, hazardous waste (e.g. containing hazardous chemicals) and radioactive waste (which may require special processing and disposal).

**General Note on Resources:** Resources can be broadly classified on bases upon their availability they are renewable and non-renewable resources. They can also be classified as actual and potential on the basis of level of development and use, on the basis of origin they can be classified as biotic and abiotic, and in the base of their distribution as ubiquitous and localized. An item becomes a resource with time and developing technology. Typically, resources are materials, energy, services, staff, knowledge, or other assets that are transformed to produce benefit and in the process may be consumed or made unavailable. Benefits of resource utilization may include increased wealth or wants, proper functioning of a system, or enhanced well-being. From a human perspective a natural resource is anything obtained from the environment to satisfy human needs and wants.

Resources have three main characteristics: utility, limited availability, and potential for depletion or consumption.
Natural resources are derived from the environment. Many natural resources are essential for human survival, while others are used for satisfying human desire. Natural resources may be further classified in different ways.

Resources can be categorized on the basis of origin:

*Abiotic resources* comprise non-living things (e.g. land, water, air and minerals such as gold, iron, copper, silver).

*Biotic resources* are obtained from the biosphere. Forests and their products, animals, birds and their products, fish and other marine organisms are important examples. Minerals such as coal and petroleum are sometimes included in this category because they were formed from fossilized organic matter though over long periods of time.

Natural resources are also categorized based on the stage of development:

*Potential resources* are known to exist and may be used in the future. For example, petroleum may exist in many parts of the world that have sedimentary rocks, but until the time it is actually drilled out and put into use, it remains a potential resource.

*Actual resources* are those that have been surveyed, their quantity and quality determined, and are being used in present times. The development of an actual resource, such as wood processing depends upon the technology available and the cost involved. That part of the actual resource that can be developed profitably with available technology is called a reserve resource, while that part that cannot be developed profitably because of lack of technology is called a stock resource.

Natural resources can be categorized on the basis of renewability:

*Non-renewable resources* are formed over very long geological periods. Minerals and fossils are included in this category. Since their rate of formation is extremely slow, they cannot be replenished, once they are depleted. Out of these, the metallic minerals can be re-used by recycling them, but coal and petroleum cannot be recycled.

*Renewable resources*, such as forests and fisheries, can be replenished or reproduced relatively quickly. The highest rate at which a resource can be used sustainably is the sustainable yield. Some resources, like sunlight, air and wind, are called perpetual resources because they are available continuously though at a limited rate. Their quantity is not affected by human consumption.

Many renewable resources can be depleted by human use, but may also be replenished, thus maintaining a flow. Some of these, like agricultural crops, take a short time for renewal; others, like water, take a comparatively longer time, while still others, like forests, take even longer.

**City Goods and Services:** City products include all economic goods and services consumed in a city. They include all economic sectors’ and industries’ products in the form of goods and services. They can logically be categorized by different sectors or industries (e.g. by SIC – Standard Industrial Classification⁸) within a city economy.

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⁸ [https://www.osha.gov/pls/imis/sic_manual.html](https://www.osha.gov/pls/imis/sic_manual.html) SIC has been subsequently replaced by NAICS (North American Industry Classification System) in USA.
Circular Action Items

As mentioned above, circular action items refer to a set of specific, discrete, outcome-orientated tasks that can be applied to above defined city assets and products shown in Figure 1 to improve their utilization and lifetimes. Sharing, recycling, refurbishing, reusing, replacing, digitizing, and harvesting indirect benefits have been identified in this document as potential circular action items.

I. Sharing: Sharing is the joint use of city assets and products. It refers to simultaneous or alternating use of inherently finite city assets and products.

II. Recycling: Recycling is the process of converting city assets and products into new materials and objects. Recycling can prevent the disposal of potentially useful materials (treated as waste) and reduce the consumption of fresh raw materials (that would otherwise be thrown away as trash). It is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions among other environmental impacts. It can reduce energy usage, air pollution (from incineration), and water pollution (from landfiling), etc.

III. Refurbishing: Refurbishing is about restoring an old city asset or product and bringing it up to date for further usage. Refurbishing entails collecting discarded products or materials that can be refinished and sanitized to serve their original functions. Refurbishment is often aesthetic in nature and results in a product that, although in good condition, may not be comparable with new or remanufactured products. Refurbishing or remanufacturing is a potential circular action that can be applied to extend city assets’ and products’ lifetimes. The process of refurbishing aims for existing city assets and products to be returned to 'like-new' or a better performing condition.

IV. Reusing: Reuse is the action or practice of using something again, whether for its original purpose (conventional reuse) or to fulfil a different function (creative reuse or repurposing) to extend the lifespan of city assets or products.

V. Replacing: Replacing refers to filling the place of or to providing a substitute for a city asset or product. Replacement of city assets and products or their constituent components may enhance their circularity potential in terms of extending their lifetimes and utilization.

VI. Digitizing: Digitization is the conversion of analogue or physical (tangible) products and materials to digital resources. City assets and products may be potential candidates for digitization enabling to reach more customers, achieve cost savings and reduce environmental impacts. Digitization is a form of dematerialization.

Circular City Outputs

A circular action item applied to a city asset or product constitutes a circular city output in this document. Naturally, there is a large number of potential circular city outputs given the sheer large number of city assets and products and the number of circular city actions identified in the previous two sub-sections. Hence, each entry in the below table is a potential circular city output.

<table>
<thead>
<tr>
<th>Circular Action Items</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling MP3s (digital music files) instead of compact discs; Telecommuting (reducing travel time, pollution and required office resources); Asset tracking and performance monitoring</td>
<td></td>
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</tbody>
</table>
For instance, reusing circular action item can be applied to water city resource to determine a
circular city output. Obtaining drinking water through desalination of sea water is an example of
this circular city output.
Similarly, sharing action item can be applied to economy services. Combining day care for
children and elderly people care facilities by placing a day care center in a nursing home is an
example of sharing economy services.
Segregation of compostable from non-compostable waste, with reusable items such as bottles,
metal, footwear and plastic cups being sold to scrap dealers, and the remainder being composted
and sold to farmers is an example of recycling and reusing circular action items applied to
household items as city resources.
Sharing action item can be applied to public spaces. Public spaces can be used for alternating
distinct purposes. For example, a public square can be used as a general place for public gathering
and can also be used for various art events and festivals during certain times.

Above examples are given to illustrate the concept of generating potential circular city outputs and
can be easily increased by considering various combinations of circular action items applied to
city assets and products as defined in this framework.

Circular City Enablers
Following is the list of Enablers that a city can use to assess, implement and to boost its circular
city outputs.

a. Circular KPIs and their baseline and target values11: A city’s circular
approach can be translated into Key Performance Indicators (KPIs) to measure
progress and outcomes toward intended results. Prior initiatives have already been

Table 1 – Potential Circular City Outputs10

<table>
<thead>
<tr>
<th>City Assets &amp; Products (from Figure 1)</th>
<th>Sharing</th>
<th>Recycling</th>
<th>Refurbishing</th>
<th>Reusing</th>
<th>Replacing</th>
<th>Digitizing</th>
<th>Harvesting indirect benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
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<td>Public Spaces &amp; Infrastr.</td>
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</table>

10 If time permits, we can populate the above table with various examples in the next version.
11 This U4SSC deliverable will not develop or identify circular city / economy KPIs. Rather, it will encourage utilizing applicable existing KPIs.
undertaken to define circular economy KPIs. Also, general city related indicators have been formulated some of which can be recast with a perspective of circularity. Some examples of earlier formulated circular city related KPIs are indicated below:

i. Ellen MacArthur Foundation has undertaken The Circularity Indicators Project. It provides a methodology and tools to assess the performance of a product or company in the context of a circular economy. The Circularity Indicators Project has published a toolkit and methodology for circularity indicators12.

ii. There are several other circularity indicators developed by different organizations addressing various aspects of circularity13. Cities can explore existing circularity indicators to determine which ones would be applicable to them in their own context.

iii. ISO 37120: ISO has developed 37120 under the ISO/TC 268 to help cities measure their performance for improving quality of life and sustainability14. Some of the KPIs in ISO 37120 can be utilized in the context of circular cities (e.g. waste management related KPIs).

iv. U4SSC KPIs: The “United for Smart Sustainable Cities” (U4SSC) is a UN initiative coordinated by the International Telecommunications Union and the United Nations Economic Commission for Europe and supported by the Convention on Biological Diversity, the United Nations Economic Commission for Latin America and the Caribbean, the Food and Agriculture Organisation, the International Telecommunications Union, the United Nations Development Programme the United Nations Economic Commission for Africa, the United Nations Economic Commission for Europe, United Nations Educational, Scientific and Cultural Organization, UN Environment, United Nations Environment Programme-Finance Initiative, United Nations Framework Convention on Climate Change , UN-Habitat, United Nations Industrial Development Organization, United Nations University – Operating Unit on Policy-Driven Operating Governance, UN-Women and the World Meteorological Organisation to achieve SDG1115. U4SSC serves as the global platform to advocate for public policy and to encourage the use of ICTs to facilitate and ease the transition to smart sustainable cities. U4SSC developed a set

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12 [https://www.ellenmacarthurfoundation.org/programmes/insight/circularity-indicators](https://www.ellenmacarthurfoundation.org/programmes/insight/circularity-indicators)
13 Circular Metrics Landscape Analysis - World Business Council for Sustainable Development May 2018
14 ISO 37120 briefing note: the first ISO International Standard on city indicators
15 [https://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx](https://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx)
of international key performance indicators (KPIs) for Smart Sustainable Cities (SSC) to establish the criteria to evaluate ICT’s contributions in making cities smarter and more sustainable, and to provide cities with the means for self-assessment in order to achieve the sustainable development goals (SDGs)\textsuperscript{16}. A subset of these KPIs can be used as circularity indicators.

v. The implementation framework depicted in this document is flexible enough to incorporate other KPIs which can be formulated by cities themselves for their circularity implementations. Such additional KPIs can be included in this framework during implementation by a city.

b. Awareness of circular city initiatives / action items: The success of circular city initiatives to a large extent depend on awareness of their stakeholders. The uptake of circular city initiatives / action items is highly dependent on city-wide awareness and adoption by their potential users. Explaining the benefits of circular city initiatives / action items may help in cultural and behavioural change required in some cases.

c. Training and circularity skills enhancement programs: Targeted skills enhancement programs may help in institutionalizing circularity in cities. Academic programs (e.g. university degrees and courses, related curricula changes) will help in boosting circularity skills through formal education. On the other hand, vocational and professional training programs may also help in enhancing circularity skills. In addition to education and training programs, sharing and disseminating circularity related publications, reports, research, etc. may also help in circularity related skills enhancement in a city. These programs and initiatives help create a highly skilled human capital to implement circularity in a city context. They would help close skills and expertise gaps required for implementing circularity initiatives / action items.

d. Instilling trust, safety, and security for sharing implementations in cities: Circularity includes sharing action item applied to various city assets and products. Sharing implementations may involve commercial (e.g. AirBnB for shared accommodation or Uber for ride sharing) as well as non-commercial ones (e.g. sharing of household items on a complementary basis in a city among its inhabitants). It is important to instil trust among city users for such sharing implementations. Hence, the service providers involved in sharing implementations need to ensure they gain the trust of their city customers by addressing their concerns, protecting their rights, and providing reliable and high quality services among others. Additionally, it is important for service providers involved in sharing implementations to ensure the safety and the security of shared

city assets and products. Addressing such issues consistently and reliably build trust over time for service providers.

e. **Urban industrial symbiosis:** Urban industrial symbiosis is a subfield of industrial ecology in an urban context that engages separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy and services among them\(^\text{17}\). In particular, waste resulting from a generic production process can be used as primary inputs (materials or energy) for other production processes. This allows creation of closed loops within and across industries which in turn enhances circularity for cities.

f. **Circularity related strategic planning and policy making:** City level holistic circularity strategies and policies led by the city administration can certainly align city stakeholders around a common target and mobilize them for successful implementation. In the absence of city administration led strategies and policies, private sector can assume a leading role and implement circularity in the context of city economy. Impact investment and corporate social responsibility initiatives undertaken by private sector can also catalyse circularity in a city.

g. **Utilizing procurement as a lever for circularity:** Procurement is a strong lever to emphasize and enforce circularity for both public and private sectors. It can be used as a tool to avail the supply of circular city assets and products during their or their constituents’ procurement (e.g. raw materials, components, etc.). Procurement would act as an incentive to ensure circularity in the city.

h. **Existence of financial incentives for boosting circularity:** City administrations and public sector organizations may utilize financial incentives to boost circularity in a city. That is, monetary (financial) benefits can be offered to consumers and suppliers of circular city outputs which encourage behaviour or actions to participate in circularity. Financial incentives include, but are not limited to, tax breaks, tax reductions, tax exemptions, tax holidays, lower loan rates, impact investment alternatives, excise taxes, VAT, etc. An alternative might be to provide financial disincentives for non-circular products (e.g. higher taxes for non-circular products and their suppliers), which in turn would act as indirect financial incentives for circular products and their suppliers.

i. **Public Private Partnerships for circularity:** City administrations (public sector organizations) and private sector organizations may collaborate and form alliances and partnerships to implement circularity in the city. This approach would allow partners to align and unify their goals and share risks and rewards for circularity implementations. They can also complement each other’s skills and resources.

\(^{17}\) Industrial symbiosis for a sustainable city: technical, economical and organizational issues Vito Albino, Luca Fraccascia*, Tommaso Savino - International Conference on Sustainable Design, Engineering and Construction 2015
j. **R&D programmes for circularity:** Circularity provides an enormous innovation potential for cities in addressing some of their sustainability challenges. In some cases, further research and development would be required to turn circularity ideas into reality. Well-designed R&D programmes targeting actual city challenges conducted through academia, private and public sector organizations may help overcome various obstacles for circularity implementations.

k. **Circularity regulations:** City administrations can issue various regulations and standards to boost circularity in the city. They may take the form of circularity related technical standards, product regulations, compliance standards, trade regulations, waste and safety regulations, etc. Regulations are in general ancillary or subordinate to laws; however, they are enforceable and hence constitute a strong lever for circularity.

l. **National laws and directives:** Law is a system of rules that are created and enforced through governmental institutions to regulate behaviour. Laws can take the form of legislations, directives, acts of parliament, etc. and they are influenced by the constitution. Laws can potentially be used as an alternative tool to change behaviour in a society towards circularity (in general laws are made at the national level rather than city).

m. **Certifications for circularity:** Cities can leverage on existing certifications or create new ones to encourage and incentivize circularity. Certifications rely on well-defined standards which are verifiable. Certifications are voluntary, rather than required or mandated; however, they can provide a competitive advantage for certified organizations. They are an indicator of compliance to well-defined standards or criteria and are usually issued by a credible third party after an independent auditing process.

n. **Engagement and participation of stakeholders:** It is important for cities to engage their wide range of stakeholders and to ensure their participation and inclusivity during the formulation and implementation of circularity initiatives / action items. It would be highly beneficial for cities to maximize the collective city capital through close collaboration with public sector, private sector, academia, individuals (public), NGOs and civil society in general for circularity. Collaboration platforms can be used by cities to ensure broad engagement.

o. **Circularity related city innovation ecosystem:** Fostering a robust and productive ecosystem will help boost circularity in cities. Entrepreneurs can be encouraged and incentivized to establish start-ups for addressing circularity implementation challenges in cities. Accelerators and incubators can be utilized to flourish and support circularity related SMEs. City circularity challenges can be posed as business opportunities to be addressed by the members of city innovation ecosystem. City circularity challenges would constitute concrete demand to be met by entrepreneurs and SMEs in the city innovation ecosystem.
6- Circular City Implementation Framework - Methodology

This section describes the four-step circular city implementation methodology. The methodology depicted in this section is an action oriented pragmatic approach emphasizing implementation.

Step 1: Assess Current Circularity (Baselining)

This step entails conducting a swift baselining audit which determines the current status for a city with respect to its circularity. More specifically, it evaluates a city’s baseline with respect to the following three components:
   a. Existing circularity KPIs,
   b. ongoing city-level circular initiatives and action items, and
   c. various circular city enablers to assist in implementation.

Each of the above components is explained below briefly.

a. Existing circular city KPIs
This component includes actual KPIs formulated and being acted upon by a city towards achieving its various circularity targets. For some cities, they may have been undertaken as part of a city’s overall approach for implementing circularity and may reflect its own city level priorities and needs. In some cases, they may be national level initiatives being implemented at the city level (or local level). Alternatively, the KPIs can also be a combination of both city and national level ones. Following table indicates a simple approach that a city can use to collect its list of circularity KPIs.

<table>
<thead>
<tr>
<th>City Circularity Key Performance Indicator (KPI)</th>
<th>Baseline Value (if known)</th>
<th>Target Value and Timeframe (if known)</th>
<th>Measurement Frequency</th>
<th>KPI Owner</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPI 1</td>
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<td>KPI 2</td>
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<tr>
<td>KPI N</td>
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</tbody>
</table>

b. Ongoing circular city list of initiatives / action items
This component includes actual initiatives / action items formulated and being implemented by a city towards achieving its circularity targets. For some cities, these initiatives / action items may have been formulated to achieve circularity KPIs used by
the city. Alternatively, they may have been undertaken as part of a city’s overall approach for implementing circularity (e.g. pilots, trials, strategic projects, etc.) and may reflect its own particular urban needs. In some cases, they may be national level initiatives being implemented at the city level (or local level).

It is quite probable that there will be multiple initiatives / action items formulated and being implemented to achieve circularity targets.

Following table indicates a simple approach that a city can use to collect its list of circularity initiatives / action items.

<table>
<thead>
<tr>
<th>City Circularity Initiative / Action Item Name</th>
<th>City Circularity KPIs (if any)</th>
<th>Brief Explanation</th>
<th>Milestones</th>
<th>Owner</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiative / Action Item 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Initiative / Action Item 2</td>
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<tr>
<td>Initiative / Action Item N</td>
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</tbody>
</table>

### c. Enablers

Circular city enablers were defined earlier in section 5. The presence and utilization of these enablers is projected to elevate the likelihood of success for a city in implementing its circular initiatives / action items.

A simple table incorporating hitherto discussed enablers is shown below. It can be used by a city to assess its current status, or baseline, with respect to its circularity implementations. The questions in the table are fairly high-level and in some cases may require further clarification and description by the city to determine its current status.

<table>
<thead>
<tr>
<th>Assessment Element</th>
<th>Currently Exists</th>
<th>Brief Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there awareness programs for circularity related initiatives in the city?</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there skills boosting programs to enhance and</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Yes/No</td>
<td></td>
<td></td>
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<tr>
<td>-------------------------------------------------------------------------</td>
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<tr>
<td>enrich circularity knowledge in the city?</td>
<td></td>
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<tr>
<td>Are there established trusted intermediaries (or plans in place) for sharing initiatives in the city?</td>
<td>☐</td>
<td></td>
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</tr>
<tr>
<td>Are there mechanisms in place to ensure the security and safety of shared city assets and products?</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there existing skills in place within public and private sectors to implement circularity?</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the city stakeholders currently aware of circularity initiatives / action items in the city?</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are broad stakeholders defined for city circularity initiatives / action items?</td>
<td>☐</td>
<td></td>
<td></td>
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<tr>
<td>Are there existing collaborations and partnerships in place among city industrial organizations for circularity implementations?</td>
<td>☐</td>
<td></td>
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</tr>
<tr>
<td>Are there circularity related existing strategies and policies in the city public and private sectors?</td>
<td>☐</td>
<td></td>
<td></td>
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<tr>
<td>Is procurement utilized as a lever for circularity related implementation projects?</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there existing financial incentives in the city for circularity related implementation projects?</td>
<td>☐</td>
<td></td>
<td></td>
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<tr>
<td>Are there existing PPP style partnerships in the city for circularity related implementation projects?</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there existing R&amp;D programs and other targeted academic programs for circularity related implementation projects?</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Are there regulations and laws (e.g. laws, directives, legislations, standards) supporting or impeding circularity related implementation projects in the city?

Are there existing certification programs in the city for circularity related implementations?

Are the stakeholders in the city engaged broadly for circularity related implementations?

Is there a vibrant and rich innovation ecosystem in the city to address and implement circularity related implementations?

Step 2: Prioritize & Determine Future Circularity

Having assessed its current status in Step 1, the city can then formulate its own circularity initiatives / action items. The city can engage its broad range of stakeholders to not only define its own city circularity priorities and needs but also determine a long list of circularity ideas for implementation.

The potential list of circular city outputs (i.e. different combinations of circular city action items applied to city assets and products) can assist in identifying a long list of potential circularity innovations in the city. Specific city needs and priorities may help emphasize certain circular city outputs among the potential ones or conversely deemphasize / eliminate others. Each city may have to go through this exercise based on its own context and specific aspirations and goals.

Another important input to this step might be an international benchmarking of other cities’ successful circularity initiatives / action items. The city needs to be careful in assessing the applicability of international benchmarks as the context of cities and their particular aspects may vary significantly.

During this step, a long list of circularity initiatives / action items can be formulated for implementation. In fact, it might be preferable for a city to utilize its collective capital extensively to come up with various ideas contributing to circularity in its own urban context.

**Circularity prioritization approach**

The city might not be equipped or may lack the requisite resources to implement the list of circularity ideas in its entirety. In such cases, a prioritization mechanism will be highly
beneficial. A pragmatic prioritization approach is included in this implementation framework with two main criteria. The first criterion is the value which identifies the projected value of the circularity idea. The second criterion identifies the projected ease of implementation of the circularity idea in the city’s own context. Each criterion is composed of several sub-criteria which are briefly explained below.

**i. Value**

- *Alignment with city circularity vision & strategy:* This sub-criterion refers to circularity idea’s overall fit to city’s existing circularity vision and strategy, (if it exists).

- *City Circularity KPI(s) Impact:* This sub-criterion indicates the extent of circularity idea’s contribution to existing circularity KPI(s) in the city (if any).

- *Social Impact:* This sub-criterion assesses the impact of the circularity idea on people and communities in the city. It would include issues such as people’s lifestyle, culture, participation and engagement, health and well-being, personal freedom and privacy, concerns and aspirations among others. It is also important to assess whether it impacts the entire city or a subset of the city inhabitants.

- *Economic Impact:* This sub-criterion assesses the impact of the circularity idea in the city’s economy. Economic impact can include issues such as Gross Domestic Product (GDP) of the city, employment, wealth, disposable income, skills of the labor force among others.

- *Environmental Impact:* This sub-criterion assesses the impact of the circularity idea in the city’s overall environment. Environmental impact captures effects of the circularity idea on urban natural environment and resources (e.g. city water, energy, emissions, air, land, waste).

**ii. Ease of Implementation**

- *Implementation Cost:* This sub-criterion measures the total cost and requisite financial resources for implementing the circularity idea.

- *Implementation Timeframe:* This sub-criterion refers to the total implementation time of the circularity idea.
• **Implementation Risk**: This sub-criterion encapsulates various risks which may potentially arise during the implementation of the circularity idea. Following factors may help in assessing various risks.

  o **PESTEL barriers**: This factor captures political, economic, social, technological, environmental and legal barriers which exist in the city and may hinder the implementation of the circularity idea.

  o **Complexity**: This factor reflects the complexity for implementing the circularity idea in terms of number of stakeholders involved, various uncertainties involved in implementation, dependencies and connections to other initiatives / action items in the city, among others.

  o **Competence and knowledge**: This factor includes the extent to which the circularity idea can be implemented by harnessing the existing knowledge and skills in the city as an overall ecosystem.

  o **Health & Safety concerns**: This factor entails various concerns and ramifications related to health and safety aspects within the city regarding the circularity idea.

  o **Ethical Issues**: This factor captures various ethical concerns which may potentially arise during and after the implementation of the circularity idea.

The city can use a simple scoring system for various criteria and their sub-criteria. For example, a simple three level (Low, Medium, High) or a five level scoring system can be adopted by the city. The scores can be determined either quantitatively or qualitatively relying on available data and conducted analyses, if any. Having a well-defined prioritization approach helps cities facilitate their relative scoring among the circularity ideas.

The city can apply the prioritization approach described above and can evaluate all formulated ideas.
Figure 2 – Evaluation of Circular City Action Items

The figure above shows how the prioritization approach can be used to facilitate the selection of a subset of circularity ideas by applying the well-defined criteria. The city administrators can subsequently short list circularity ideas for implementation; such as selecting high value and easy to implement circularity ideas. Similarly, low value and relatively highly difficult circularity ideas may be either eliminated or given low priority during implementation.

Hence, at the end of Step 2, the city will have a concrete list of circularity initiatives / action items implementation. The city can then craft an implementation plan by deciding which circularity initiatives / action items to kick-off and when certain constraints such as resources availability may determine actual implementation timings. The circularity initiatives / action items can be phased out depending on dependencies, constraints and their mitigation timeframes. In some cases, cities may select to reduce implementation risks before commencing implementation.

**Step 3: Catalyze / Boost Circularity**

Some of the earlier discussed enablers can be utilized during this step to potentially enhance the effectiveness of selected circularity initiatives / action items for implementation. The city can utilize an appropriate mix of the earlier defined enablers to implement its own circular initiatives. In other words, combinations of enablers can be used during the implementation. Some examples of potential enablers are given below to illustrate the concept.

Circular city / economy KPIs can be defined together with their baseline and target values which may guide the implementation. They can be used to measure performance of circular city initiatives and also monitor their implementation progress.
Various tools that can be used to overcome awareness gaps such as education and training programs, university programs, vocational programs to enhance skills and competencies; existing published materials in this area such as reports, publications which can be distributed and disseminated to public as well as various related entities in circularity. A trusted intermediary might be essential for various shared social and economic circularity. Ensuring security and safety of shared resources would be important. Skills and expertise in both public and in policy makers can be a potential barrier. Hence, capacity building, peer learning and twinning among cities can be used as potential action items (policy levers). Cultural and behavioural (e.g. in recycling) aspects may pose barriers and it might be beneficial to inform and explain the benefits of circular actions to related stakeholders. Urban industrial symbiosis initiatives may be utilized for exchanging resources at an industry, cross-industry or city level. Strategic planning and circularity related policy making in public and private sectors might be beneficial to adopt a holistic high-level approach. Procurement can be used as a lever for circularity (e.g. procuring circular materials). Financial incentives can be used for boosting circularity (e.g. tax breaks, reductions, exemptions, holidays, lower loan rates, impact investment, etc.). Public Private Partnerships and other appropriate financial mechanisms may be used to boost circularity. R&D programmes may be formulated and implemented in collaboration with academia in the city. Regulations may be used as policy levers and tools to catalyse circularity implementations. (e.g. technical standards, product regulations, compliance standards, trade regulations, waste and safety regulations, etc.). National laws and directives (legislation) provide an enabling framework to encourage and boost circularity. At the national level, a proper legislation system can direct the circularity processes and enable stakeholders to coordinate efforts and operate in an appropriate manner. Certification programs may be formulated to incentivize and encourage both the public and the private sectors for circularity implementations. Engaging a broad range of stakeholders may increase the likelihood of success for circularity implementations (e.g. public sector, private sector, academia, individuals, NGOs and civil society in general). Nurturing a rich innovation ecosystem and involving and incentivizing entrepreneurs and SMEs to address circularity implementation challenges would help boost circularity in a city. Incubators, accelerators, hackathons, etc. might be leveraged for enriching the city innovation ecosystem around circularity.

**Step 4: Assess Projected Circularity Impact**

This step involves either interim or final assessment of the results of implementing circularity initiatives / action items in a city. Cities are strongly recommended to retrospectively and objectively conduct assessments comparing actual outcomes with respect to intended ones. If the city had adopted circularity KPIs with target values and target implementation timeframes for circularity initiatives / action items, it would be highly beneficial for the city to evaluate whether the targets have been met.
Similarly, the city can evaluate various enablers for their effectiveness during the implementation. Gaps in them can be identified to address and correct in due course. Lessons learnt can be derived to understand positive and adverse consequences of the circularity initiatives / strategic action items. Positive aspects of successful circularity initiatives may be potentially cross-utilized among other circularity initiatives / action items; for example, a successful policy in one initiative may trigger the use of a similar policy approach in another one. Such examples can be extended to other enablers as well. On the other hand, identification of ineffective enablers would result in their potential relinquishment in due course.

Circularity initiatives / action items are interventions in an urban context and inevitably lead to various transformations. Therefore, it is important to assess their impact retrospectively. An ex-post impact assessment would be highly beneficial to understand various social, economic and environmental changes that occurred in the city and compare them to the intended ones prior to implementation.

The comparison of ex-ante and ex-post impact assessments will indicate deviations in terms of intended and actual outcomes. Such deviations may aid in planning more accurately in due course or fine-tuning circularity initiatives / action items.

1. **Further Actions / Steps**

- Further revise / fine-tune the framework.
- Turn this into an iterative (circular) framework whereby Step 4 feeds back into Step 1 kicking off another implementation cycle.
- Add a conclusion
- Enhance the overall structure, look and feel of the document eventually.