

# Circular Economy Guidebook for Cities



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# Preface

## The Collaborating Centre for Sustainable Consumption and Production (CSCP)

The CSCP is a Think and Do Tank that works with businesses, policymakers, partner organizations and civil society towards a sustainable planet. The United Nations Environment Program (UNEP) and the Wuppertal Institute for Climate, Energy and Environment jointly founded the CSCP in 2005. As a non-profit organisation we focus on the promotion of sustainable patterns of consumption and production (SCP).

Our vast expertise in the fields of consumption and lifestyles, entrepreneurship and products, services and infrastructure enables us to connect thematic knowledge with skills in supporting successful and effective stakeholder engagement and capacity building. Our experience has proven the most powerful solutions emerge when the creativity of a range of actors is brought together within a single “collaborative umbrella”. For that reason, we strive to initiate and facilitate multi-stakeholder processes that catalyse partnerships to implement sustainable solutions.

Over the last years, we have grown more and more into the realm of circular economy and it has become a topic of priority for us. Under this umbrella, the practical development of circular cities has garnered our attention and fascination. We believe only through collaborative action can progress be achieved. This action might include the enabling of necessary technical innovation, creating new or redesigning existing infrastructure, identifying circular-based business models, circular procurement or setting in motion the right environment for citizens to adopt sustainable lifestyles.

Based on our work from international research projects as well as regional ground work on circular cities, the objective of this guidebook is to give practical advice to actors involved in the development of a circular city as well as a contribution to the overall discourse.

We are steadily looking for further opportunities to bring in our expertise and commitment to the development of circular cities as well as the circular economy through collaborative endeavours. We do this with partners who share our fascination with sustainability.

We’d like to thank Piyush Dhawan who temporarily joined the CSCP as a fellow of the Alexander von Humboldt Foundation in 2018 and who is also the lead author of this publication.

## Circular Cities: Why is this desirable?

Over 90% of the raw materials used globally are not cycled back into the economy, resulting in massive overexploitation of the finite natural resources of our planet and burdening our climate. The Earth Overshoot Day, a yearly indicator of the overexploitation of the planet's biocapacity, is advancing every year. In 2019, it falls on July 29, whereas at the beginning of this century it was on September 23. Greenhouse gas emissions and pollution have reached unprecedented levels, risking human livelihoods, food security, biodiversity as well as the general well-being of the planet.

While looking for solutions, sustainability forerunners started moving away from the traditional and still widespread linear economy model of producing and using goods and services (take, make, dispose) to circular solutions (make, (re)use, recycle). Circularity has great potential to overcome global sustainability challenges in our world, reducing the use of raw materials and keeping the materials in the loop as long as it is feasible. This reduces and minimises the ecological footprint of every human-made product, saving the Earth. According to the UN Environment Statistics, a fully circular economy would both cut down our resource use by 28% and reduce carbon emissions by 72%.

Cities are growth engines in need of supervision and control. They are the major contributors to climate change and responsible for up to 76% of the carbon emissions. Even though they occupy less than 2% of the Earth surface, they account for 75% of natural resource consumption and 50% of global waste production. On the solution side, cities are also magnets for creative potential and thus facilitators of societal transformation towards more sustainability in public as well as the private sector. Cities are among the most important actors which can positively influence development if they turn circular.

That said, there are challenges that need to be addressed to enable cities to pursue circularity. These include the need for technical innovation, creating new or redesigning existing infrastructure, understanding and tapping the potential for new business models, managing the shift to more sustainable and fair procurement as well as developing approaches to motivate citizens to adopt sustainable lifestyles. When looking at the „how to achieve progress“ it becomes clear that common collaborative action between different stakeholder groups within cities – such as citizens and private initiatives, entrepreneurs, NGOs, policymakers, academia – is needed. This guidebook addresses challenges by suggesting systematic approaches, deriving context-related recommendations and providing concrete examples united under the goal to achieve progress towards circularity in cities.

# Key messages

There is growing optimism about the potential of the ‘circular economy’ (CE) as a new model for sustainable growth. A CE is one in which products are recycled, repaired or reused rather than thrown away, and in which waste from one process becomes an input into other processes. The circular economy may best be realized at the city level where cities and their metropolitan regions are at just the right scale to make the shift.

In recent months there has been CE-related activity in cities as diverse as Maribor in Slovenia, Peterborough in the UK and Abuja in Nigeria. There is as much traction on the topic of CE in major cities of China, India, South Africa, Rwanda as there is the Netherlands and the UK. However, there is no silver bullet as to how a city could become circular? No two cities are the same and it is important to understand what is it that a city’s USP is and what is it that it wants to make circular?

The prospects of a Circular City excited the imagination but dreaming up what a “Circular City” will look like in the future is nothing less than a Utopian exercise. What is appealing for the citizens in Copenhagen or London is surely not going to be the same for a citizen in Mumbai or Sao Paulo.

In this guidebook, cities have been classified into four broad categories of whether a city is a legacy city or a pioneering city in a developed or an emerging economy. Based on the classification a number of examples from cities across the continents have been documented which have already embarked upon the journey to being more circular.

The circular economy will not emerge on its own, apart from technical innovation which would play an integral role in the road to circularity, the process will also require collaborative efforts across the value chain, involving individuals, the private sector, different levels of government and civil society. Companies need to design products with circularity in mind and build components that can close loops in production. Individuals have a key role in creating demand. The public sector needs to play its part in making available the necessary infrastructure, and formulating policies and regulations that incentivize innovation including circular public procurement efforts without imposing burdens that dampen growth. In this guidebook we would also discuss some of the mechanisms and initiatives that could be implemented by all the stakeholders; and how stakeholders can be enabled to contribute to a circular city development.

# 1

## The connected us!

Globally, 3 million people move to urban areas every week. 54% of the world's population live in urban areas, and cities account for 85% of global GDP generation<sup>1</sup>. With only 1% of the world's total land mass, they are home to over 50% of the human population (Wang, Lee, Zhang, Chen, & Li, 2018). Cities are also aggregators of materials and nutrients, accounting for 75% of natural resource consumption, 50% of global waste production, and 60-80% of greenhouse gas emissions (Ellen Macarthur Foundation, 2017). As Christopher Chase-Dunn has pointed out, it is not population or territorial size that drives world-city status, but economic weight, proximity to zones of growth, political stability, and attractiveness for foreign capital. In other words, connectivity matters more than size. Cities thus deserve more nuanced treatment on our maps than simply as homogeneous black dots (Khanna, 2016). In 2020, we will witness the coming of age of the first cohorts of the Generation C ("C" for connected) that have lived their entire lives surrounded by the digital world. By then, the four horsemen of the Fourth Industrial Revolution – automation, augmented reality, cloud computing, and ambient intelligence – will have ushered in Industry 4.0 in all its digital splendour (Puutio, 2018).

Cities, particularly in developing countries face multiple major challenges, including a rapid increase in urban populations with limited access to social services, burgeoning municipal waste generation, inefficient infrastructures and air pollution. People are generally striving for a higher degree of well-being, one of the main motivations of moving to cities, but it appears that urban consumption and modern lifestyles are only partially fulfilling this desire. Having said that, cities in developed countries also face huge challenges related to reducing resource and energy requirements and climate change, as well as social challenges related to deprived groups, shrinking populations, decreasing labour conditions, and withdrawal of the welfare state. Citizens in developing countries are more concerned about getting a livelihood, in the developed countries the emphasis has been more on moderation of lifestyles and reducing resource and energy intensity of lifestyles (Future Earth KAN SSCP Working Group, 2018).

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<sup>1</sup> World Bank, Urban Development Overview (March, 2017), <https://bit.ly/2ClyDpZ>

# 2

## Challenges of cities

Cities are under siege: despite crumbling infrastructure, they must accommodate thousands of new people each year who move in search of better jobs, services and culture. As demands for energy and better infrastructure increases, we can no longer afford – environmentally, politically or economically to ignore that cities have become the cusp of all human activities.

### 2.1 Structural waste and economic losses in cities

In the urban context where analysis has found significant structural waste in key sectors such as mobility, food, and the built environment. For example, in Europe, the average car is parked 92% of the time, 31% of food is wasted along the value chain, and the average office is used only 35–50% of the time, even during working hours. The waste generated through these ineffective processes brings about additional costs due to waste management and collection spending which increases pressure on municipal budgets. In developing markets today, solid waste management and collection costs can sometimes reach 50% of municipal annual budgets.<sup>2</sup>

### 2.2 Ecosystem degradation and negative environmental impacts

The negative externalities of the linear model in cities include air, water, and noise pollution, the release of toxic substances,

and greenhouse gas emissions. Urban areas are major contributors to greenhouse gas emissions (60-80% on a global scale). As cities grow, so does their exposure and vulnerability to natural disasters. With over 90% of all urban centres<sup>3</sup> located in coastal areas, cities are facing increasing risks from devastating hurricanes, floods, and other natural hazards that are becoming more frequent, intense, and severe due to climate change. At the same time approximately 80% of urban areas have air pollution levels that exceed the World Health Organization's limits. These conditions have adverse effects on cities that go beyond the direct impacts on human health; for example, in China, studies have shown that low air quality is undermining city competitiveness and is leading to a significant brain-drain from China's largest cities.

### 2.3 Consumer culture and lifestyles

Higher income levels and a culture of consumerism leads to more material consumption and more waste. This includes the “nutrition transition” toward higher caloric and more processed food. These lifestyles are spreading worldwide, especially in urban centres and suburbs, and are major drivers for increasing material consumption levels and urban footprints (Future Earth KAN SSCP Working Group, 2018).

### 2.4 Growing inequality within cities

Especially in relation to consumption and production patterns an unequal distribution of benefits and burdens through urban provisioning systems (including unequal access to services like healthcare, housing and education) is a growing concern. This includes quantitative relationships between income levels, education levels, and age distribution and the ecological footprints in cities; as well as qualitative relationships and case studies.

<sup>2</sup> World Bank, Urban Solid Waste Management (2016), <https://bit.ly/2CGyHqk>

<sup>3</sup> Worldbank, 3 Big ideas to achieve sustainable cities and communities <https://bit.ly/2DxOwiY>

### The rise of Urban Mining (Webster, 2017)

Professor Dr. Thomas E. Graedel from the Yale School of Forestry and Environmental Sciences idea of Urban Mining as it stands today involves careful stock assessment, periodic tables and timelines recapitulating availability. He explains that the energy used for primary production is embodied, to a large extent, in the metal and, consequently in the building, too. Today's buildings and their contents therefore present large 'urban mines' of around 400 million tonnes of aluminium metal that can be extracted and recycled by further generations through the use of only 5% of the originally used energy, not just once but repeatedly. It is estimated that roughly 30 times more gold in mobile phones circuitry than in ore as processed in mines on a tonne to tonne basis, the potential within cities surely seems striking. Urbanization also represents a powerful opportunity for emerging cities to be designed in a way that is sustainable and inclusive.



## What is circular economy?

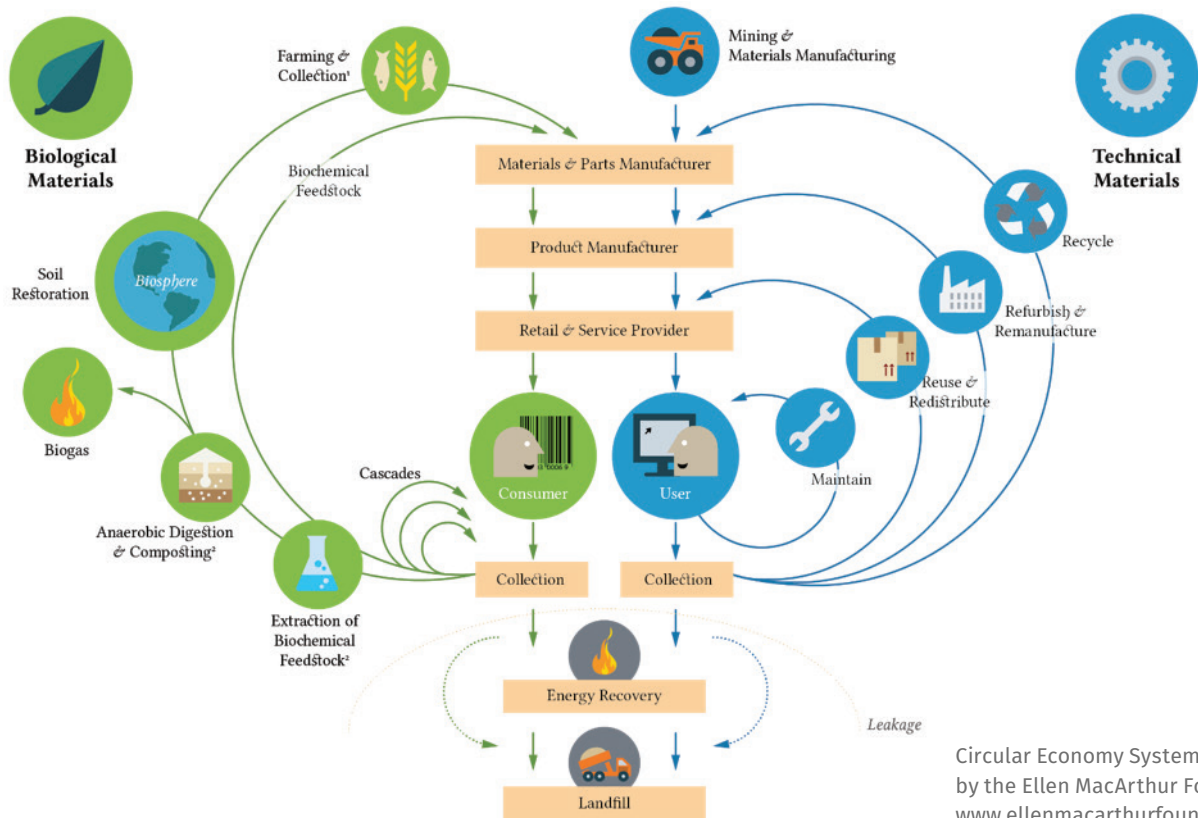
A circular economy is a systemic approach to economic development designed to benefit businesses, society, and the environment. In contrast to the 'take-make-dispose' linear economy, a circular economy is restorative and regenerative by design and aims to decouple growth from the consumption of finite resources. It is based on three principles i.e. to design out the waste and pollution, keeping the products and materials in use and to regenerate natural systems.

The model distinguishes between technical and biological cycles. In a true circular economy, consumption happens only in biological cycles, where food and biologically based materials (e.g. cotton or wood) feed back into the system through processes such as composting and

anaerobic digestion. These cycles regenerate living systems (e.g. soil), which provide renewable resources for the economy. Technical cycles recover and restore products, components, and materials through strategies including reuse, repair, remanufacture or (in the last resort) recycling. The butterfly diagram of the Ellen MacArthur Foundation depicts how every product needs to be designed taking into consideration both the technical and biological cycles involved in the manufacturing process.

<sup>4</sup> <http://www.product-life.org/en/cradle-to-cradle>





A circular economy is characterised by a number of principles which hasn't been thought in a linear industrial economy viz a viz (adapted from the Cradle to Cradle Approach)<sup>4</sup>

- The smaller the loop (activity-wise and geographically) the more profitable and resource efficient it is
- Loops have no beginning and no end

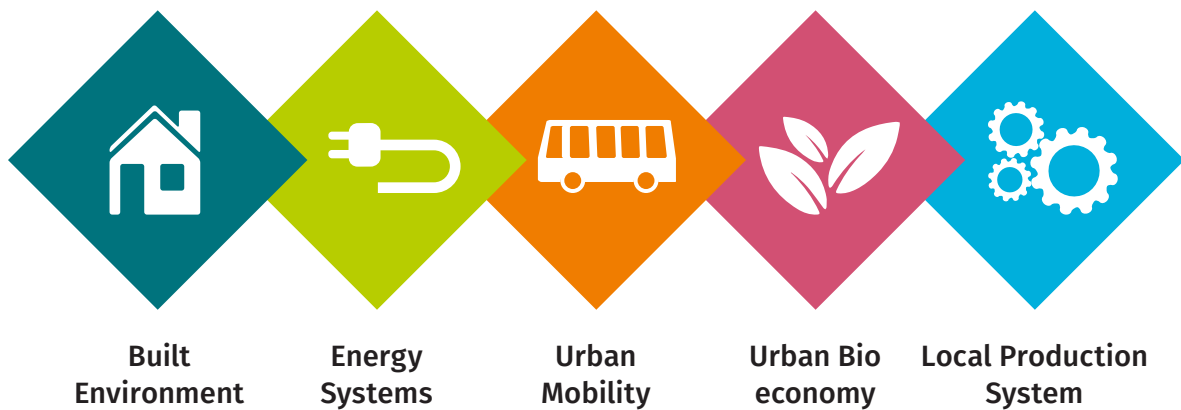
- The speed of the circular flows is crucial: The efficiency of managing stock in the circular economy increases with a decreasing flow speed
- Continued ownership is cost effective: Reuse, repair and remanufacture without a change of ownership saves double transaction
- A circular economy needs functioning markets

# 4

## What could a vision for a circular city look like?

A circular city embeds the principles of a circular economy across all its functions, establishing an urban system that is regenerative, accessible and abundant by design. These cities aim to eliminate the concept of waste, keep assets at their highest value at all times, and are enabled by digital technology. A circular city seeks to generate

prosperity, increase liveability, and improve resilience for the city and its citizens while aiming to decouple the creation of value from the consumption of finite resources (Ellen Macarthur Foundation, 2017). By focusing on the following thematic topics which are present in every city we could progress towards circularity.



- **A built environment** is one that is designed in a modular and flexible manner, sourcing healthy materials that improve the life quality of the residents and minimise virgin material use. The forms and constructs of buildings, infrastructure, districts and cities have the capacity to shape how we achieve circularity in every other part of the economy. (Components of buildings will be maintained and renewed when needed, while buildings will be used where possible to generate, rather than consume, power and food by facilitating closed loops of water, nutrients, materials, and energy, to mimic natural cycles.)

- **An urban mobility system** that is accessible, affordable, and effective. A multi-modal mobility structure that will incorporate public transportation, with on-demand cars as a flexible last-mile solution. Transportation will be electric-powered (from renewable energy), shared, and automated. Central to vehicle design will be remanufacturing, durability, efficiency and easy maintenance.

- **An urban bio economy** where nutrients will be returned to the soil in an appropriate manner while generating value and minimising food waste. Nutrients could be captured within the organic fraction of municipal solid waste and wastewater streams and processed to be returned to the soil in forms such as organic fertiliser – used for both urban and rural agriculture.

- **Energy systems** that are resilient, renewable, localised, distributed and allow effective energy use, reducing costs and having a positive impact on the environment. Visions on a circular economy have been formulated in response to concerns about resource scarcity and impacts associated with unsustainable use of resources. Replacing non-renewable resources, especially fossil fuels, by biomass is a corner stone in the circular economy. Even though the use of biomass grows, fossil fuels will probably be part of the energy mix for decades to come. Therefore, we also need to find solutions that reduce fossil carbon emissions in the near term and bridge to longer term development.
- **Production systems** that encourage the creation of 'local value loops'. This means more local production and increased and more diverse exchanges of value in local economies. The circular economy could also help in examine the food system in a comprehensive manner with the aim of minimising food waste.

Additionally, the transition to a circular economy would need

- **Circular Economy Legislation and Policies**  
Governments and local authorities can play a major role in the transition towards CE. CE enabling legislation as well as incentive policies can drive producers and consumers towards a more circular economy. Prices of resources and products influence consumer and producer behaviour. Thus, governments can influence this behaviour by influencing prices by means of taxes and subsidies. Besides influence on prices, governments can also affect the ways in which consumers may be inclined to buy CE products. By providing CE labelling for products and companies consumer choices may also be affected. A further major level to be used by governments is a circular procurement strategy to scale-up markets and pull for innovation.

- **Awareness, Education and Research**  
This driver is on the top priority of the Zero Waste concept and also for the CE Cities concept. Without the right amount of environmental awareness and knowledge among governments and academia, society remains unable to achieve CE goals. Governments and scholars play an important role to disseminate knowledge to both producers as well as consumers by CE programs, transformative education, and research.

In the following chapters, we will discuss who are the key stakeholders that can drive this transition forward and also what kind of tools and mechanism each stakeholder could use to make their city circular.

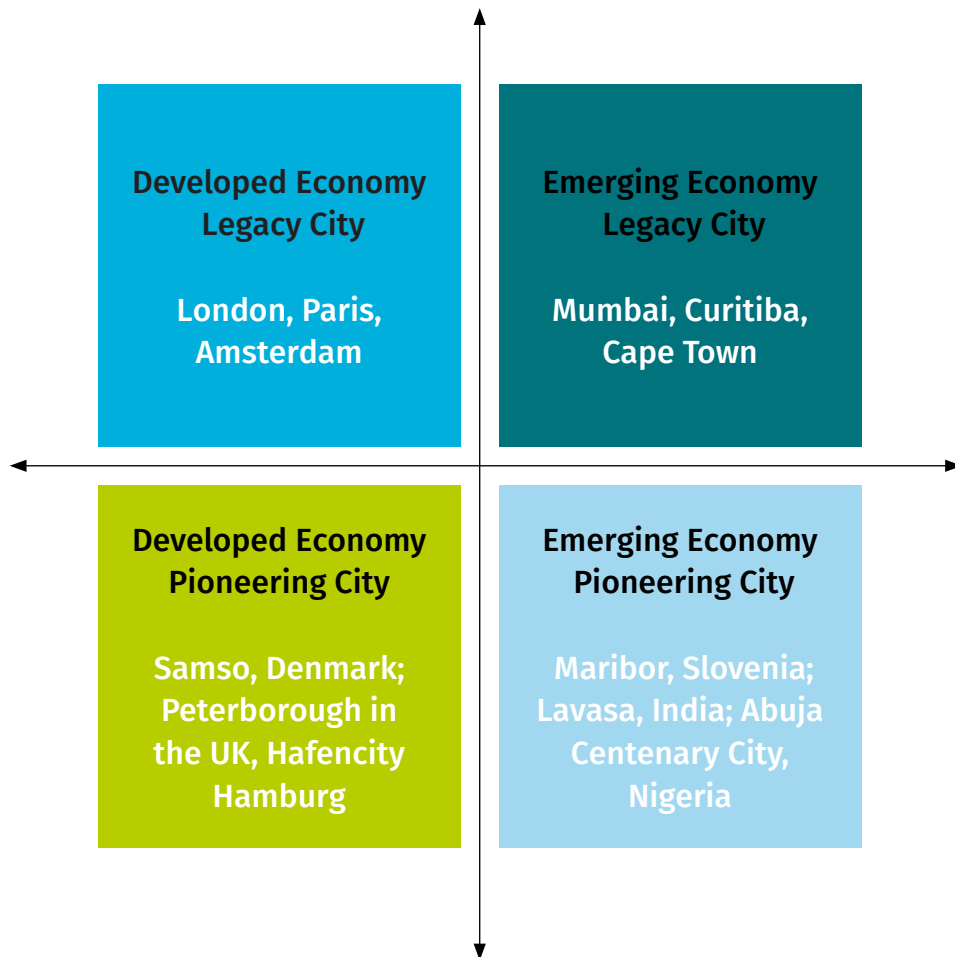
# 5

## Let's make our city circular!

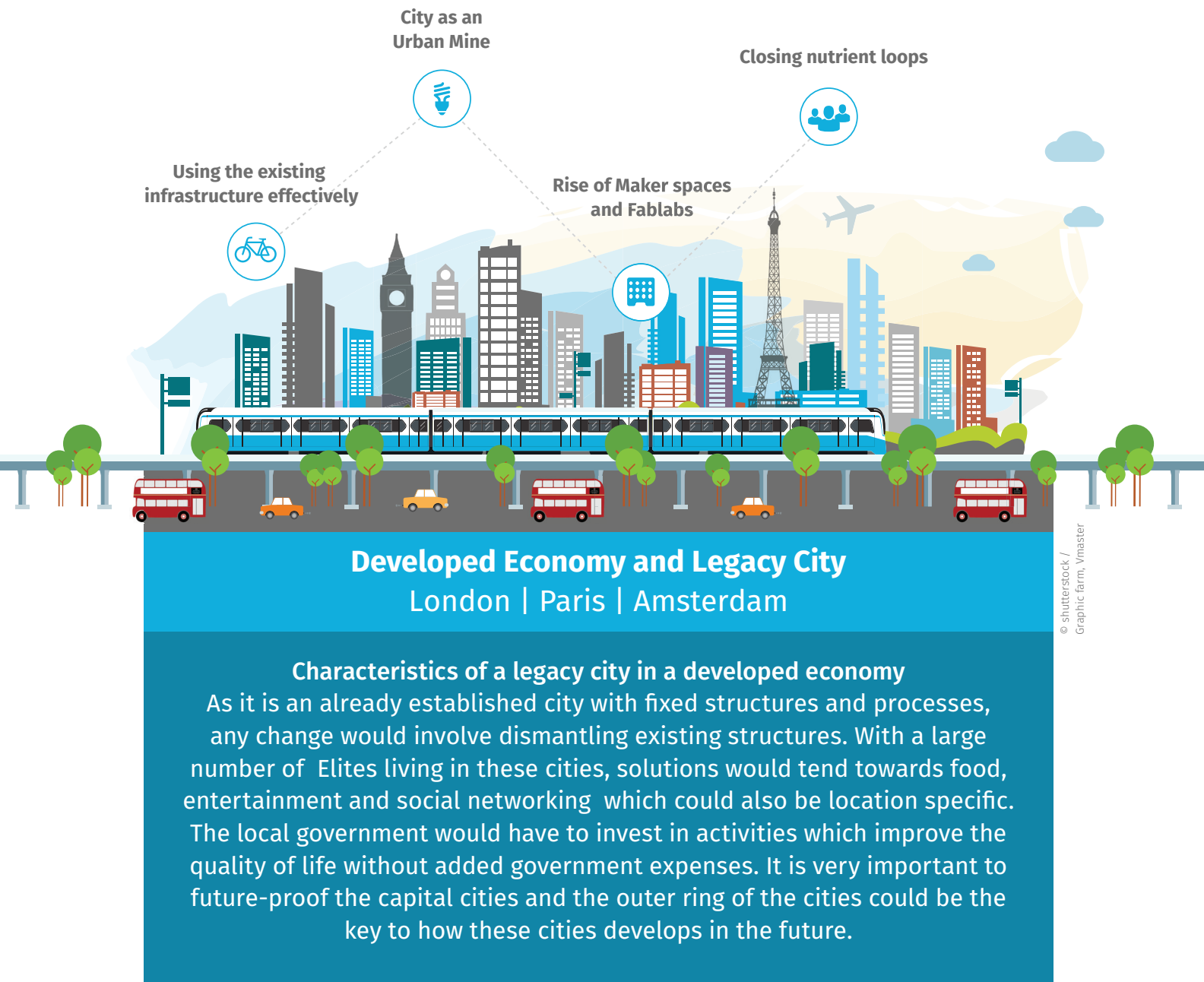
Cities are different. So are solutions.

The prospect of urban innovation excites the imagination. But dreaming up what a “Circular City” will look like in some gleaming future is, by its nature, an utopian exercise. The fact is that no two cities are same, what’s appealing for the young in Copenhagen certainly won’t help millions of workers in Dhaka or Lagos. John D. Macomber<sup>5</sup> recommended to classify cities

into four segments across two distinctions for his work on Smart Cities which could be used for a Circular City as well. Here we differentiate cities into four quadrants i.e.: legacy vs. pioneering cities, and developed vs. emerging economies. We have used this framework to document how various cities across the globe are incorporating principles of Circular Economy into a city framework.



<sup>5</sup> John D. Macomber is a senior lecturer in the finance unit at Harvard Business School. He teaches in HBS’s Business and Environment and Social Enterprise Initiatives



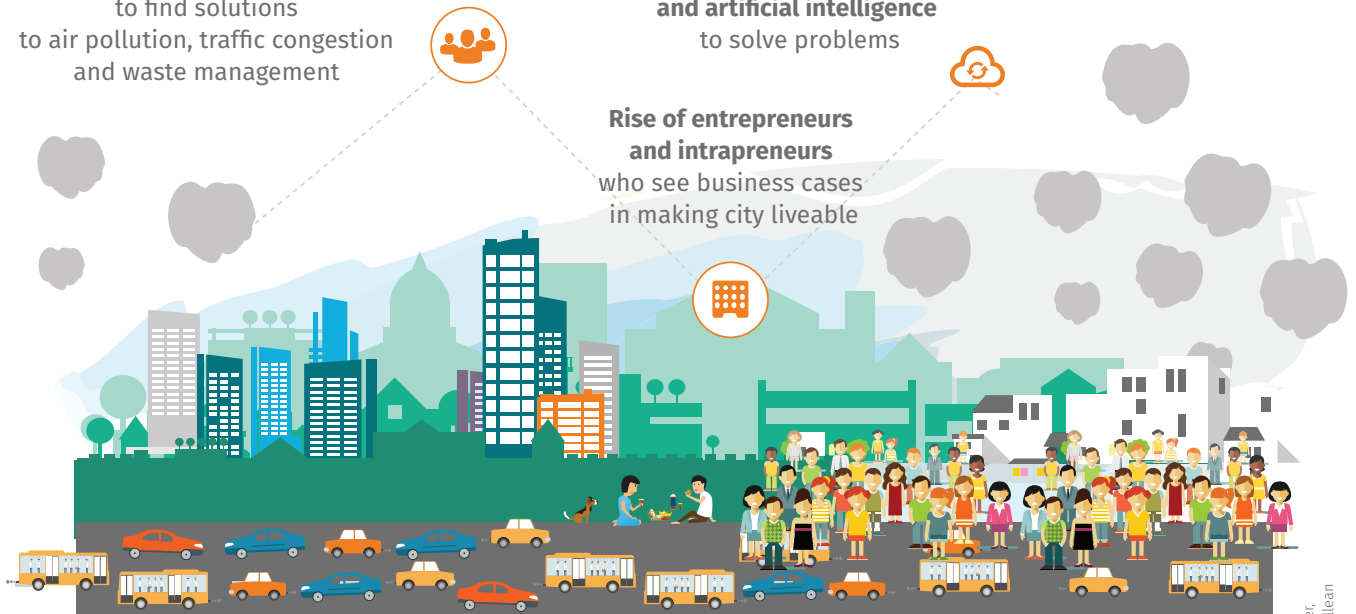
### Initiatives

- In July 2017, the Paris City Council unveiled a 15-point action plan as part of the first roadmap to transition the City of Light to a circular economy.
- Amsterdam's material flow analysis address how inputs such as water, energy, metals and minerals are used by the various industrial sectors in the city (Circle Scan Amsterdam)
- The London Waste and Recycling Board (LWARB) in 2017 published a route map to accelerate the circular economy in London. In each of five focus areas – built environment, food, textiles, electricals and plastics – it details opportunities, challenges, current initiatives and practical actions
- The FORCE project with (Copenhagen, Hamburg, Lisbon and Genoa) aims to minimise the leakage of materials from the linear economy and work towards a circular economy.
- Rotterdam's extensive mapping of resource flows also shows the potential for Urban Metabolism approach to urban planning and design, one that regards cities as living bodies.

**Public-private partnerships (PPP)**  
to find solutions  
to air pollution, traffic congestion  
and waste management

**Use of big-data technologies  
and artificial intelligence**  
to solve problems

**Rise of entrepreneurs  
and intrapreneurs**  
who see business cases  
in making city liveable



## Emerging Economy Legacy City Mumbai | Curitiba | Cape town

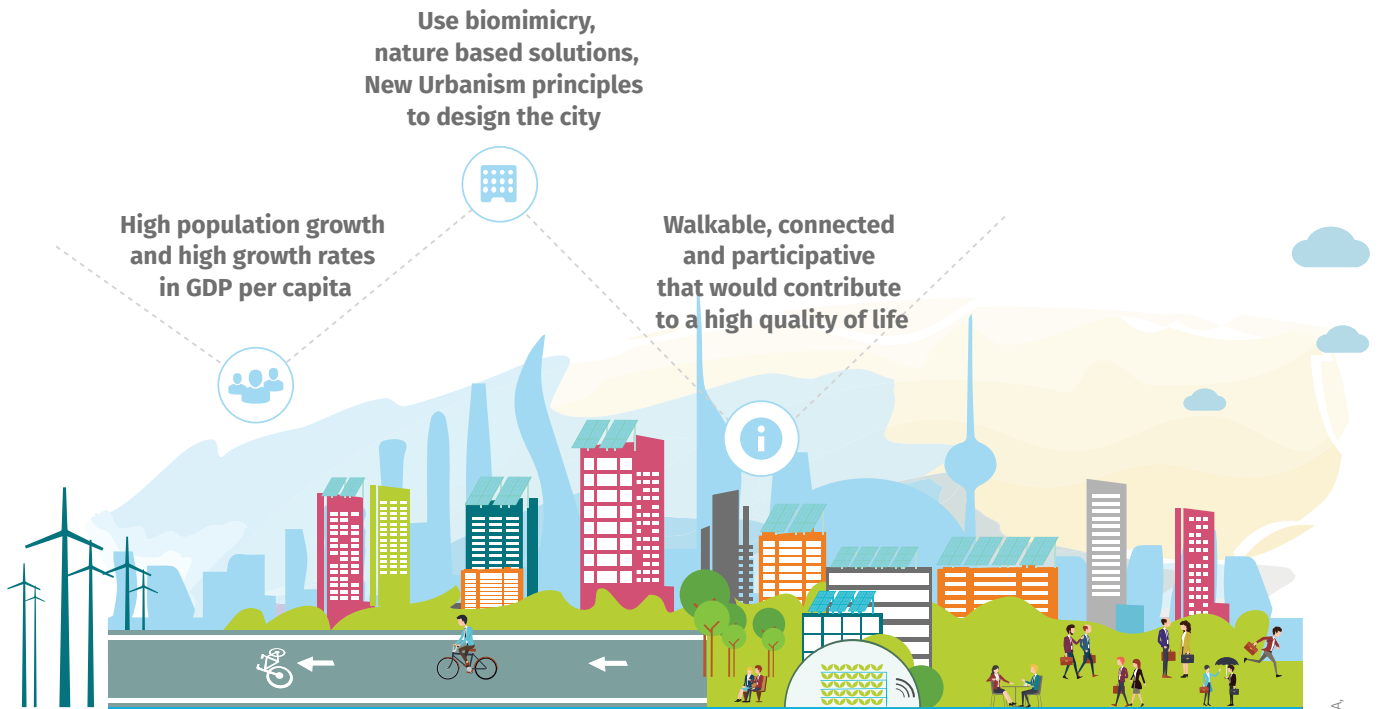
### Characteristics of a legacy city in an Emerging economy

These cities have dense populations and have significant urban core but is still managing the characteristics of a demographically young nation. With fast-growing populations and severe congestion, there is an opportunity to create value by improving efficiency and livability. The local leaders should loosen restrictions so that private finance can invest in improvements to physical infrastructure. It is useful to have a long term vision and then with a layered approach of policy reform, major infrastructure proposals, and visible quick wins motivated stakeholders would pursue the transformation.

### Initiatives

- Improving mass transit use by sorting refuse – Curitiba, Brazil. Today, 85% of Curitiba citizens use the bus, and 90% participate in recycling. The city recycles 70% of its refuse – one of the highest rates in the world.
- In Cape town, South Africa, the Integrated Waste Exchange is a peer-to-peer exchange platform facilitates a circular flow of materials like batteries, textiles, metals and other materials while saving users money, conserving energy and reducing pressure on already constrained landfills.
- The historic city of Izmir, Turkey is using the urban metabolic approach to harness the output of one urban system, like solid waste management, to fuel another, like electricity generation.

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## Emerging Economy and Pioneering City Maribor, Slovenia | Lavasa, India | Abuja Centenary City, Nigeria | Izmir, Turkey

### Characteristics of a new city in an emerging economy

The cities have fewer existing physical and social structures. It is vital that everything is built right the first time, notably with respect to the roads, bridges, water, and power that will determine both economic competitiveness and quality of life for decades. If this is missed informal sprawl and new settlements would sprout up which would be hard to reach in terms of basic amenities. The local leaders would have to build hard infrastructure and encourage commercial platforms for entrepreneurs to create services including data connectivity, banking, and insurance.

### Initiatives

- The city of Maribor in Slovenia is redirecting its operations, the performance of its businesses and citizens, toward the efficient resource management model
- Lavasa, India, a hill city prone to monsoons, droughts, and threats of erosion, has been modelled after the ecosystem of the dense forest around it incorporating the principles of Biomimicry
- UrbanWINS project which is funded by the Research and Innovation Program Horizon 2020 that studies how eight cities in Europe consume resources and products, and how they eliminate the waste produced, in order to develop and test innovative plans and solutions aimed at improving waste prevention and management
- Abuja Centenary City is using biomimicry on a systems level. The city is being modelled on nature's systems in terms of its transportation, water and waste management, energy production.

**Defining City's USP  
and vision**  
with a clear masterplan

**Citizen centric planning**  
where citizens are part  
of the planning process



**Unique High rises**  
with multi use facilities

## **Developed Economy Pioneering City** Samso, Denmark | Peterborough UK | Hafencity Hamburg

### **Characteristics of a new city in a developed economy**

Such cities are very rare. The so called “New Cities” are either self-proclaimed large integrated real-estate developments or cities which are trying to find new identity especially after the closure of large industrial units. The citizens of such cities want clean air, water, green space. Large technology companies are especially interested in such cities and often have to attract talented participants in the creative economy.

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### **Initiatives**

- Peterborough, a town in the UK also has an ambition of operating as a truly circular city by middle of this century.
- Samso, an island off the east coast of Denmark committed to living a green life, using and producing only 100 percent renewable energy
- The municipality of Haarlemmermeer in Netherlands has developed the program Haarlemmermeer Beyond Sustainability, with amongst others the first fully cradle-to-cradle business park and 100 more sustainable initiatives
- In the new Songdo City in South Korea with pneumatic pipes, the waste is transported to a central sorting facility—in seconds—where it's either recycled or turned into energy and thus eliminating the need for garbage trucks.



Learning from the activities of what other cities across the globe are doing, we have come up with an eight-step process which every city could undertake to make their city Circular.

### 1. What is your city's USP?

In the context of city marketing, citizens play an important role as potential brand ambassadors, but also because they have to feel comfortable with how their place is promoted to the outside world – the brand has to preserve the city's identity as perceived by its residents. Any intervention in a legacy city has to dismantle something that existed before a road or building, or even a regulatory authority. A legacy city in an emerging economy would have to improve the liveability and efficiency for its ever-growing citizen base. In a pioneering city both in an emerging as well as in a developed economy the urban areas have few existing physical or social structures to dismantle as they grow, hence fewer entrenched obstacles to new offerings. Hence to make the city circular it is vital to build it right the first time, with respect to the roads, bridges, water, and power that will determine both economic competitiveness and quality of life for decades. There is growing recognition that protecting cultural heritage is fundamental to urban resilience. Traditional knowledge embedded in cultural heritage, such as historical evacuation routes or shelters, can help societies cope with natural hazards. There is no one size fit all solution for a circular city, the city leaders should spend a lot of time with their citizens in understanding how they would like to see their city in the next decades. In this section, we would see how some of the cities have embarked upon with the vision of a circular city. The Regeneration and Optimisation of Cultural heritage in creative and Knowledge cities (ROCK)<sup>6</sup> project focuses on historic city centres as extraordinary laboratories to demonstrate how Cultural Heritage can be a unique and powerful engine of regeneration, sustainable development and

economic growth for the whole city. Seven role model cities and three replication cities have been selected for this very interesting project.

### 2. Defining a vision

In the future, circular cities, driven by digital technology, would allow access to high-quality living space, mobility, food, and consumer goods, such as textiles and electronics, at lower cost. The decoupling of this higher standard of living from negative environmental and societal impacts would also offer residents a cleaner and healthier urban environment. Cities around the world are embarking on the journey to become circular, they see clear benefits for its citizens. This could be achieved only if they have a clear vision, implemented by strong, inspiring leadership. Without these factors, the city risks falling victim to other, unmanaged forces. Amsterdam, one of the leaders in the application of circular economy concepts to city governance, follows seven principles in its transition towards a circular economy and aims to become a circular city by 2050. Peterborough, a town in the UK also has an ambition of operating as a truly circular city by middle of this century. The city of Maribor in Slovenia is redirecting its operations, the performance of its businesses and citizens, toward the efficient resource management model.

### 3. Circularity roadmap

A clearly spelled out roadmap with guiding principles would ensure that society develops in the right direction during its implementation. It is very important to focus on key areas for a city. With understanding the limitations of a city (as explained in the previous section of legacy vs pioneering city) it is vital to narrow down on the sectors which could also be measured.

Finland became the first country in the world to publish its road map to a circular economy from 2016-2025. The country for the next decade shall focus on five interlinked areas: sustainable food system, forest-based loops, technical loops, transport and logistics and joint actions (which includes initiatives that are essential to systemic change and apply to the entire society). China on the other hand

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<sup>6</sup> <https://rockproject.eu/about>

even introduced “Circular Economy Promotion Law” in 2008. The law contends that circular economies strategies will be implemented only if it is viable in technology, practical in economy, suitable in saving resources and protecting the environment. If we talk about cities then Amsterdam’s core themes are mobility, nutrition, housing and infrastructure. The Paris City Council unveiled a roadmap to transition the City of Light to a circular economy. The roadmap was devised with input from 240 players from the private sector, civil society and academia. It identifies 15 practical action items, to enable sustainable production and consumption, and eliminate waste in Paris by 2020.

#### 4. Map and document circular economy initiatives happening in the city

The Circular Economy Club (CEC)<sup>7</sup>, non-profit international network organized a voluntarily set up group sessions to map the circular initiatives in 65 cities across the globe. In all the cities initiatives along the whole circular economy value chain, ranging from design & materials, manufacturing & logistics, sales & business models, product life extension, recycling, and across many industries, like textile and fashion, food, electronics, packaging and retail were mapped. Over 3000 initiatives were documented across the globe are now made open source. This is an important first step to understand what initiatives are already present in the city.

<sup>7</sup> <https://old.circulareconomyclub.com/circular-economy-mapping-week-by-cec/>

<sup>8</sup> <https://www.urbanwins.eu/the-project/>

<sup>9</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5055480/>

<sup>10</sup> <https://amsterdamsmartcity.com/projects/circle-scan-amsterdam>

<sup>11</sup> <http://h2020repair.eu/about-repair/concept-and-approach/>

<sup>12</sup> geodesign is ‘an integrated process informed by environmental sustainability appraisal, which includes project conceptualisation, analysis, projection and forecasting, diagnosis, alternative design, impact simulation and assessment, and which involves a number of technical, political and social actors in collaborative decision-making’

<sup>13</sup> <https://www.circulus-project.de/>

Another example is the UrbanWINS<sup>8</sup> project which is funded by the Research and Innovation Program Horizon 2020 that studies how eight cities in Europe consume resources and products, and how they eliminate the waste produced, in order to develop and test innovative plans and solutions aimed at improving waste prevention and management.

#### 5. Tools and methodologies to quantify circular economy

If we talk about tools then Urban metabolism has emerged as a leading methodology for quantifying energy consumption and use patterns in urban environments.<sup>9</sup> It can show the nature of energy generated, transmitted into, and consumed in cities, including the number of renewables; the amount of greenhouse gas emissions generated; and the categories of energy end use. Traditional urban metabolism approaches can be expanded to incorporate socioeconomic analysis, policy analysis, and additional quantitative methodologies such as life cycle analysis. Material flow analysis (MFA) and Input/output (I/O) accounting are examples of useful tools for understanding the energy and material metabolism of a city and its per capita distribution across its resident population. Urban metabolism is an example of a complex process that cannot be expressed in linear and deterministic terms, but more in system-dynamic ways. Amsterdam’s material flow analysis address how inputs such as water, energy, metals and minerals are used by the various industrial sectors in the city<sup>10</sup>. Also, the REsource Management in Peri-Urban AREas (REPAiR)<sup>11</sup> project which applies geodesign<sup>12</sup> approach including waste and resource management in order to reveal the local space-specific challenges of waste and resource management using life cycle analyses (LCA) and Urban Metabolism. Six cases across Europe (Amsterdam, Ghent, Hamburg, Lodz, Naples and Pecs) have been documented in this project. The research group Circulus: Opportunities and challenges of transition to a sustainable circular bio-economy<sup>13</sup> which is hosted at the University of Freiburg, takes on a constructivist systems perspective that connects political visions of a circular economy to current transformations in economic sectors and specific value chains across different countries.

## 6. Circular strategy

On a national scale, many countries such as Finland, Scotland and China have already come up with national strategies for Circular Economy. Not many cities, however, have a well-defined CE strategy. Amsterdam, Peterborough,

Rotterdam, Haarlemmermeer and Glasgow are some of the examples that have embarked upon a Circular Economy transition. Below we could see the key elements on which three cities are working on:

### Amsterdam

The 7 key elements which highlights a core strategy that businesses and organizations could implement to achieve circularity

1. Prioritize regenerative resources
2. Design for the future
3. Preserve and extend what's already made
4. Rethink the business model
5. Incorporate digital technology
6. Use waste as resource
7. Collaborate to create joint value

### Peterborough

Circular Peterborough programme, centered on the 7R's – the practical steps Peterborough has developed to help it embark on its journey

1. Rethink
2. Redesign
3. Repurpose, Reuse and Share
4. Repair
5. Remanufacture
6. Recycle
7. Recover

### Paris's 15-point action plan as part of the first roadmap

1. Building materials: develop territorial organisation for the recovery and reuse of materials
2. Building sites: diagnosis, sorting and recovery of site resources
3. Sustainable and circular construction: lay the foundations of new economic models
4. Waste reduction: reduce disposable packaging use
5. Repair: promote the repairing of objects with a set of complementary initiatives
6. Reuse: creation of a central municipal workshop for the reuse of building materials
7. Re-manufacturing in Paris: develop charity shops and reuse centres in Paris
8. Incubator: create an innovation platform for the circular economy
9. Sharing: organise sharing of premises for actors in the circular economy and social and solidarity economy
10. Promote and raise awareness: create a place in Paris for actors of the circular, solidarity and innovative economies: Les Canaux
11. Inter-company synergies: develop territorial synergies between economic actors
12. Network: create an online platform for information on the circular economy
13. Sustainable purchases: increase the proportion of Eco designed products in public purchases and develop a functional economy approach in public procurement contracts
14. Clothing: reform of clothing for City of Paris staff, extension of useful life and end-of-life recovery of occupational clothes
15. Responsible consumption: promote circular consumption in Paris

## 7. Developing demonstration projects and set clear targets

In order to build an evidence base –there is a somewhat limited evidence base of the social, economic and environmental impacts of the circular economy. This is not only important in building confidence in circular solutions and encouraging other actors to follow suit, but also important in changing policies to support the circular economy.

- Samsø, an island off the east coast of Denmark and nestled in the Kattegat Sea, is home to a population of 4,000 people committed to living a green life, using and producing only 100 percent renewable energy. In 1997, the Danish government organised a contest to create a model community for renewable energy; the Samsø community came together and won that contest. The islanders now boast a carbon footprint of negative 12 tonnes per person per year.
- Peterborough has set up demonstration projects around food, drink and agricultural systems as well as around construction and manufacturing sectors<sup>14</sup>.

- The Wcycle project<sup>15</sup> is a strategic development model to transform the City of Maribor (Slovenia), as an urban centre, in the areas of integrated waste management, wasteful energy and wastewater, based a policy of the circular economy as a material, energy and water strategy for the use of recovered waste, excess energy and purified water. The integration model also includes the community's involvement as a cooperative economy.
- The City of Paris and the RATP Group, the state-owned public transport operator that runs the Paris Métro subway, have jointly launched Les Deux Rives, a bold initiative to build the world's greenest business district.
- Amsterdam aims to reduce consumption of primary raw materials (minerals, fossils and metals) by half until 2030 and also to separate 65% of all the household waste by 2025.
- The city of Maribor (Slovenia) envisages to recycle 70% of municipal waste and 80% of packaging waste by 2030. Also reducing marine waste and food waste by 30% by 2025<sup>16</sup>
- Grow Bristol is an urban farming enterprise, which grows food locally and employs local people. The enterprise uses renewable energy and aims to reduce the water footprint for market gardening. The Bristol Energy Cooperative is a community owned renewable energy cooperative which enables the citizens to co-produce local carbon, renewable energy for the city.

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<sup>14</sup> <http://www.futurepeterborough.com/circular-city/>

<sup>15</sup> <http://www.wcycle-maribor.si/>

<sup>16</sup> <http://www.circularchange.com/wp-content/uploads/2017/05/5-Igor-Kos.pdf>

## 8. Measure progress

Successful development of Circular Economy requires a system of indicators to assess and track progress, and provide guidelines for decisionmakers to further develop policy instruments. The FORCE<sup>17</sup> project aims to minimise the leakage of materials from the linear economy and work towards a circular economy. The four cities involved in the project, Copenhagen, Hamburg, Lisbon and Genoa, will engage enterprises, citizens and academia in 16 participatory value chain-based partnerships to create and develop eco-innovative solutions. Each city will establish a lead partnership for one of the four materials: plastic waste, strategic metals from electronic and electric equipment, surplus food and biowaste, and wood waste. Each city will also establish three local partnerships for the other materials.

Urban CE is changing from simple recycling of post-consumer products to whole value chain circularity; from single industry to cross-industry development; and from focusing primarily on production to considering the entire life cycle of products. Various tools and methodologies exist to evaluate national and regional CE development, among which, material flow accounting or analysis (MFA) has been the most popular. The United States of America, Japan, Austria, Germany, Netherlands, Brazil, Venezuela, Switzerland and Sweden, with support of the World Resources Institute (WRI) completed material flow research at the

national level. Where the EU indicator system contains three categories: input indicators, consumption indicators, and output and balance indicators, the Japanese indicator system also contains three categories: resource productivity (RP), recycling rate and rate of final waste disposal.

The non-profit organisation Collaborating Centre on Sustainable Consumption and Production (CSCP) in Germany has, together with partners, developed the Handprint approach, which comprises a methodology to facilitate the measurement and evaluation of the ecological, economic and social sustainability impacts of products. As an indicator-based measurement, it addresses both positive and negative impacts and finally allows to draw a holistic picture of a product's sustainability performance (a product's handprint) by using the SDGs as an evaluation standard. This approach could also be transferred on to a city level to evaluate a city's progress towards circularity and indicate specific development potentials.

China's recently issued EIS2017 divides indicators into three categories: comprehensive indicators, special indicators and reference indicators. In January 2018, the European Commission adopted a monitoring framework for the circular economy, which aims at assessing progress towards circular economy in the EU and its Member States. While most of the systems have been applied at the national level, none of them have been adopted at an Urban level.

<sup>17</sup> <http://www.ce-force.eu/>

### UCDI Index System

The system which builds up on the EIS2017 index of China includes 17 individual indicators grouped into four main criteria: Resource output, industrial circularity, residential circularity, and mechanisms and culture. index was calculated for 40 cities that were part of China's pilot CE cities program for alternating years in the five-year period between 2012 and 2016 (that is, the index was calculated for 2012, 2014 and 2016). Since China embarked on the CE journey many years earlier, the result of the index is perhaps the only one known at a city level (Wang, Lee, Zhang, Chen, & Li, 2018)

# 6

## Benefits from a circular economy in cities

### 6.1 Increase disposable income

Across three sectors analyzed (Ellen Macarthur Foundation, 2017) research (mobility, food systems, and the built environment), it was found that a circular economy development path could increase the disposable income of an average European through the reduced cost of products and services, and a conversion of unproductive to productive time (e.g. reduction in congestion costs). The average disposable income for EU households would increase by EUR 3,000, or 11% higher than the current development path by 2030.

### 6.2 Reduce carbon emissions

In the same report it was indicated that for Europe, a circular economy development path could have carbon dioxide emissions by 2030, relative to today's levels, and similar analysis conducted for India indicates that greenhouse gas emissions would be 44% lower in 2050 compared to the current scenario. Lower carbon emissions mean a healthier ecosystem for humans and other species coexisting in the cities. (UNEP and IRP, 2018) latest findings suggest that at the product-level, remanufacturing and comprehensive refurbishment can contribute to GHG emissions reduction by between 79% and 99% in appropriate sectors.

### 6.3 Increase livability

Previous research indicates that circular economy activities can influence aspects of livability in cities. Circular economy activities (particularly in the built environment and mobility systems) can have a positive impact on indoor air quality (through the use of healthy materials such as EU-funded Buildings as Materials Banks (BAMB) project<sup>18</sup>, which looks to create “buildings passports” in combination with flexible building design so the value of

the constituent materials is retained) and can reduce air pollution (through more effective mobility systems). In a circular economy, less unprocessed waste in open-air dumpsites, and improved water and wastewater treatment processes can also increase livability in cities. A pioneering community in south Germany practices what it preaches: Vauban became the first housing community in the world to display a positive energy balance. By 2009, 70% of the residents had given up their cars. All the houses and buildings were designed to have the lowest energy consumption.

### 6.4 Potential for positive impact on employment opportunities in the city

Employment opportunities would not be limited to remanufacturing and growth within large corporations; the employment story in the circular economy could be rich and diverse with jobs created across industrial sectors, by the development of local reverse logistics, within small and medium enterprises, through increased innovation and entrepreneurship, and a new service-based economy.

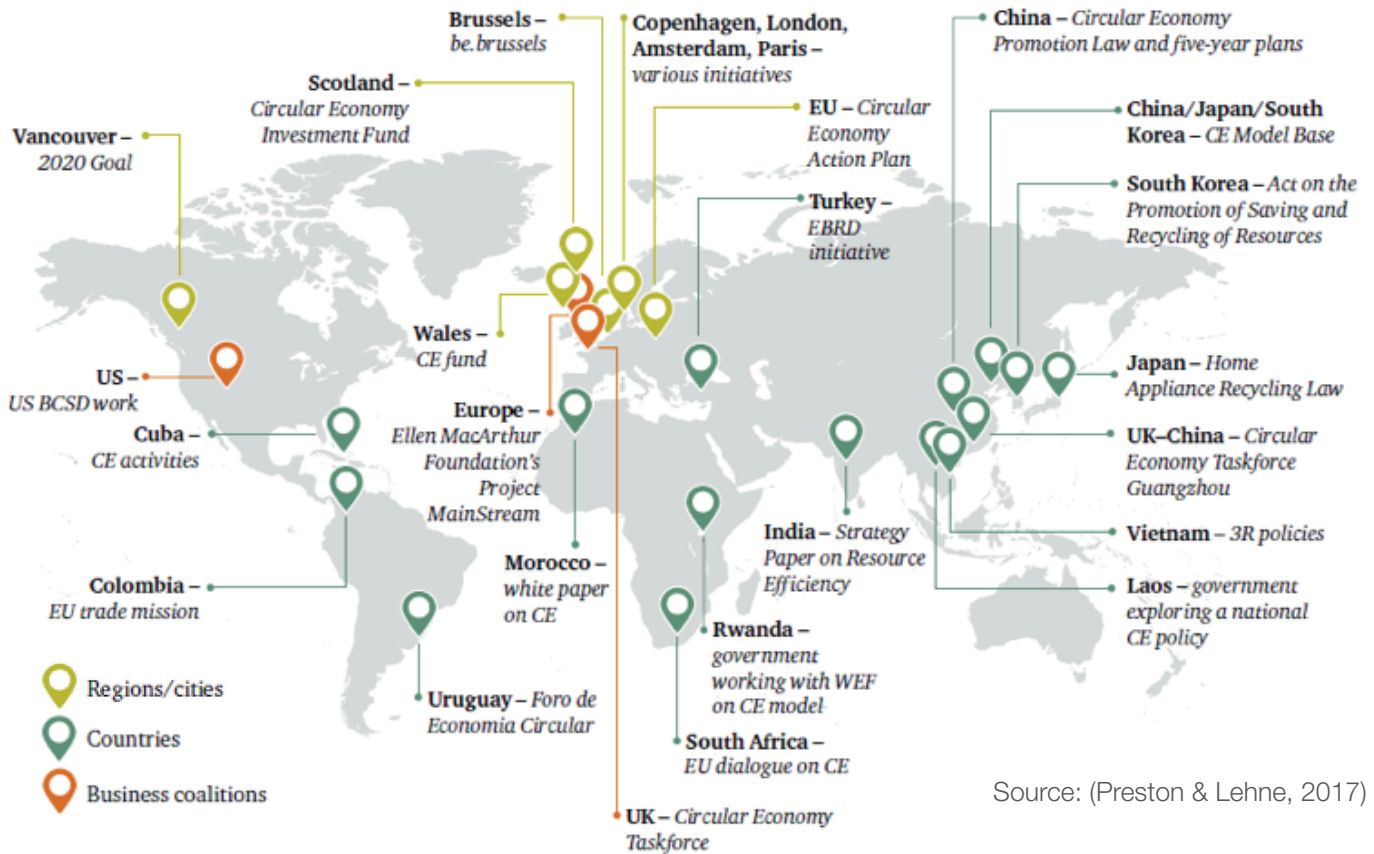
### 6.5 Health benefits

A transition to circular economy provides a major opportunity to yield potentially substantial health benefits while contributing to the attainment of a number of SDGs. The benefits are both direct, such as savings in the health care sector, and indirect, from reduced environmental impacts of production and consumption. So far, consideration of the health implications of a transition to a circular economy has been relatively limited; health studies are still in their infancy and the health sector has been relatively absent from the discussion on the positive and negative implication of circular economy. The World Health Organization (WHO) has launched In August 2018 and disseminated widely an evidence report on “Circular Economy and Health – Opportunities and Risks”.

<sup>18</sup> <https://www.bamb2020.eu/>

# 7

## Circular economy discussions across the globe



Source: (Preston & Lehne, 2017)

While the discussions around Circular Economy has been from the West-European perspective there are many examples of initiatives across the globe which are related to Circular Economy. In recent months there has been CE-related activity in countries as diverse as Laos to Colombia. Last year Rwanda, Nigeria and South Africa, along with the World Economic Forum and the Global Environment Facility, have launched the African Circular Economy Alliance to fast-track the adoption of the new model of sustainable development across the continent.<sup>19</sup> The Indian Resource Panel (InRP), an advisory body on natural resource use, recently unveiled an action agenda on resource efficiency highlighting the CE.

Lower-income countries are in many ways more 'circular' than their developed economy counterparts – the question is how to turn this into a development opportunity. Much economic activity in lower-income countries revolves around sorting and reusing waste. However, higher-value, employment-generating opportunities for reuse and remanufacturing are yet to be captured (Preston & Lehne, 2017).

For more than 15 years, China's government has been a frontrunner on circular economy policies, with a focus on addressing pollution, promoting resource efficiency, and industrial ecology. Building on these efforts, in 2017 the government introduced a new set of policies, centred on concepts such as product redesign and the sharing economy, which highlight the innovation and value creation opportunities of a circular economy approach – particularly for cities (Ellen MacArthur Foundation, 2018).

<sup>19</sup> Press release: Ministry of Environment, Republic of Rwanda on November 29, 2017 <https://bit.ly/2EV2Krd>

# 8

## Who can enable the transition to a circular city?

The transition cannot be achieved by any single actor. It will require collaborative efforts across the value chain, involving individuals, the private sector, different levels of government and civil society. Companies need to design products with circularity in mind and build components that can close loops in production. Individuals have a key role in creating demand. The public sector needs to play its part in making available the necessary

infrastructure, and formulating policies and regulations that incentivize innovation without imposing burdens that dampen growth. In the graphic below we could see important tools and mechanisms that stakeholders in any city across the globe can use to contribute to the circular economy transition.



This infographic is using elements of: © shutterstock / Graphic farm, Vmaster, Denis Cristo



## Local government

- The Local Government can promote recycling of building materials from its own buildings, renovations, and demolitions. By doing so, it stimulates the market for recycled building materials
- The local government can support technical development through subsidies, incentives and tax breaks to develop new technologies
- Facilitating partnerships with other forerunner cities on CE
- Promoting bottom up initiatives (idea competitions, funding start-up ideas)

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## Local companies (Energy, Waste, Water)

- Subscription-based models are a viable entry point into the circular economy. This enables economic and environmental benefits for both sides, including cost savings for customers and more sustainable outcomes for companies.
- Waste to energy companies and other recycling companies are interested in good quality 'resources' which they could bring back to the market
- Take back programmes that focus on reselling and recycling builds up trust and goodwill amongst the customers

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## Other stakeholders

### (Media, financial institutions, consumers)

- The financial industry could form a uniform framework of guidelines for identifying, selecting and financing initiatives based on new circular business models. (ABN AMRO, ING and Rabobank have initiated a process).
- Media could promote stories that contribute positively to the society (CE transition would improve disposable income, health standards and quality of life)
- Consumers should demand products which last long and are incorporating CE principles, also to save their own money through longer usage

## Academia

### (Students, Professors and Universities)

- As a university's main role is in accreditation and transformation of knowledge into innovation, it is desirable that universities engage individual students in the CE process by establishing living labs, promoting transformative research or hosting events on CE in order to spread the word. This could be done by co-designing and co-producing knowledge
- Universities can also partner with local businesses that would enable benefits to be shared and two-way support with implementation and financing. Local circular partnerships can be mutually-beneficial cutting material costs or providing a new income flow
- Development of a hidden curriculum plan would further enhance sustainability strategies and learning in practice by encouraging sustainable consumption and behavior.

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## Citizen led initiatives

- While consumers are considered as a part of the economy and as users of products, they are not seen as goal-setters nor even as domesticators of new opportunities. This is fast changing. Sharing of resources (Book share, equipment sharing, clothes, furniture, etc.)
- Sustainable sourcing and local distribution channels lead to better traceability of products, especially food, with significant environmental and social benefits. Setting up local collaborative consumption networks reduces the costs of acquisition and use of the products while encouraging social cohesion among citizens.



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### **German Chancellor Fellowship**

The Alexander von Humboldt Foundation's German Chancellor Fellowship Programme is targeted at young prospective leaders from the United States, the Russian Federation, the People's Republic of China, Brazil and India who have an international outlook and initial leadership experience. It addresses prospective decision-makers, multipliers and thought leaders from a broad range of professional fields such as politics, public administration and business as well as society and culture. This fellowship programme is under the patronage of the Chancellor of the Federal Republic of Germany and is financed by the Federal Foreign Office. More information about the fellowship could be found at <https://www.humboldt-foundation.de/web/german-chancellor-fellowship.html>



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### **The Collaborating Centre on Sustainable Consumption and Production (CSCP)**

The Collaborating Centre on Sustainable Consumption and Production (CSCP) was jointly founded by the Wuppertal Institute and the United Nations Environment Programme (UNEP) in 2005 to establish an internationally visible institution for scientific research, outreach and transfer activities on sustainable consumption and production (SCP). The CSCP comprises an interdisciplinary group of more than 50 researchers. The scope of the Centre's activities comprises development, testing, implementation and monitoring of projects and programmes, enabling leapfrogging sustainable consumption and production patterns and practices, knowledge transfer, multistakeholder and interdisciplinary networking and international partnerships. The programmes developed and carried out by the organization are built on three milestones: capacity building, establishment of infrastructures to support sustainable innovations and encouraging bottom-up participative models for sustainable innovation and its ripple effect on lifestyles.