Circular Cities

A practical approach to develop a city roadmap focusing on utilities

Climate-KIC

2EI VEOLIA

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Cities can play a pivotal role in creating an enabling environment through regulations and incentives, but the private sector needs to collaborate and explore the cross-sectoral synergies required to achieve a circular model. There are immense opportunities for public-private collaboration in achieving goals that might not otherwise be possible for cities to accomplish alone.

Cities are embedding circular thinking in their utility processes, placing the onus on the private sector to come up with new business models that are both economically viable and ecologically sustainable. This could potentially result in a situation whereby circular products and services become the new market standard.

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Foreword

The concept of the circular economy is rapidly gaining traction as an approach to the decoupling of growth from resource constraints. However, the multiple understandings of the transition process require some interpretation regarding the definition of goals, the timeframe of changes, the assignment of agency to actors, and the perception of responsibility. Thus, it is time to redirect efforts to facilitate alignments between practitioner perspectives and the key messages of the overall narrative embedded in the current European agenda on Circular Economy.

EIT Climate-KIC itself aims to further develop collaborations between circular economy communities of practice and the global value chains of high-emissions materials and products. To achieve this, EIT Climate-KIC has created Transformation, in Time, a strategy to meet Europe's obligation under the Paris Climate Change Agreement by contributing to shaping the priorities of the European Green deal while also accelerating the implementation of the deal on the ground to unlock rapid decarbonisation and resilience.

Addressing the circular economy in cities requires the design and implementation of transformative activities where different sectors such as water, energy and waste are integrated into systemic roadmaps. A collective understanding of societal problems is essential to progress towards combined system assessments and co-design processes for a portfolio of transformative products and services for facing systemic obstructions and institutional gaps. A portfolio approach facilitates multi-actor dialogue for integrating cross-sectorial, cross-ministerial and cross-value chain perspectives for the design and adaptive implementation of policy mixes. Dialogue works as an enabling mechanism by which actionable knowledge is channelled through co-design processes aimed to foster rapid change by tackling the circular economy transitions via a systemic approach.

This document aims to contribute to developing good practices for achieving more and better dialogue between systemic actors to establish a collaborative multi-stakeholder arena in the utilities sector starting with a demand-led approach, working with city authorities, regional bodies, governments and industry leaders committed to transitioning to the circular economy.

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Transitions Hub Lead
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A word from the authors

More than ever we need to action the preservation of resources and fight against climate change targeting the reduction of inequalities at the same time. Focusing on the circular economy in utilities is a way to enable systems thinking in cities through urban planning.

An average person living in a high-income country consumes over 13 times what is consumed by someone in a low-income country.[1]

This white paper is an opportunity to highlight the importance of the circular economy as a tool for cities to transition towards more sustainability.

***WHY** IS IT SO IMPORTANT TO FOCUS ON CITIES?*

CITIES ARE LEVERAGE POINTS FOR THE TRANSITION.

Future cities must engineer an economy that is regenerative and waste-free by design. A circular approach to urban development unlocks integrated opportunities for resource savings, job creation, capacity building, civic engagement, healthy and inclusive environments, and resilience to external shocks.

HOW TO IMPLEMENT THE CIRCULAR ECONOMY IN CITIES ?

THROUGH SYSTEMS THINKING.

Systems thinking is about understanding the dynamics around complex interactions in a system. It can also provide new insights into structural causes of impacts. Thinking holistically can identify interventions which lead to meaningful and lasting change.

***WHAT** CAN BE ACTIONED BY CITIES?*

ENHANCE BEHAVIORAL CHANGE, LEVERAGE ALL STAKEHOLDERS, CIRCULAR ECONOMY TOOLS AND STRATEGIES.

Cities are in a position to influence and set trends for stakeholders' engagement and their crucial participation in the transition.

Circular economy tools and business models need to increasingly be applied to achieving the ***"Decoupling"*** of economic activities from resources use. The gains have usually been canceled out by increased consumption. This is called the ***"Rebound Effect"*** and should be among the strategies cities should avoid. One of the best ways would be to conduct a Life Cycle Assessment on every circular project.

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1 'UNEP Previews Global Resources Outlook 2019 | News ....' 5 mars. 2019, https://sdg.iisd.org/news/unep-previews-global-resources-outlook-2019/.

Grasping the concept of the circular economy is not easy for everyone, but people do understand the value of drinking good tap water or breathing clean air. Many cities have taken up the challenge of creating a circular economy strategy but they often fail to take on board the realities and perceptions of everyday citizens and engage in high-tech, infrastructure and complex approaches instead.

This white paper contributes to the discussion around circular economy strategies in cities by looking at examples and concrete solutions offered by technologies regarding energy, waste or water management. It thus provides a practical approach for policy makers and other practitioners to develop their own roadmaps.

Steven Beckers – a front- runner in the circular economy in Belgium – shared some lessons learnt and reflections about how cities and businesses can complement each other. But governments, business and research institutions cannot implement circularity alone, they need to work together with citizens and end-users. Governance and participation issues are thus addressed.

The Transitions Hub has been working over the past few years on developing a knowledge management and curation approach in participatory processes. Every post-it is important and every piece of information is used in later analyses to create smarter conversations. The white paper showcases the results of a workshop that took place in Bulgaria, led by Veolia and EIT Climate-KIC, with some European cities in 2019.

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Public participation is not a box-ticking exercise imposed by the EU, but a sign of good governance.[2]

2 *'Power for the people - EEB - The European Environmental ….' https://eeb.org/library/power-for-the-people/.*

EIT Climate-KIC's Circular Cities Project

Using the Circular Economy in Utilities to Fast-Track Zero Waste Cities

This publication is the second white paper in the Climate-KIC Circular Cities project and provides concrete examples of circular initiatives from utilities for inspiration and replication.

Cities and municipalities increasingly recognize the potential of the circular economy as a catalyst for both efficiency and innovation, thereby providing benefits of both an operational and strategic nature. Urban areas lend themselves particularly well to a circular economy system due to their close proximity to citizens, producers, retailers and service providers. Initial research suggests that the circular economy could lead to more jobs and entrepreneurial activity within the areas of remanufacturing, repair, logistics and services. Municipalities' way of measuring success is well established within conventional areas, such as healthcare, education and transport. When it comes to circularity and sustainability several organizations are developing frameworks for circular indicators - such as recently the WBSCD developing an indicator for companies and the OECD for cities and regions. However, things are not that clear cut.

Thus having identified the crucial need to define strategies, goals and indicators for sustainability, four pioneering cities, along with C40, Cleantech Bulgaria and 2Ei Veolia, have been uniting since 2018 to work on a circular economy project under the leadership of the City of Malmö, Sweden; Copenhagen, Denmark; Helsinki, Finland; Sofia, Bulgaria, and Utrecht, The Netherlands.

Though the Circular Cities Participatory Event 2Ei Veolia held in February 2019, it was evident that despite our high recycling rate for many types of waste, much remains to be done in order to make the economy circular on a long term basis in the European Union. Addressing these waste recycling and heavy consumption challenges will be a key market opportunity for both start-ups and well established companies and could lead to the EU becoming a global circular economy. Water utilities are early adopters of technologies and practices that support the circular economy, driven by increasingly stringent regulations, informed by breakthrough science and compelled to respond to climate change impacts and urbanization.

Beyond strengthening the connection between cities, the goal of the project is to be able to provide input and feedback to cities' long-term strategies by highlighting how processes can be made easier, smarter, cleaner and more resource efficient. The Circular Cities project is working on identifying the effects, both positive and negative, of incorporating circularity into the cities' planning instruments, as well as how these can be assessed. The outcomes are meant to help policymakers, investors, businesses, consumers and civil society to find the most promising transition pathways.

2Ei Veolia and EIT Climate-KIC Transitions Hub have managed and delivered this publication that showcases how the circular economy in utilities could best work in systems thinking by municipalities, private and other public stakeholders.

Cities occupy 3 % of the global surface but consume 75 % of global resources and produce between 60 % and 80 % of global greenhouse gas emissions.

UN Data

Interview

Forefront businesses for a circular city

Today's transition is shaping innovations and new activities and therefor impacts utility services as well in some cases. The example of urban agriculture shows how a local solution being developed within a city can become a utilities issue. In order to develop more stable and sustainable business models, expertise in water resource and energy efficiency management can in the process become an important attribute.

Previously exiled beyond the city boundary, new forms of agriculture are now returning to city centers. Cities around the world are rolling out initiatives designed to relocalize part of their food systems. Discover the interview with Steven Beckers, founder of BIGH - Building Integrated Greehouses; the first large scale urban agriculture aquaponics system in Europe.

Steven Beckers is the founder of BIGH and Lateral Thinking Factory. He advises companies and different institutions in sustainable and circular architecture, construction and urban design all over the world. Steven is considered a guru on these topics in Belgium and beyond. This interview took place on August 23 in The EGG, Brussels.

How did BIGH come into existence?

As an architect, I have been studying circular economy theory for many years, always working on real projects alongside. I have pushed for urban agriculture as one of the solutions for circular economy, closed loops, and the conservation of energy, air quality, biodiversity, and water (which is especially important to me), and to increase the chances of resilience in cities. In 2013, I was asked by the Ministry of Environment in Brussels to do a study on the potential of urban agriculture in the Brussels region. So, I found about 6 million m^2 of potential roofs, car parks, and impermeable areas that we could use to develop it. I concluded that about 60 hectares of space was available in Brussels for urban agriculture. The ministry that had no money to do the project said "oh, who is going to do it and what can we do to implement it?" and the response to that was that nobody was really ready to take it on - neither the public sector nor the private sector. I, therefore, reached out to several experts on the topic and created BIGH to develop aquaponic farming. We chose aquaponics because it was the only project that had the potential to be economically sustainable, but also that was really in symbiosis with buildings using sustainable energy: CO_2, water, and sun.

What we've done here is a world's first, everything was unknown and not in the books

Do cities understand the potential of the circular economy?

When I started talking about the circular economy, which began as cradle-to-cradle, over 12 years ago, people thought I was crazy. Since then, I have given hundreds of conferences and worked with the founders of cradle-to-cradle, William McDonough and Michael Braungart. Little by little it became a reality, with the help of exposure from the European Commission taking circular economy more seriously. This widespread acceptance of the idea is quite recent; however, it is not well defined. Well, it is defined to a certain level, but it has yet to be implemented and produce results. Therefore, I have been pushing for real projects rather than studies or white papers because studies often oversimplify the concept of circular economy, reducing it to recycling or upcycling. This is what I am trying to explain to people, that you must target main elements and then not forget about the minor ones. When you talk about urban development you're talking about mobility, people's health, and biodiversity. All these elements form an ecosystem, and it is very complex.



What is the nature of your relationship with the city of Brussels?
We've been very welcomed and pushed by the city to implement the projects. There were no grants available, but the region still invested in the company by taking shares as Finance Brussels. Once the public sector was involved, it reassured the banks and other investors.

Your background is in architecture and you are now at the forefront of urban agriculture and the circular economy, when did you make the transition?
My end-of-study project, which I did in Morocco, was already working with urban design in the city of Meknes. They were dealing with local materials, local labour, no fossil fuels, natural cooling, water treatment, and even urban agriculture. I have always known that I wouldn't just do design; I like to make things work. I am always trying to resolve as many elements as possible. What I've learned as an architect is that everything is systemic. For instance, if you put photovoltaic cells on a building and then suddenly your client says, "I don't have the budget for that," it's easy to remove the cells, but if the cells are protecting from the sun, cleaning your water as part of a system, it's cooling your building, etc. then as soon as you remove it, it doesn't work anymore. This is a case of systemability, which is always seen as something expensive, but it produces more, and it can pay more. It's a question of looking at building over time and not just when it's finished.

Utilities are often overseen by cities and the public sector; do you think they make the link between the utilities sector and the circular economy?
Yes, I think so. In big cities they have the means and the teams that can work on these matters. I think there is an increasingly strong vision of all these utility networks being interconnected. Jeremy Rifkin, who defined the Third Industrial Revolution, says that we should consider the electricity network as a utility that everyone can both produce and use, so producers and consumers are all intertwined. I asked him, "why are you talking only about electricity, you should be talking about water, CO_2, hydrogen, energy, education?". All these networks are interconnected, and everyone can teach something and learn something and it's all the same principle. I understand a city as a living organism and that the metabolism of a city is what comes in, what comes out, and what is used inside. A few years ago, the amount of wasted energy, water, materials, concrete, etc. was measured to determined how the city could be more resilient and how waste could be avoided. So, yes, I think the public sector is aware of the link, although they don't know how to navigate it.

I think the public sector is aware of the link between the circular economy and utilities, although they don't know how to navigate it

So, should energy, water and waste be linked to the implementation of circularity?
Yes. They should be linked, because if you want to implement circularity at some scale, it's not by linking buildings or even districts, but it really has an impact by making it at the city or regional level; one of the best examples of wastewater and energy treatment is their relation to food production.

Aren't people reluctant to accept that food might come from waste?
Well that is something I am trying to change, because there are countries where there is not enough water, Spain is one but it's a world problem. Drinking water is a luxury, we don't realize it in our countries. I did a couple of projects in Belgium regarding water treatment within the building. And people say, "it's raining all the time here, we are full of water" and I said, "it's not true". Water is polluted, water is scarce in Flanders. I cannot drill a well to pump water in the ground because there's not enough. I can in Brussels because the regulation is okay, I can in Wallonia, and therefore Flanders imports water from Wallonia. So, there is a water problem even here. The technology is there, it is economically viable if people realize that water has a value. That's why the

public sector must be at the centre of this, because water is a human right.

So, is drinking wastewater the future?
People say it's dirty or it's dangerous. Frankly, in our cities we only drink wastewater, at the end of the day even if it's been treated and sent back to the river it's only a bit further up or further down in the water table but it's all been through our system before, all the water we drink, unless you go to Alaska.

Is BIGH meant to set an example for others to follow?
It is not the solution, but it is a solution in terms of clean and local food production, but it has so many advantages in terms of employment, air quality and energy. Of course, not everything can be resolved with building integrated greenhouses. You can't grow potatoes or cereals or rice, but what we do here with BIGH is using hundreds of times less water than the equipment elsewhere in the fishing industry because we are a closed circuit.

What is the main challenge you are currently facing in BIGH?
The main challenge is, as usual, to prove the financial viability. As it is new, it takes time to get on the market. How do you sell fish at a good price that corresponds to the quality when it's competing against fish imported from Greece that is not as fresh nor as good but is sold at a quarter of the price? It is very difficult. There is a market, otherwise we would not be doing it. For the moment we're at the medium-top level of the organic product market. Organic is more expensive in the shops but there is no good reason for that. It's just because the others are sold dirt cheap in comparison.

Do you see any specific economic measure that could help overcome this barrier?
Well, waste is very cheap to get rid of. Take circular economy for carpets, for instance, there are many ways of upcycling carpet tiles, but it's cheaper to have it burned for energy. If you want to recover that material, it's totally feasible, but it costs a little bit more. The solution is to tax waste.

It is less than five years since the circular economy became a buzzword. And now to move from buzzword to reality is difficult.

There are a lot of fake sustainability systems put in place, including in Belgium. Denmark is crazy because they are importing waste to burn because they've decided that it's ecological to burn waste to make energy. There is a huge power plant in the center of Copenhagen, to make it work, they must import waste. It's not the circular economy at all. But they say it's an example because it's heating all the city and producing electricity and all that, it's better than putting in the ground.

How do you think the EU policy framework has affected the opportunities and discourse surrounding circular economy?
Well, there have been a few demonstration projects like C2CBs in my domain, but it's happening in other industries, I hope. I think that the biggest problem the European Commission has is the lack of communication. It also tends to overcomplicate things when they're presented, producing too many books and not enough projects. The EC should be able to invest directly into the private sector or into private projects. We were promised 350 000 euros for projects by the region, twice. Then they realized that because we are an agricultural initiative, we fall under the Common Agricutural Policy (CAP) and all subsidies were cancelled.

What is your vision for BIGH in 2030?
Start thinking Europe-wide, I would like to have a couple of farms bigger than what we have now in every city in Europe. I believe that cities are not the problem, they are the solution. People see cities like pollution monsters that are not nice to live in. It's true for many cities and it's true for the moment, but we cannot avoid developing cities because the human population is


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increasing. Overpopulation is a problem of resources, not a problem of space. When you have the resources, then you remove the fear, you remove the aggressivity, you improve people's lives by providing water, food, and safety. Do you know the area 15 billion people on single beds next to each other would cover?

No idea
Belgium. The size of Belgium. 15 billion people times 2 m^2 covers Belgium. Which means it's not a question of space, it's a question of being able to live together.

Last question, if you were to advise a city on implementing circularity, what three steps would you tell them to start with?
The first point is to have a vision. If you don't have a vision you won't go anywhere. That vision must be a roadmap towards a circular economy in all domains. If you have a vision, you have different steps to reach your goal and whichever path you take, the vision is still the same. The vision would probably have to extend fifty years.

Why fifty years?
A building lasts longer than that, infrastructure last a lot longer than that. If you don't have a long-term vision, you don't have a dream. You don't have a common aim and you always find somebody who says it's not possible. So rather than trying to go and live on Mars like Elon Musk or Trump, spend a lot more effort on the future for cities on the planet. The planet doesn't care, the planet will still be there even if we aren't.

If you put photovoltaic cells on a building and then your client tells you that they do not have the budget, it's easy to remove the cells. However, if the cells are cleaning your water or cooling your building, it does not make sense to remove them

The second is that the public sector must be more flexible and responsive.

And the third?
Do not only involve financial means and economical means but also involve the general population. Education is essential.

My daughter, she's 20 now and she's studying in Holland. We were on vacation in Formentera in the Balearics and every time she went to the beach, she would bring a bin and collect thousands of cigarette ends and bits of plastic. There was one thing she could not bring back and it was a tire. This is education, putting trash in a proper bin. I think education is especially important, because people don't understand why the circular economy is important and why they should stop wasting and polluting. However, you need to give solutions it's not only telling people to stop smoking, for instance, but also distributing little pockets where you can put your cigarette and take it back from the beach. That's not a vision, just an immediate solution, but you need those, too.

How many emails do you receive per day asking about BIGH?
Lots

Thank you very much, it was very inspiring
My pleasure

What is the Circular Economy?

In this section:

What is the Circular economy?

- Sustainability Transitions
- The circular economy: an opportunity to tackle social challenges

Cities & the Circular Economy

- The circular economy for sustainable urban planning
- The link between urban planning and utility services

What is the Circular Economy?

The model of production and consumption predominant since the industrial revolution relies on abundant natural resources and a linear economy:

"Extracted raw materials>production>consumption>waste".

This model of development hastened progress and enabled a billion people to access material prosperity. The bedrock of the consumption society currently finds its limits with the environmental challenges, the progression of unemployment and the increase in the global population. Intakes of natural resources overwhelmingly exceed the biocapacity of the Earth, which is its ability to regenerate renewable resources, to provide non renewable resources and to absorb waste.

How do we go from today's linear economy to a circular economy?

Systems take inspiration from ecology and living systems, where both materials and nutrients are cycled to restore and regenerate the economic and ecological system.

The recycling economy alone without thinking of all circular economy steps before recycling is not the solution. It can be seen as a transition solution to tackle today's huge amount of "waste" that cannot yet be optimized or recovered due to economic issues.

There is so much the linear economy will not be able to provide for humanity in the near future that we need to go deep into the circular transition.

CIRCULAR ECONOMY & SUSTAINABILITY TRANSITIONS

The Brundtland report (1987) summarised the end goal of sustainability transitions - "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Policy makers, scientists, businesses and civil society have been working for the past 30 years figuring out how to achieve this goal.

In 1989, Pearce and Turner developed an early formulation of the concept of the circular economy that underlines the progression of the structure of the economy towards a reduction of waste outputs.

The circular economy uses theory and principles from industrial ecology. Theoretically, a circular economy can reach an optimal state of accomplishment and it rarely reflects on intergenerational equity, suggesting a diminished role for this goal and a shorter time horizon. However, there are more and more systemic circular economy approaches such as the Circular Humansphere.

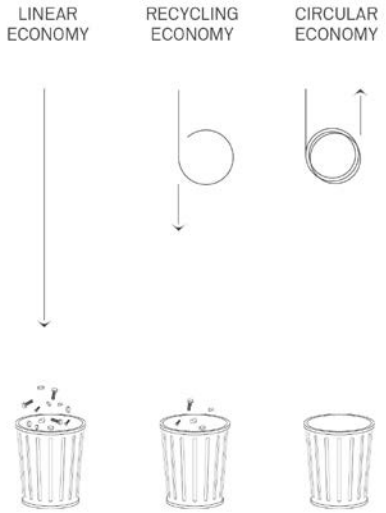


Figure 1. From linear to circular economy, Plan C, Empowering Circular Futures

The concept of sustainability transitions, on the other hand, has developed over the last couple of decades. A prominent approach in the transition literature combines ideas from evolutionary economics, the sociology of innovation and institutional theory.

Climate change cannot be solved with incremental and technological changes alone but rather through a combination of radical changes at different levels. The concept does embrace experimentation as a key aspect of delivering transformation.

Both literature streams are intertwined and touch upon similar concepts and frameworks. Understanding the

way in which discrete projects interact with wider forces is critical in advancing common goals.

In defining the concept of "transition to a circular economy", it is useful to generate a shared understanding. A method of achieving such shared construction and bridging these differences may be found through bottom up approaches that create a collective understanding of the socio-technical system that needs to be transformed.

The presence of a shared vision of the direction and potential means of the transition is critical. In this respect, using multi-stakeholder collaborative processes, in which practitioners' perspectives are gathered and analysed, is one of the key recommendations for supporting a transition process.

See Section 5 for a concrete example of a participatory process.

THE CIRCULAR ECONOMY: AN OPPORTUNITY TO TACKLE SOCIAL CHALLENGES

It is well known by now that since the 1970s, the global population has doubled and global Gross Domestic Product has grown fourfold. These trends have required large amounts of natural resources to fuel economic development and the attendant improvements in human well-being this has brought across the globe. However, these gains have come at a tremendous cost to our natural environment, ultimately impacting human well-being and exacerbating inequalities within and between countries (GRO 2019).

In 2018, the 26 richest people on earth had the same net worth as the poorest half of the world's population, some 3.8 billion people [3]

3 'Public good or private wealth - Indepth - Oxfam GB.' https://indepth.oxfam.org.uk/public-good-private-wealth/.

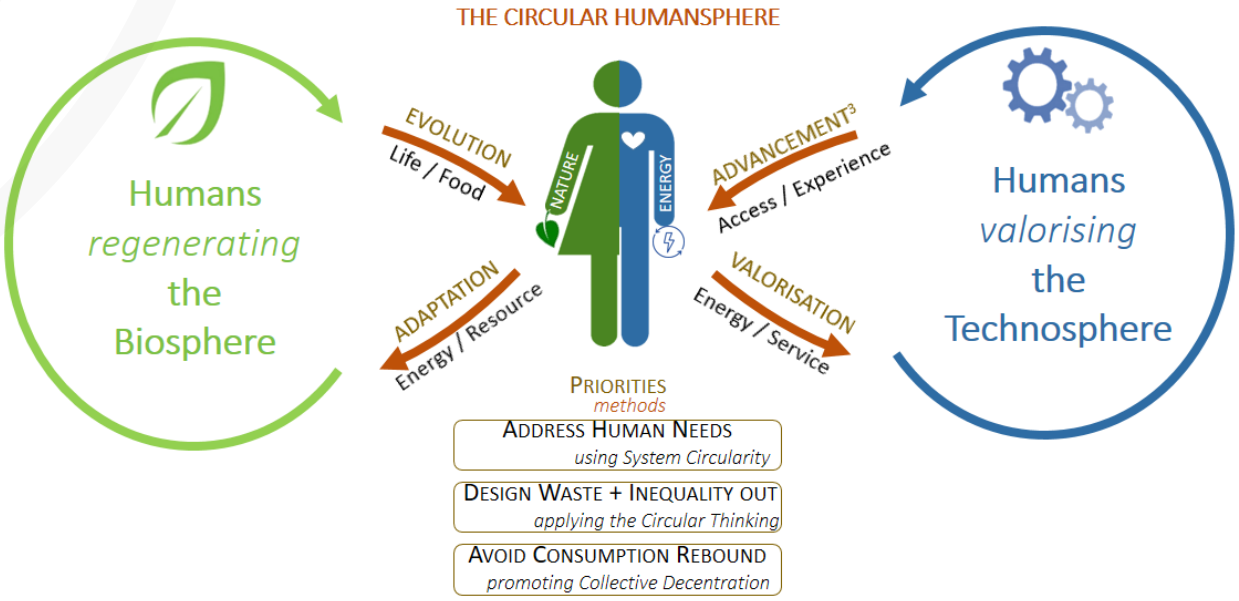


Figure 2. Alexandre Lemille, Adapted from the 'Butterfly Diagram' by the Ellen MacArthur Foundation.

The increasing inequalities that we see today lead to more and more social tensions (social unrest, disputes) and political consequences; citizens increasingly vote for conservative/extreme right political parties.

In this context, it is crucial to understand the circular economy's overall potential for social inclusion. Its framework, if taken as a whole, needs to integrate all environmental, social and economic dimensions into a comprehensive symbiotic approach to regenerate, restore and protect. As in all economic systems **Human Capital** should not be forgotten or sidelined. Maximizing resource efficiency gains for society as a whole cannot be seen in isolation. It should be linked to how well an economy can provide jobs and other forms of social welfare gains. While citizens can be used as sensors to move forward sustainable transitions, as in the circular economy, this topic has received little attention in academic studies and policy reviews so far.

Following is Alexandre Lemille's theory on how to build equitable circular societies.[4]

From Circular Economy to circular societies
Rethinking relations between the economy and the environment is a great approach to hopefully fixing the way we live by sharing access to resources.

The "Circular Humansphere" (See figure 2)
The circular economy is a model based on the notions of regenerating our natural capital and restoring our reusable and re-manufacturable capital. It is a matter of optimizing resources and flows in order to keep them as long as possible in our eco-systemic sphere (economy of system).

The circular economy is defined as a closed-loop process where optimisation and implementation has measurable and specific limits.

Today, biological nutrients from **the Biosphere** and technical nutrients from **the Technosphere** are the two stocks favored in the circular economy model. Yet, in designing a truly symbiotic model for the preservation of future generations, we could benefit from the dynamism of a third stock: humans.

When applying "circular thinking" and including humans in all stocks and flows four points of intersection appear (see graph below): the four Humansphere Strategies. The first two strategies focus on our ability to change and therefore to adapt in depth to the two spheres to be preserved: **Adaptation** ("We Are Nature") and **Valorisation** ("We Are Energy"). They consist in understanding our future roles in an economy of system context where humans will play several key roles in the preservation of the two spheres evolving under its impacts, positive or negative. **Evolution** (life and food) and **Advancement** (access and experiences) strategies aim to measure our impacts in order to understand the return loops from biological (adaptation to ecosystems guaranteeing well-being) and technical spheres (advances in human well-being) over the human one. They consist of evaluating the remaining distance to be traveled towards a circular and equitable world.

4 *'THE HUMANSPHERE | Alexandre Lemille.' https://www.alexandrelemille.com/optimising-circular-value.*

Cities and the circular economy

THE CIRCULAR ECONOMY FOR SUSTAINABLE URBAN PLANNING

Cities and regions are the centers for change. They "have a key role to play in building thriving, livable, resilient cities that are regenerative by design."[5] A circular approach to urban development unlocks integrated opportunities for resource savings, job creation, capacity building, civic engagement, healthy and inclusive environments, and resilience to external shocks.

The Ellen MacArthur Foundation (EMF) clearly expresses the role of urban planning and how it refers to the physical shaping and development of a city. It assesses physical, social, and environmental factors and determines the allocation, development and usage of urban structures such as buildings, infrastructure, and parks. **Urban planning has a powerful impact on how people and goods move around a city and can have a strong impact on whether materials, products, and nutrients can be re-captured and kept in use.** It can also create long-term housing, mobility, and behavioural lock-ins. It is therefore invaluable to include circular economy principles in urban planning decision making.

With populations growing, cities are expanding, areas are being redeveloped, and new cities are being built. The UN expect there to be 43 megacities by 2050. Urban planning is predominantly a local task. Decisions made in urban planning contribute significantly to how materials, products, and nutrients flow between people and sites in the city. They can also influence how people work and travel, and how organisations operate.

The EMF paper on urban transition explains how cities are using urban planning in a variety of ways to help deliver circular economy transformations:

- Urban planning for compact city development to improve access to services and circulation
- Site planning for circular material use and nutrient flows
- Mobility planning for lower emission and better-connected cities

Urban planning in a circular economy includes working on three main different value chain processes:

Figure 3. City, governments and their role in enabling a circular economy transition (2019). An Overview of urban policy levers.

5 *'city governments and their role in enabling a circular economy ....' https://www.ellenmacarthurfoundation.org/assets/downloads/CE-in-Cities_Policy-Levers_Mar19.pdf.*

These previous three value chain processes are mainly included in the utility services. Which is why the circular cities EIT Climate-KIC project has been focusing on studying utility services within the unavoidable urban planning strategy.

THE LINK BETWEEN URBAN PLANNING AND UTILITY SERVICES

"A public utility is a business that furnishes an everyday necessity to the public at large. Public utilities provide water, electricity, natural gas, telephone service, and other essentials. Utilities may be publicly or privately owned, but most are operated as private businesses".[6]

Focusing on utilities provides a systemic view of urban planning where all the main resources are involved:

- Water and energy
- Urban development and the rise of huge quantities of waste in the private and public sectors
- Human capital is a resource and the need for social inclusiveness in the circular transition is crucial.

Moreover, cities have significant material and energy flows that are involved in the lifecycle of an urban area. These flows are known as **the urban metabolism and are a prerequisite to implementing synergies between the public and private players.**

The following image shows the critical challenges territories are facing today ; among them employment, growth, resources preservation of resources and the reduction of CO_2 emissions. These challenges are interconnected with utility services, and utility services are integrated in cities' strategies to develop a way towards more sustainability. From sustainable supplies (including renewable energy) and eco-designed goods to accompanying cities in managing consumer behavior to managing waste in an integrated system, the utility services are among the key stakeholders in the circular transition.

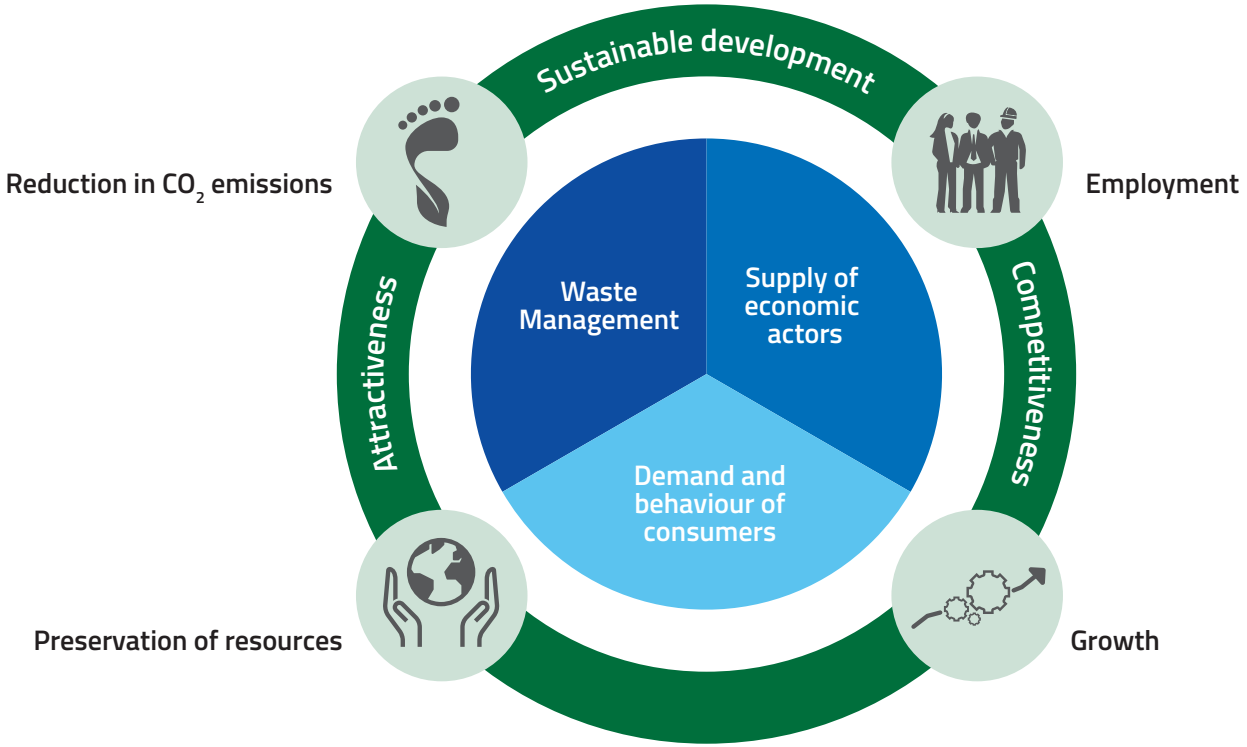


Figure 4: The link between urban planning and utility services, Veolia.

6 *'Public Utilities - Legal Dictionary - The Free Dictionary.' https://legal-dictionary.thefreedictionary.com/Public+Utilities.*

Policy Landscape:

The Circular economy in Europe

In this section:

European level

National level

Local level

The circular economy has become a policy trend from the international to the local level. Despite not being specifically mentioned in the Paris Agreement or the 2030 Sustainable Agenda, the circular economy is being mainstreamed as a necessary approach that tackles today's environmental and societal challenges. The G7 Alliance for Resource Efficiency is another collaborative approach that tackles this issue.

European level

The European Commission Thematic Strategy on the sustainable use of natural resources (2005) was one of the first policies introducing waste and resource efficiency in the European debate. However, the concept of the circular economy was introduced with the Roadmap to a Resource Efficient Europe (2011), six years later .

After a public consultation process and internal revision, the Circular Economy Package was presented in 2015, including the "Circular Economy Action Plan" (CEAP) and legislation on waste and water reuse among other things.

Further developments are the Circular Economy Monitoring Framework, new legislative proposals and the European Circular Economy Stakeholder Platform (2017). The platform is one of the spaces where cities and the European Union interact and exchange practices. On 4 March 2019, the European Commission adopted a comprehensive report on the implementation of the Circular Economy Action Plan.

National level

More and more member states are adopting circular economy strategies (see Table). In general, more recent strategies include more inclusive partnerships and value chain approaches. Other member states such as Czech Republic, Estonia and Bulgaria are currently working on their own strategies.

Construction and food are recurrent sectors in many of the strategies because of their large consumption of resources. While waste processing is the second most common sector at the national and local levels, energy and water processing and management fall much lower down in the list of priority sectors. Additionally, there are horizontal priorities common to many of these strategies. For instance, urban development and knowledge sharing.

Local level

As unique socio technical ecosystems, cities are key stakeholders regarding the design and implementation of circular economy policies in relation to utilities (waste and wastewater among others). Cities such as Paris, Oslo, Porto, Maribor, The Hague, Rotterdam,

Member State	Name of the strategy
Belgium	Belgium as a pioneer of the circular economy
Denmark	Strategy for the circular economy
Finland	Leading the cycle: Finnish road map to a circular economy 2016-2025
France	Roadmap for the the Circular economy – 50 measures for a 100% circular economy
Germany	German Resource Efficient Programme II: Programme for the sustainable use and conservation of natural resources
Greece	Transition to a circular economy model for sustainable production and consumption patterns
Italy	Towards a Circular Economy Model for Italy
Luxembourg	National Waste and Resource Management Plan
Poland	Road map – transformation towards a circular economy
Portugal	Leading the transition: a circular economy action plan for Portugal 2017-2020
Slovenia	Roadmap towards Circular Economy in Slovenia
Spain	Circular Spain 2030. Spanish strategy for circular economy. Draft for public consultation
The Netherlands	A Circular Economy in the Netherlands by 2050

Figure 5. List of strategies identified for the study (2019). Circular economy strategies and roadmaps in Europe: Identifying synergies and the potential for cooperation and alliance building.

Overview of existing and planned circular economy strategies in Europe

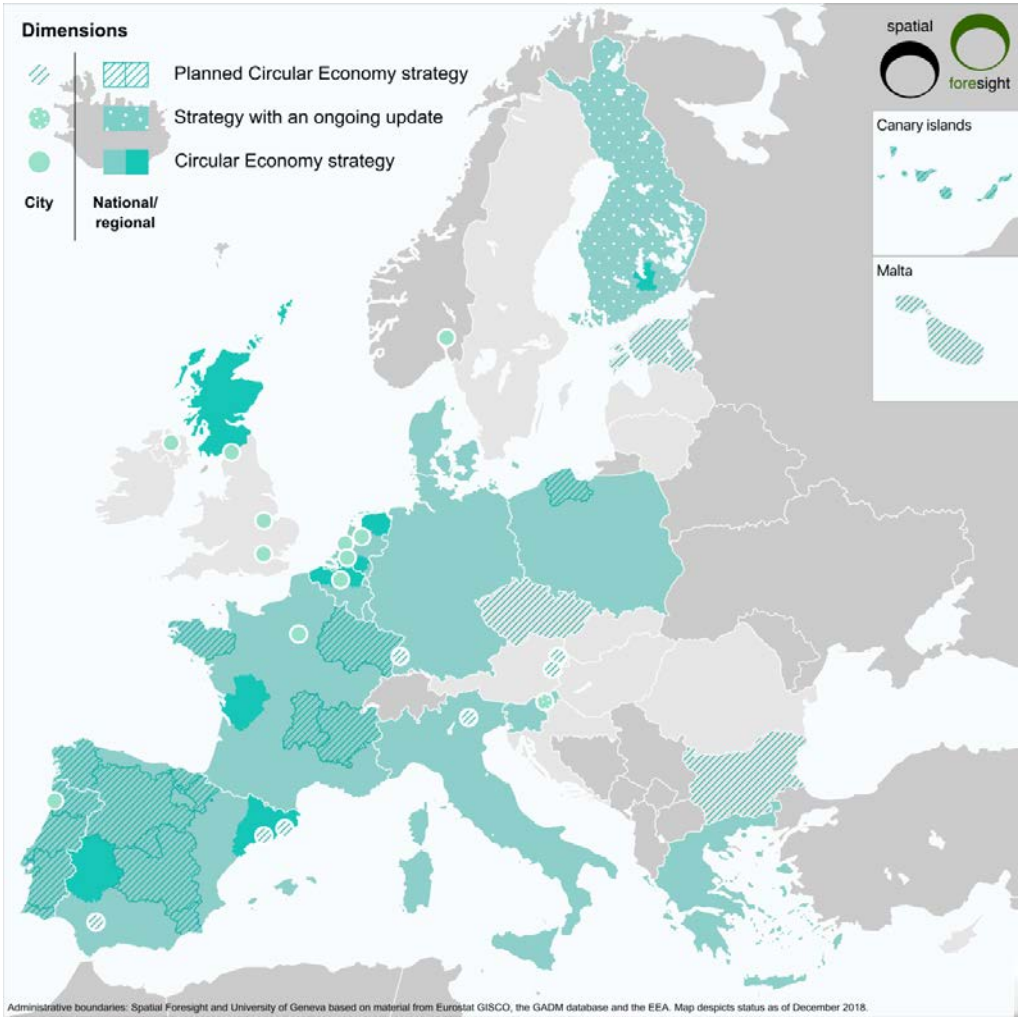


Figure 6. Spatial Foresight, 2019 based on the strategies collected for this study and information from stakeholders about upcoming strategies.

Amsterdam, London and Glasgow have developed their own circular economy plans or strategies (see map). Local transitions are at the core of much EU legislation. For instance, the revised EU waste directive, includes a common EU target for recycling 65 % of municipal waste by 2035, a binding landfill target to reduce landfill to maximum of 10 % of municipal waste by 2035; and separate collection obligations are being strengthened and extended to hazardous household waste (by end 2022), bio-waste (by end 2023) and textiles (by end of 2025).

There are different instruments that cities can use to become a zero waste city, among them, the creation of roadmaps and strategies, networking and partnering, i.e. policy innovation labs or urban planning.

The development of a long-term, holistic vision regarding circular economy and utilities is a crucial step towards becoming a zero-waste city or region. In their transition to a circular economy, cities face multiple economic, technical and social barriers. The promotion of knowledge exchange, the inclusion of a wide range of stakeholders, the development of a solid knowledge base and the participation of citizens are all key drivers for a zero waste city. This white paper thus also explores the results of a participatory exercise with cities from all over Europe and discusses the added value of such experiments at the local level.

5 ESSENTIALS IN ROADMAPS

Many European cities have developed their own circular economy roadmaps and strategies. Roadmaps are tools for cities to plan their transitions towards a circular economy. While there are no set-in-stone guidelines and every organization follows their own approach, this white paper presents different priority areas and concrete solutions that can inspire cities by sharing best practices and tested innovations. Generally, roadmaps include five main elements:

1 Vision & goals

Some may argue that most roadmaps do not get implemented and do not bring change. However, identifying a vision for your city, region or country provides 1) a framework for different initiatives, sectors and players, 2) develops common and clear objectives and aims, and 3) might inspire other players to get involved in the transition to this vision. In order to define a vision, current state of the art and needs have to be identified.

2 Timeframe

Defining the period of time in which a roadmap will be developed is essential to lay the groundwork for assessing and monitoring progress. Often the short termism of climate policies has been raised as a concern, but there are more and more strategies that combine short and long term objectives.

3 Participation

The understanding of inclusiveness and participation can vary among different geographies and contexts. A participatory process such as public consultation does not necessarily result in an inclusive process. While inclusiveness can have a socio economical connotation, it can also mean "making connections among people, across issues and over time". Despite its academic and practical relevance, participation is one of the vaguest elements in city strategies as its extent and implications are often not developed. The role of different stakeholders and the participatory process should be taken into account in the governance structures.

4 Tools and instruments

Identifying different resources and instruments are key for a successful implementation of any given strategy. Most of the time these instruments are financial or economic but new instruments (e.g policy and knowledge) and innovative instruments are being increasingly demanded.

5 Governance

Governance structures are very relevant. They are often the main barriers to change. The bureaucracy and power structures are difficult to change, thus identifying key stakeholders, defining roles and making sure that transparency is an overarching principle will ease both the creation and implementation of roadmaps and strategies. Identifying risks and interdependencies, defining levels of resilience, monitoring and evaluation are also part of a successful strategy.

Here you will find a table with the outlines, timeframes, authors, participation and utilities approach of the main circular economy roadmaps in European cities.

Figure 7. Roadmaps on circular economy in European cities

City	Structure	Participation and Inclusion	Time	Utilities approach	Author
Paris	Vision Challenges Strategy Actions Governance	▪ General Assembly on Circular Economy throughout the design phase ▪ Open Forum with people from the General Assembly for monitoring	2020	User and city services, especially solid waste collection, are often mentioned. There is no reference to utilities as such.	Mayor and Circular Economy Deputy Mayor
Oslo (not English version)	Strategy Framework Vision Instruments Priority Areas Execution	▪ Public Hearing ▪ Open dialogue included in the execution plan	2025	Focus on electronics, food, textiles, building materials and plastics	City of Oslo
Porto (not English version)	Vision Priority Areas Technology SDGs Governance	▪ Participation is part of the governance of the roadmap but it is NOT specified.	2030	Solid waste collection and transportation are the only services mentioned	City of Porto and other institutions
Maribor	Current situation Governance Process development Priority areas SWOT analysis	▪ Participatory local workshops in the design phase	Not specified but aligned with SDGs (2030)	Utilities are specifically mentioned: waste collection, energy and water	Private-public institute, city and others
Den Haag (not English version)	Opportunities Current situation Priority Areas Approach	Not specified	Not specified	Waste and water described as part of public services	Sustainability Councillor and City
Amsterdam	Vision Priority areas Current state Recommendations	Not specified	2039	Focus on construction chain and organic waste	City of Amsterdam and others
Rotterdam	Aim Opportunities Current situation Roadmap Challenges Principles Opportunities Actions Monitoring framework	Not specified	2030	Focus on waste and constructions	City of Rotterdam
London	Cross-cutting themes Priority areas	Not specified	2036	Focus on environment, food, textiles, electronics and plastics	Deputy mayor for Environment and Energy, London Council and others
Glasgow	Local Agenda Material Flows Circular Innovations Action PLan	Not specified	2023	Focus on food sector	Chamber of Commerce, Glasgow City Council and others

Steps to action:

mapping of some solutions

Step 1: Analysis of current state

- Territorial metabolism diagnosis: an essential step
- Governance strategy

Step 2: Priority areas and concrete solutions

- Preserve and renew resources
- Climate mitigation solutions and air quality
- Urban development and circular economy innovation
- Waste to resources: integrated management

Step 1:

Analysis of current state

From the emergence of a political ambition to the implementation of concrete actions, the circular economy approach means going through several stages:

- to carry out diagnosis of the potentials and risks of the territory;
- to define the positioning of the community / region;
- to specify its objectives and possible actions;
- to identify actors already mobilized or that need to be mobilized.

Territorial metabolism diagnosis: an essential step

MATERIAL FLOW ANALYSIS (MFA)

A circular economy approach, regardless of the objectives it sets, is anchored in a specific territory and a given context. Prior to the production of ideas and solutions to be developed in the territory, the diagnosis stage is essential and begins with the realization of a complete inventory of the different flows entering and leaving the territory.

This approach can go through different steps such as:

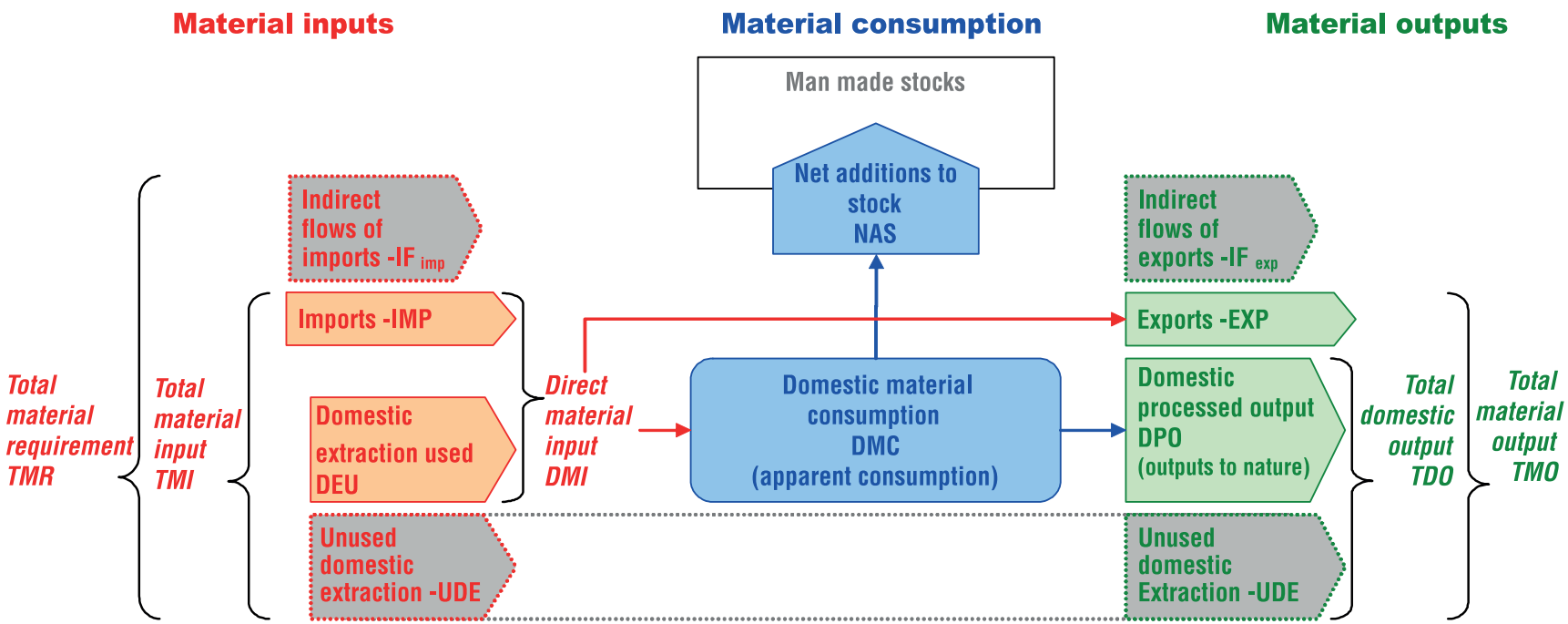
- The identification and mobilization of the different private and public actors in the territory
- An inventory of actions already taken by the actors
- Understand what is at stake in the territory. For example, understand companies' activities, their industrial processes and issues, perform a comprehensive review of incoming and outgoing flows, etc.

The following graph shows the different material flow indicators and their relation to the material balance.

The **MFA** is one of the best known methods for analyzing your flows of resources. This method does not include the energy and water flows analysis due to the amount they represent, but they should be analyzed in parallel on the basis of the same principles.

- Quantification of flows is done in mass units exclusively
- Limitation of a geographical perimeter
- Limitation to human activities
- Need to separate flows in order to analyze them and identify action plans

GROUP OF MATERIAL FLOW INDICATORS AND THEIR RELATION TO THE MATERIALS BALANCE



Input indicators
Input indicators describe the materials mobilised or used for sustaining economic activities, including the production of export goods and services. They are closely related to the mode of production of a particular country or region. They are sensitive to changes in the level and patterns of foreign trade and to other factors such as a country's endowment in natural resources, and its level of technology development and uptake.

They show the materials supply to the economy, whether extracted from the domestic environment or imported (Domestic extraction used: DEU, Direct Material Input: DMI). They can also show the total material requirements of an economy, by recording not only materials supply, but also the unused flows that are associated with the extraction of materials and the indirect flows that are associated to imports but that take place in other countries (pollution, waste, unused extraction) (Total Material Requirement: TMR).

Consumption indicators
Consumption indicators describe the materials consumed by economic activities. They are closely related to the modes of consumption. (Domestic Material Consumption: DMC), Total Material Consumption: TMC). The difference between consumption and input indicators is an indication of the degree of integration of an economy with the global economy, which also depends on the size of the economy.

Balance indicators
Balance indicators describe the physical growth of the economy. They show net flows of materials added to the economy's stock taking into account gross flows added (in buildings, infrastructures and durable goods) and removed from the stocks (construction and demolition wastes, end-of life products). They can also show the physical trade surplus or deficit of an economy by taking into account materials coming from international trade. (Net Additions to Stock: NAS, Physical Trade Balance: PTB)

Output indicators
Output indicators describe the material outflows related to production and consumption activities of a given country. They account for those materials that have been used in the economy and are subsequently leaving it. They show either the pollutant emissions and waste, or exports. They can also show the potential environmental burden of materials use, by recording in addition to emissions and waste, the unused flows of materials (Domestic Processed Output: DPO, Total Domestic Output: TDO)

Figure 8. Groups of Material Flow indicators and their relation to the materials balance, OECD, MFA Guide.

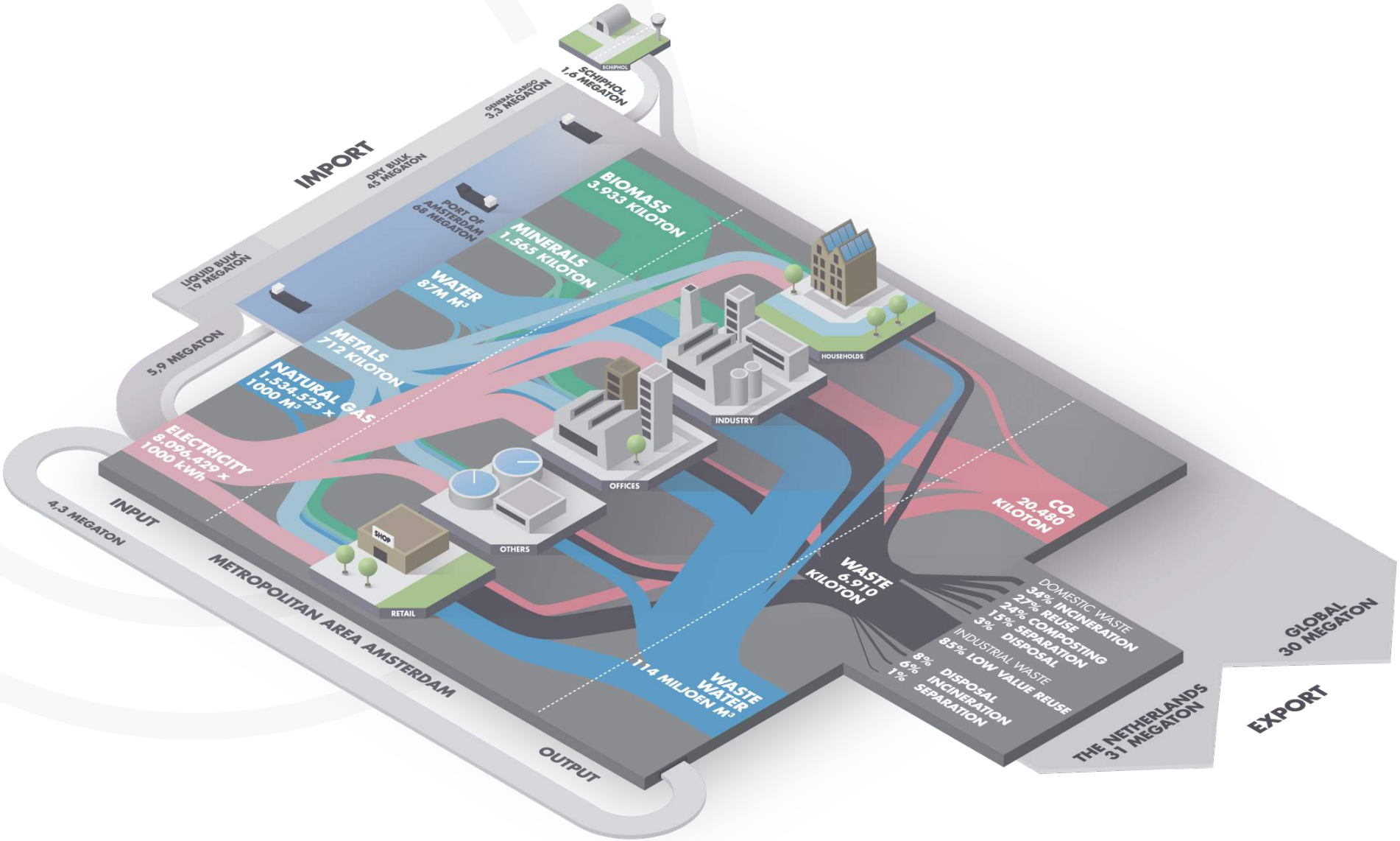


Figure 9. Amsterdam material flows through the metropolitan region - A vision and action agenda for the city and metropolitan area, Circular Amsterdam.

AN EXAMPLE OF AMSTERDAM'S MATERIAL FLOWS THROUGH THE METROPOLITAN REGION

The material flows for Amsterdam are analysed and visualised in Figure 9. This figure provides insight into how resources move through the metropolitan region and city, where they will be processed to add value to the local economy and where resources are wasted, or, ideally, cascaded back into the system to be reused. From this review, three important aspects – which are largely linear but which have the potential to create a circular economy in the region – appear to determine the current status.

One of the main reasonings and challenges behind the action plan from the material flow analysis will be to create loops and synergies between actors within the territory. Synergies can be divided into two groups: **mutualizations and substitutions.**

- Mutualization synergies can include outgoing flows, such as waste treatments, and ingoing flows such as supply, with shared logistics for example or common purchasing orders to benefit from better tarifs.
- Substitution synergies consist of using an entity's outgoing flow as an ingoing flow. The waste of a company can be transformed into a raw material for another company.

Assessing sensitive assets along with mapping sensitive populations makes it possible to concentrate on taking action on targeted areas and populations for more positive environmental and social impacts. Both the resources and risks analysis can be correlated.

RISK ASSESSMENT

Analyzing material flows is a major part of the diagnosis of the territory. Nonetheless, the diagnosis would not be complete without complementing it with a general risk assessment. Assessing sensitive assets along with mapping sensitive populations makes it possible to concentrate on taking action on targeted areas and populations for more positive environmental and social impacts. Both the resources and risk analysis can be correlated.

Indeed, urban areas are a collection of interdependent "systems within systems" and reveal an interactive and interdependent set of components, requiring partnerships and engagement across the city and/or region. Understanding these interconnections and links between each asset as well as the relationship between the risks, makes it possible to structure a correlation quantification approach between risks.

For example, floods are indeed a major issue for many European countries, especially southern ones, but the impact of these floods will be even more severe when coupled with other risks. When happening in an urban zone with a large population and sensitive infrastructures the impacts are more damaging and the need for circular economy solutions to adapt are needed even more.

Managing risks can be a complex process but here are four steps a city or a region can follow to assess them:

- Identify risks from stakeholder interviews. Risks may relate to aging infrastructure, drinking water supply, flooding and extreme weather events, economic hazards, etc;
- Combine all risks and group them into categories;
- Assign values relating to frequency, likelihood and control to risks;
- Organize a stakeholders workshop to vet the top twelve risks and come to consensus on the top six

Here, the table shows the results of step 3 and 4 from the 2019 Milwaukee Resilience Plan Strategy:

	Specific Risks	Impact	Frequency	Criticality (I x F)	Level of Control	Correlation (x)	Correlation (y)	Scoring incl. Correlation
1	Financial constraints	2.85	3.71	10.22	2.73	0.36	0.39	8.11
3	Social equity	3.43	04.04	13.72	3.23	0.09	0.36	7.75
	Efficiency of mitigation plans	3.11	4.25	13.38	3.57	0.61	0.32	7.75
2	Vulnerability of critical infrastructure	3.55	2.98	10.35	3.29	0.36	0.48	7.02
	Effectiveness of emergency and crisis management	3.12	2.65	8.01	3.06	0.45	0.27	6.05
4	Climatic hazard	2.78	2.56	7.13	2.80	0.32	0.09	5.25
	Soil and water pollution	2.38	3.50	8.31	3.25	0.11	0.32	5.00
5	Ability to adapt and respond to job market changes	2.69	3.88	10.38	3.88	0.25	0.25	4.81
	Suburban sprawl	2.04	3.77	7.65	3.70	0.43	0.20	4.25
6	Distribution of public services	1.93	3.55	6.99	3.93	0.32	0.32	3.89
	Water quality and supply security	2.64	1.87	4.44	3.46	0.27	0.30	3.82
	Access to healthcare system	1.81	3.25	6.47	4.47	0.20	0.50	3.07

Figure 10. A framework for how the Milwaukee metropolitan area can address complex threats for a stronger, more resilient region - 2019 Milwaukee Resilience Plan Strategy.

Each of the 200 risks was evaluated based on three parameters. The parameters include potential impact, likelihood/frequency, and level of control:

- The potential impact (the effect of the risk occurring in the most likely scenario) was scored based on how a risk would affect finances, population and/or the environment.
- The likelihood/frequency describes how often a risk may occur.
- The level of control relates to the current risk-mitigation activities that are in place to address a risk.

Lastly, the risk was given a correlation score. This score evaluated how strongly a risk was connected with another risk. For example, vulnerability of critical infrastructure is impacted by climate change. If pipes are designed to take in one unit of rain but the rainfall consistently is three units, then climate change impacts the ability for the pipes to function properly. Each score was entered into an equation that produced a single combined score. The risks that had the highest combined score were the top 12 risks for the region.

Governance strategy

As for all transformation projects a circular economy approach requires a strong ambition and high political support all along the process. It needs to mobilize sectoral public policies and be inclusive of the territorial project. The governance of the approach means carefully organizing the coordination of all stakeholders to collectively define objectives, establish actions to reach these objectives and determine a scope to follow, facilitate and evaluate.

There are different ways to materialize the governance, such as :

- Municipality and company commitment charter
- Contracting between companies
- Creating a specific structure dedicated to facilitating a circular economy project
- Mobilizing neighborhood committees
- Organizing project teams including public bodies, company representatives, and citizens to ensure the follow-up, the facilitation and the evaluation, etc.

The governance strategy needs to **1) take into account what already exists.** Meaning a circular economy project rarely starts from scratch with a blank page but instead takes its place within an ecosystem of private and public actors.

Figure 11. Upstream milestones, Circular Economy Roadmap for Slovenia - Circular Change.

This can be achieved by contextualizing the circular economy approach, which implies having in-depth knowledge of the economic and associative sectors as well as people directly working on the territory. Mobilizing some "key actors", for instance a structure well established in the territory can ease the project launch and perennity.

The governance strategy needs to **2) build on the territorial strategy**. Indeed, stakeholders do not have the same interests or motivation therefore the circular economy approach should highlight a common interest. For example, reducing costs of raw material supply, developing local jobs, limiting CO_2 emissions, etc.

In practice, the circular economy is best displayed as:

- A foundation or part of the territorial project
- Integrated in the planning tools translating the territorial project such as the climate-air-energy strategy, the waste prevention and management program.
- An added approach to other complementary ones such as labels, Agenda 21, zero waste strategy, etc.

The National **case of Slovenia circular economy roadmap and governance** is a good example of how a large scale transition can start. Indeed, the transition does not necessarily start top-down but at some point to fully transform a system regulations need to be put in place and national strategic plans need to create a vision.

The roadmap clearly states the importance of involving governments from an early stage within different sustainable development strategic plans. It is mentioned that the Circular Economy is "one of Slovenia's strategic development priorities. It is closely tied to the *Sustainable Development Goals (SDG's) and included in key national documents such as A Vision for Slovenia in* 2050 *and Slovenian Development Strategy* 2030 *as well as in Slovenia's Smart Specialisation Strategy.* The strategy's main goal is improved quality of life for everyone. The involvement of multiple stakeholders with the goal of facilitating the transition from a linear to a circular economy has been going on since 2016, starting with the Partnership for Slovenia's Green Economy project, taking place under the patronage of the Prime Minister Dr. Miro Cerar and uniting over 3000 partners.

Following are the upstream milestones of the project group in creating a circular economy roadmap for Slovenia, including all government stakeholders.

GOVERNANCE OF SLOVENIA CIRCULAR ECONOMY ROADMAP:

Contractor: Ministry of the Environment and Spatial Planning, Republic of Slovenia

Authors: Circular Change and a consortia of partners.

Objective: Pave the way towards transitioning from a linear to a circular economy in Slovenia through an inclusive multi-stakeholder process.

The goals of the Roadmap are:

a. Outline the potentials that establish Slovenia as the leader of the transition into the Circular Economy in Central and Eastern Europe;

b. Involve stakeholders to identify and connect circular practices;

c. Create recommendations for the Government of the Republic of Slovenia to facilitate a more efficient transition;

d. Identify circular opportunities for strengthening international economic competitiveness and quality of life for all.

Source: circular change

Step 2:

Priority areas and concrete solutions

Cities and regions can position and involve themselves in different ways according to the diagnostic results with a view to promoting and supporting circular economy projects. Many circular economy actions are often already taken by local actors in the territories and are common sense. For example, companies mutualizing the collection of waste to reduce transport and hence costs and CO_2 emissions. To deploy these types of circular economy actions more systematically, resource optimization is a must.

Stakeholders need to think holistically when responding to climate change and resource management issues.

Based on different research and well-known scientific papers such as those published by the World Economic Forum, this white paper identifies four priority areas for a circular economy in utilities:

- **Preserve and renew resources;** focusing on the construction and water sectors.
- **Mitigation solutions and air quality;** focusing on waste to energy loops.
- **Circular urban development;** focusing on solutions around urban heat island challenges as well as urban densification and water stress challenges.
- **Integrated waste to resources management;** solutions focusing on collection and sorting, recycling and recovery.

Preserve and renew resources

Resource extraction increased 12-fold between 1900 and 2015 and is expected to double by 2050. By that same year material consumption by world's cities will grow from 40 billion to 90 billion tonnes.

Climate change mitigation solutions and air quality

More than two-thirds of the world's energy is consumed in cities, accounting for over 70% of global CO_2 emissions

Urban development and the circular economy

Between 1900 and 2015, the urbanized population increased from 14 % to 54 % and is forecasted to rise to 68 % by 2050

Waste to resources: integrated management

Cities generated 1.3 billion tonnes of solid waste per year in 2012 and is expected to rise to 2.2 billion tonnes by 2025

How to read this section:
The following section provides concrete solutions for the four priority areas regarding water, waste and energy. These case studies can be identified through the colour coding and the reader can come back to them separately. These three topics are at the core of utility services and can inspire cities and regions to find solutions that have been implemented in cities or in the private sector.

Water
Case studies related to water activities.

Waste
Case studies related to waste activities.

Energy
Case studies related to energy activities.

Preserve and renew resources

To better understand which sectors and and product supply chains GHG emissions come from, the WBCSD/ Ecofys studied the global material flows and their carbon, water and land footprints. Eight main materials, steel, aluminium, plastic, cement, glass, wood, primary crops and cattle have shown to have the biggest carbon, water and land use impacts on the planet. Cities and industries can have an impact on two main sectors: the construction sector (accounting for 34%: "shelter") and the food sector (including agriculture, food processing and social consumption, accounting for 33%). The energy sector is not included in the WBCSD/Ecofys study (which is why there is only 20% GHG, see figure 12.) but we know that cities account for at least 60% of global GHG emissions. Hence, the need to act on renewable energy solutions.

Figure 12. CEO Guide to the Circular Economy, WBCSD.

According to this analysis we understand the urgent need to focus on different sectors such as the resource and waste material flows in the construction sector as well as in the food and energy sector. How we preserve and optimize these resources are the main topics covered in the following examples showcased.

PRESERVE AND RENEW RESOURCES IN THE BUILT ENVIRONMENT

When it comes to new buildings, the greatest environmental impacts caused by construction are related to energy and material choices and the placement of buildings relative to the rest of the city structure. The carbon footprint of construction is considerable and practical steps can be taken. Circular procurements can be defined as procurements that support the five principles of the circular economy and circular economy business models (see figure below):

Here are some steps a city can follow to start engaging on circular procurement in construction:

- Use public procurement criteria to promote a local circular economy;
- Define public procurement criteria that are compatible with environmental demands. If municipalities want to have a diversity of options and implement innovative solutions, it is better to keep a certain flexibility in their specifications;
- Adopt a sustainable purchasing charter;
- Give priority to recycled materials and energy valorization in public purchases;
- Reuse construction waste for urban public spaces.

Amsterdam has been working on a full vision and action agenda for the city and metropolitan area. As mentioned in the next case study the construction chain is one of the strategies developed.

Product as a Service	Circular Supply Chain	Life Cycle Extension	Sharing Platforms	Returns & Recycling
▪ Total cost of ownership is borne by producers and retailers ▪ Leasing and paying for use ▪ Performance over quantity sustainability over disposal	▪ Renewable, recyclable and biodegradable materials ▪ Successive life cycles	▪ Active mantenance of products ▪ Repair ▪ Upgrading ▪ Remanufacturing ▪ Remarketing	▪ Increasing the utilisation of goods and resources ▪ Renting ▪ Sharing ▪ Exchange	▪ Waste is valuable raw material ▪ Recycling and use for other purposes ▪ Waste to energy

Figure 13. Circular Economy Business Models that can be Supported through Procurement according to Herlevi, 2015.

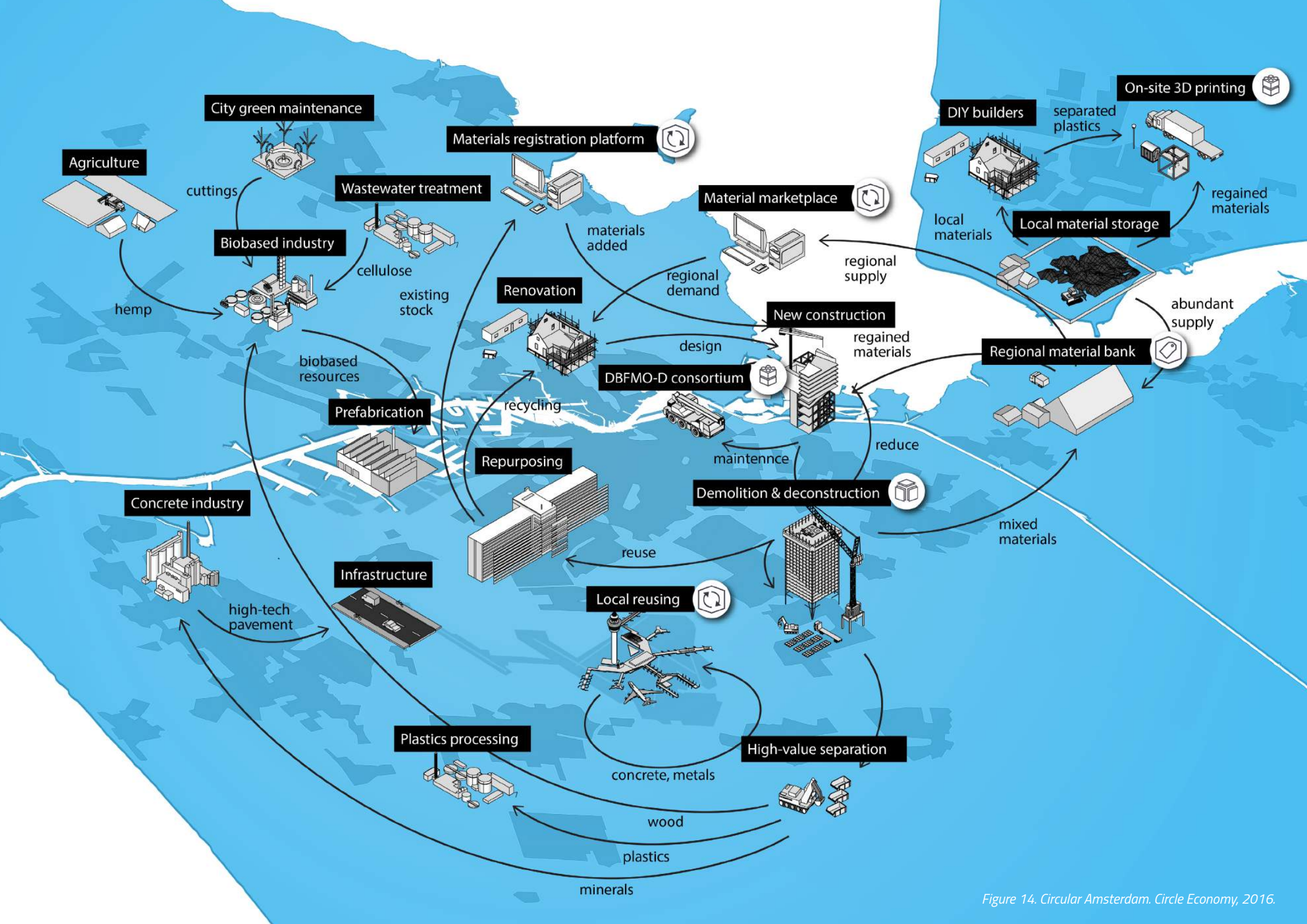


Figure 14. Circular Amsterdam. Circle Economy, 2016.

Activity:
Level of implementation: City and around
Maturity level: Strategy level
Actors involved: City, Region and local actors

Construction and demolition materials strategy avoiding waste:

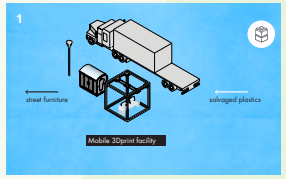
Amsterdam city

What is the project?

Amsterdam has been working on a circular city strategy which is "Circular Amsterdam: A vision and action agenda for the city and metropolitan area". Within this strategy the city is making the construction and demolition of buildings a circular process to maximize product utilisation and keep products and materials in cycles for as long as possible.

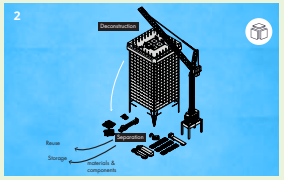
Description of the strategy

Four strategies are being planned and actioned as follow:



1. SMART DESIGN OF BUILDINGS SO THAT THEY ARE BETTER EQUIPPED WHEN THEIR PURPOSE CHANGES AND THEIR MATERIALS CAN BE REUSED. THREE TYPES OF SMART DESIGN:

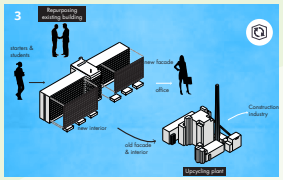
- Modular and flexible design
- Bio-based materials
- Experimental construction areas



2. DISMANTLING AND SEPARATION

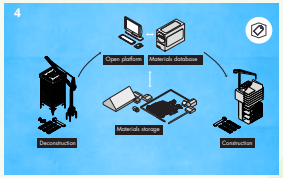
Decommissioning: The cost and time for each partner are monitored during all DBFMO-D (design, build, finance, maintain, operate and demolish) phases in which clauses for not only design, building, financing, maintenance and use of buildings are contained, but also demolition (Netherlands Court of Audit, 2013). Such contracts allow the components and materials in the building to be used again. These components and materials can then be sold to compensate for the demolition costs.

Waste separation: By separating construction and demolition waste, materials can be retrieved in a high-value manner without cross-contamination. Hybrid waste management systems, which combine individual and central sorting methods, can lead to better business cases.



3. HIGH-VALUE RECYCLING OF MATERIALS AND COMPONENTS:

- Better reuse: building and waste materials can be reworked into new products. In Amsterdam, a special installation can be built that enables high-value recycling of building materials.
- Demo clean building materials
- The city of Amsterdam aims to retrieve more materials from street furniture by introducing certain procurement criteria (such as in the project "The Street of the Future" in Amsterdam).
- Repurposing existing buildings. Excessive and vacant buildings in Amsterdam have a large share in the material and energy costs in the region. It is recommended that these buildings are optimised and given a new purpose.



4. MARKETPLACE AND RESOURCE BANK

Online Marketplace

Via an online marketplace, supply and demand of building materials for local construction projects can be aligned (by means of GIS data) (Zhu, 2014). Besides information on the building, an information management system, building passports, and information on the quality and quantity of materials used in a specific building can be documented and made accessible. This provides opportunities for trading and the exchange of building materials between parties, and encourages reuse and high-value recycling.

Logistics for collection

An online marketplace alone does not necessarily make the collection and transportation of construction and demolition waste easier or cheaper as the material is very diverse and voluminous. Therefore, there is a need for an advanced collection system and for intelligent logistics, which would make the exchange of building materials easier.

Figure 14bis. Circular Amsterdam. Circle Economy, 2016

Commodity bank

Currently, there are challenges in the temporary storage of construction waste at companies, mainly because this requires space and, thus, investment. A solution could be to arrange centrally located physical storage for materials (commodity bank) – materials that are then traded in the online commodity market place.

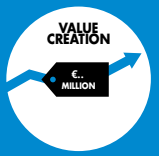
Even though the above four strategies are formulated separately, they are partially interwined. Successful implementation of high-value reuse, for example, is dependent on efficient dismantling and separation techniques.

Indicators

For further information on Amsterdam's roadmap and action agenda link: https://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf

To get in depth information on public procurement, Helsinki municipality, as part of Circular Cities consortium, has written a detailed white paper. You can find it via this link: https://www.climate-kic.org/wp-content/uploads/2019/06/Procurements-in-Public-Construction.pdf

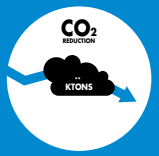
NET ADDED VALUE IN EURO
The circular strategies directly enable a number of sectors in Amsterdam to realise added value: more sales and more profit. "Net" means that any decreases in added value are calculated and that the indirect effects of all other sectors are taken into account.



NET JOBS GROWTH IN FTE
One of the social aspects of an increase in circularity is represented, among other things, by the realisation of jobs (FTE, Full Time Equivalent). Job growth is estimated on the basis of the increase of added value, of salaries in that sector and of the demand for low, medium and highly skilled workforces. Net jobs growth refers to job growth that results in a direct reduction of unemployment.

MATERIAL SAVINGS
Use of materials is expressed in Domestic Material Consumption (DMC)*, which, in addition to the use of materials in an area, also looks at materials that are imported and exported. Apart from CO_2-missions (which already is explicitly included), DMC makes all environmental impact factors related to the circular projects quantifiable.

CO_2-REDUCTION
The most well-known impact of economic activities is CO_2-emissions. The impact of the strategies on emissions is expressed in Global Warming Potential (GWP), a globally adopted measure that expresses the avoided CO_2-emissions in the coming years, by an increase in circularity, over a period of 100 years. To make the impact comparable with the annual emissions in the region, the choice was made to convert the indicators to annual CO_2-emissions.



Activity:
Level of implementation: At Region or country scale
Maturity Level: Innovation
Actors involved: Businesses and public construction sector

Wastebox

A digital waste innovation solution in the construction sector

What is the solution?

Wastebox supports the collection, recycling and treatment of construction waste B to B. Waste Box is a platform that links construction and demolition companies within a network of collection, recycling and treatment partners.

The seed company is being developed in Austria, and its business model is developed in franchised countries.

Description of the solution:

Through an app, Construction and Demolition companies will be able to order containers, and their removal on a 24/7 basis.

Waste Box platform will offer the job to a network of partners and the best geographically located partner will get the job.

Partners have access to the system and will provide information about their abilities and prices, and then will execute the jobs with full traceability that allows containers to be identified at the various stages in the process.

The system is fully paperless. It contains all the documents.

Thus the system provides both customers and partners with very complete reporting on waste streams, and costs.

Where is the solution in operation?

- Austria since 2016: first market developed and origin of the company (a subsidiary of Saubermacher Group) ; Turnover 2019 , 6M€
- Since March 2019 in Germany
- Since June 2019 in France

Positive impacts:

- Real time tracking of key figures for partners and customers
- Efficient & environmental friendly
- Saves time & money
- Fast & safe
- Simple & transparent

Barriers/challenges:

- Resistance from the traditional organisations
- Platform costs

Indicators:

- Number of transactions per country, objectives, up to 250 000 transactions for a large country.

WASTEBOX.BIZ CONNECTS (CONSTRUCTION) COMPANIES

DIRECTLY TO DISPOSAL COMPANIES OR
VIA TRANSPORT COMPANIES TO DISPOSAL SITES

Fast and easy via smartphones.

All of the advantages of a state-of-the-art online service such as real-time communication, complete transparency, etc.

Reliability and consistently high quality standards with access to a large resource pool of vehicles and skips.

Wide network of well located disposal sites for transport optimization

Preserve and renew resources

WATER AS A VITAL RESOURCE

There is an existing framework for all urban stakeholders to support the development of a holistic and progressive vision of water management in cities. Each city needs to develop a unique vision specific to its social, economic and environmental context.

The International Water Association Principles for water-wise cities are driven by the need to address three paradigm shifts in the way cities are planning:

- Resources are limited,
- there is increasing urban densification, and
- an uncertain future underlies the planning of cities in the face of climate change or unplanned growth.

The following graphic presentation of the Principles can be used as a framework to guide cities in the holistic planning for their water systems to increase security and deliver benefits to people and the environment. Working across silos and building water-wise decision makers, technicians and citizens is the enabler.

17 Principles for Water-Wise Cities
4 Levels of Action

1 Regenerative Water Services
- Replenish Waterbodies and their Ecosystems
- Reduce the Amount of Water and Energy Used
- Reuse, Recover, Recycle
- Use a Systemic Approach Integrated with Other Services
- Increase the Modularity of Systems and Ensure Multiple Options

2 Water Sensitive Urban Design
- Enable Regenerative Water Services
- Design Urban Spaces to Reduce Flood Risks
- Enhance Liveability with Visible Water
- Modify and Adapt Urban Materials to Minimise Environmental Impact

3 Basin Connected Cities
- Plan to Secure Water Resources and Mitigate Drought
- Protect the Ecological Health of Water Resources
- Prepare for Extreme Events

4 Water-Wise Communities
- Empowered Citizens
- Professionals Aware of Water Co-benefits
- Transdisciplinary Planning Teams
- Policy Makers Enabling Water-Wise Action
- Leaders that Engage and Engender Trust

Figure 15. The "Principles for Water-Wise Cities" Framework. International Water Association, 2019.

Activity:
Level of implementation: City
Maturity level: Advanced implementation (2010 – 2020)
Actors involved: Cities, Region, utilities, other local actors

Lisbon regenerative water services

Growing green without compromising the blue

What is the city's water-wise plan?

Over the last ten years Lisbon has built a different urban model, moving towards a city that adapts and is resilient to climate change. The city grew greener by developing policies for energy, water and green infrastructure in a common framework. Lisbon has developed and actioned five main topics and solutions for growing greener.

- Increasing permeable green areas (2009-2021: 350 ha, 20% new green)
- Investing in wastewater treatment infrastructure for the depollution of the River Tagus (2008-2018: 770M€ investment covering 18 municipalities, 3,7 million inhabitants)
- Nature based solutions for flash flood resilience (25 new retention/detention basins)
- Saving and reusing water (smart metering, efficient leakage control and a new recycled water distribution network to replace non-potable uses)
- Empowering citizens for water savings and climate action (community activities, online communities sharing best practices, green participatory budget, etc,)

Description of the water saving and reuse strategy:

Lisbon's strategy:

- In the distribution network: reducing losses by optimizing network efficiency, from 32,04 to 11,06 million m^3/year savings between 2002 and 2017 (25% to 11,1%);
- In city uses: Introducing smart meters, improving irrigation systems and building efficiency (2014-2018: 49% savings in municipal water consumption, from 8,2 to 4,2 million m^3/year)
- In green spaces: Replacing plant cover to adapted or entirely rainfed species (such as biodiverse rainfed meadows)
- In planning policy: designing a water reuse strategy to close the urban water cycle:
  - Production of high quality recycled water in three modern wastewater treatment plants – now called Water Factories
  - Designing a new distribution network for recycled water, reaching the highest non-potable water consumption sites (Implementation underway, estimated 30% city coverage by 2025)
  - Implementing recycled water use for irrigation and street washing. Fostering national and European legislative and regulatory changes to promote water reuse and to establish recycled water as a new water product that can replace non-potable uses with a business model that creates value.

Currently, water reuse in Portugal is still limited by the lack of regulations, namely in the business model for distribution of recycled water. Regulation on quality requirements and risk assessment was recently passed (August 2019). Lisbon believes that its pioneering initiative will create the conditions for wider acceptance of recycled water for urban uses. As the city is implementing a distribution network (currently exclusively for its own use), as soon as the regulation exists, the city will be able to provide water for other public and private users, not only for irrigation or washing but

also for large heating/cooling systems (office buildings, large commercial spaces. etc.).

Positive impacts:

- Increase in accessible permeable green areas creating an ecological continuum that provides ecosystem services such as heat island effect mitigation, water retention for flood resilience, increased urban biodiversity and improved air quality
- Potable water savings and increased circularity by introducing water reuse
- New business models in the water reuse sector
- Lisbon has been recognized as European Green Capital 2020

Barriers/Challenges:

- Southern European climate change challenges:
  - Average rainfall: 29 % by 2100
  - Average temperature: rise from 1 to 4°C by 2100
  - Sea level rise by 17-38 cm by 2050
- Rise in extreme events such as flash floods and wind storms
- Very recent (August 2019) national regulation on minimum quality requirements and risk assessment for water reuse: Lisbon is testing it for the first time
- European regulation on minimum requirements for water reuse under discussion (in line with national legislation passed in August 2019)
- Lack of regulation on business models for recycled water, as a new water product
- Lack of financial instruments for water efficiency

Indicators:

- 11,1 % water network losses down (2017)
- 49 % potable water savings in municipal consumption (2014-2018)
- 20 % + potential savings of potable water through replacement by recycled water (until 2025)

Climate change mitigation solutions and air quality

Renewable energy strategies and urban mobility systems are the two main issues when it comes to air quality in a city. Urban mobility systems need to be planned with diverse modes of transport for people as well as for products and materials. Nonetheless, in this white paper we are focusing on renewable and alternative energy solutions.

Cities need to define a low-carbon energy strategy by developing an energy mix that prioritizes the use of renewable and alternative energy sources: geothermy, biomass, cogeneration or recovery of heat generated by the incineration of household waste, wastewater plants, etc. **Recovering energy from incineration can be an alternative source of energy for a city but is in no way the best circular solution as waste going to incineration is considered as a lost resource that could have been be valorised.** Incineration should only be a transition solution with a deadline of operations while in parallel the design of goods should be planned and produced differently; eco-designed and easy to breakdown in order to reuse the materials at the end-of-life stage.

Several solutions exist to actively reduce CO_2 emissions. They can be implemented at a local level (city or district) as well as at a territorial level.

ORGANIC WASTE LOOPS

Reducing waste, complying with upcoming environmental regulations, providing transparency and security as well as boosting the local economy are challenges cities face today. Organic waste treatment represents a huge opportunity to reinvest in our natural capital while creating a high value chain industry. Coming from households, hotels, restaurants, food and beverage industries (f&b), retailers and wastewater treatment, organic waste can be recovered to make organic fertilizer, bioplastics and often biogas which produces heat and/or electricity.

The following graph gives a good and simple overview of the organic waste circularity ecosystem. The whole recovery process requires upstream organization: to collect and sort all biowaste, prioritize local food loop supplies for biogas and other utilities.

Organic waste versus Bio-waste
Organic waste: Organic waste contains materials which originated from living organisms. There are many types of organic waste. It can be found in the form of municipal solid waste, industrial solid waste, agricultural waste, and wastewater. Organic materials found in municipal solid waste include food, paper, wood, sewage sludge, and yard waste. (Source: Encyclopedia.com)

Bio-waste: Bio-waste is defined as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood. It also excludes those by-products of food production that never become waste. (Source: Ec.europa.eu)

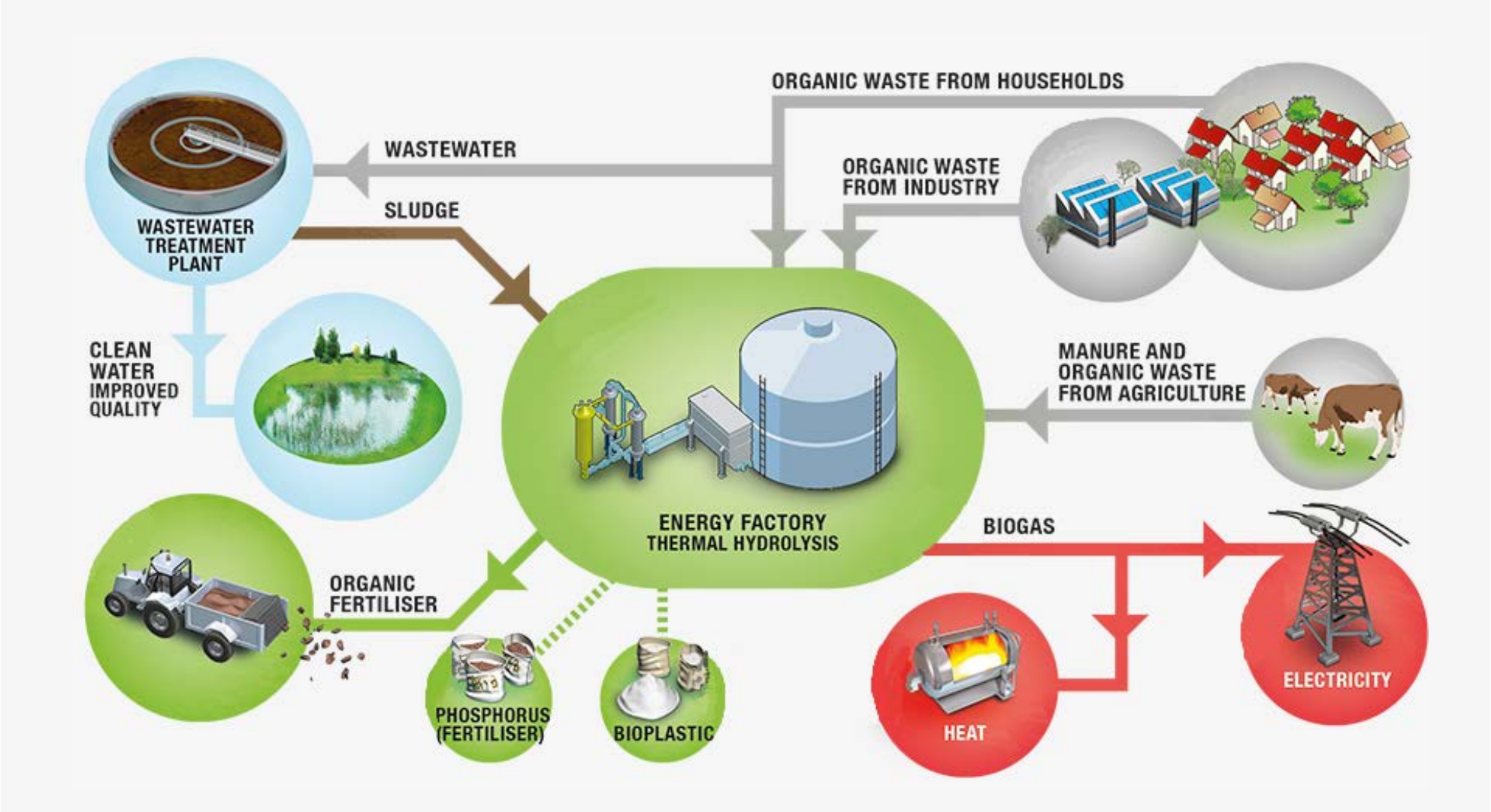


Figure 16. Organic waste loops, Veolia.

Activity:
Level of implementation: City
Maturity level: Advanced (2004-2023 & 2013-2029)
Actors involved: City, region and local actors

Pécs Biomass

One of the largest generators of energy from biomass in Europe

What is the project?

As a short-term goal, Hungary aims for 15% of renewable energy supply by 2020. The project, which aimed to turn Pécs into the greenest city in Hungary, fits within this strategy.

A woodchip-fuelled boiler was inaugurated in 2004. This was achieved by converting an existing coal-fuelled boiler to become suitable for the fluidized sand-bed technology, which is able to produce as much as 185 tonnes of steam per hour.

A second biomass plant with a capacity of 35 megawatts of energy from the straw-fired units was built by the operator of the power plant, Dalkia Energia.

Description of the solution:

For this first biomass plant, a 28-meter-high oven was built, which uses 600 tonnes of materials each day to convert into heat and electricity. Sufficient agricultural by-products are available as inputs for the biomass plant from within a 100km radius and used within less than 5 days. These comprise mostly wood waste, including outputs from local saw milling.

For the second biomass plant, inputs include straw, as well as by-products from corn and sunflower production.

Long-term contracts to supply the two power plants were established with farmers and forestry and saw-mill operators in the region, involving 20 farms.

In 2015, the biomass cogeneration plants opened a visitor centre. After one year, 1,300 visitors had already discovered its circular model.

Positive impacts:

- The energy supply for Pécs is fully provided by wood-biomass and straw, contributing to 6% of Hungary's overall energy demands.
- CO_2 emissions reduction: the 1st biomass plant saw 150,000 tonnes of CO_2 avoided per year and 400,000 tonnes per year for the 2nd biomass plant.
- The biomass-fired units provide 100% of the heat demand for the district heating system of 31,500 flats and 460 institutions in the South western Hungarian city of Pécs.
- Extra overall income of 4 billion Hungarian Forints (€12.4 million) for farmers in the south western Hungary.
- Transportation and collection of the straw packed in bundles or bales has created 170 permanent jobs. A further 500 seasonal jobs provide supplementary and repeat income for local farmers.
- The ash produced from the combustion at both plants, makes excellent fertilizer and provides bio-nutrients for the soil. It returns to feed the earth with the potassium, magnesium and phosphorus it contains.
- Independence from international energy price fluctuations: the second biomass plant decreased the natural gas imports by 80 million cubic meters a year.
- In 2014, the second biomass plant received an award from COGEN, the European co-generation

trade association, which voted it the best plant in Europe in the “market development” category.

Barriers/Challenges:

- Implementing this new and unknown technology in Hungary required a cultural shift.
- The most significant challenge for the second straw biomass plant was creating a baled fuel base. It took five years to fully organise the whole supply chain.

Indicators:

- CO_2 emission reduction/avoided
- Number of households or public services institutions supplied with the biomass energy
- Job creation
- Economic value

Activity:
Level of implementation: City
Maturity level: Advanced (2012)
Actors involved: Municipality, local actors

Municipal and industrial waste recovery in valorization in Graincourt

What is the project?

French legislation states that renewable energy must account for 23% of electricity consumed by 2020. Since 2012 large producers of organic waste are compelled to sort and recover organic waste. So industries and municipalities are obliged to source segregate their waste.

Artois Methanisation is «The eco-responsible solution for the organic waste generated by industries and municipalities in the Nord-Pas de Calais region ». Located in the heart of a farming region which supplies the food & beverage industry, the Artois Methanisation site is a local solution for eco-responsible recovery.

Description of the solution:

Anaerobic digestion provides a dual response to the problem of fermentable waste treatment and green energy production. This oxygen-free natural biological process uses methanogenic bacteria to break down organic matter. It produces biogas and a residue called digestate. The solution provides a full range of services based on anaerobic digestion:

- A center of expertise: analysis of the organic waste composition and of the potential biogas production in pilot units to determine the suitability of various kinds of waste for the anaerobic digestion process.
- Depackaging : a mobile unit is used to separate the organic matter from any packaging (PP, PET and PEHD bottles, tin cans, etc.).
- Biogas recovery to produce heat and generate electricity.
- Digestate recovery through a composting process.

Positive impacts:

- Adapt collection logistics to clients' needs, minimizing transport costs
- Treat any flows of organic waste: 25,000t/y of treatment capacity
- Produce energy and digestate that can be used as fertilizer: 8,000 MWh/y of electricity generated representing 6,500 people supplied with electricity
- Reduce the environmental footprint: 2,000t/y of GHG emissions avoided

Barriers/Challenges:

- Large CAPEX and OPEX to be planned: Artois Methanisation received financial support from the European Union through the European Regional Development Fund (ERDF), the Nord-Pas de Calais region and the French Environment and Energy Management Agency (ADEME).

Indicators:

- CO_2 emission reduction/avoided
- Number of households or public services institutions supplied with the biomass energy
- Job creation
- Economic value

Activity:
Level of implementation: City
Maturity level: Past experimentations and concept proven (Since 2014)
Actors involved: Public and private actors

Energido:

Heat recovery from wastewater

What is the solution?

Energido is an energy recovery system including a remote exchanger able to recover wastewater calories as heat and energy power for buildings, eco-Districts, hospitals, aquatic centers, shopping centers, schools, etc. The wastewater used comes from sanitation networks or treatment plants which make it a green and renewable energy.

As a consequence of the environmental protection trends, the municipalities and regions promote the development of renewable energies through the energy mix. Wastewater is considered as a new, local, innovative and green energy to explore.

Description of the solution:

The innovation uses a remote heat exchanger to transport the heat produced by the sewage system to a reversible heat pump that transfers energy from the water feeding either the heating system or cooling system.

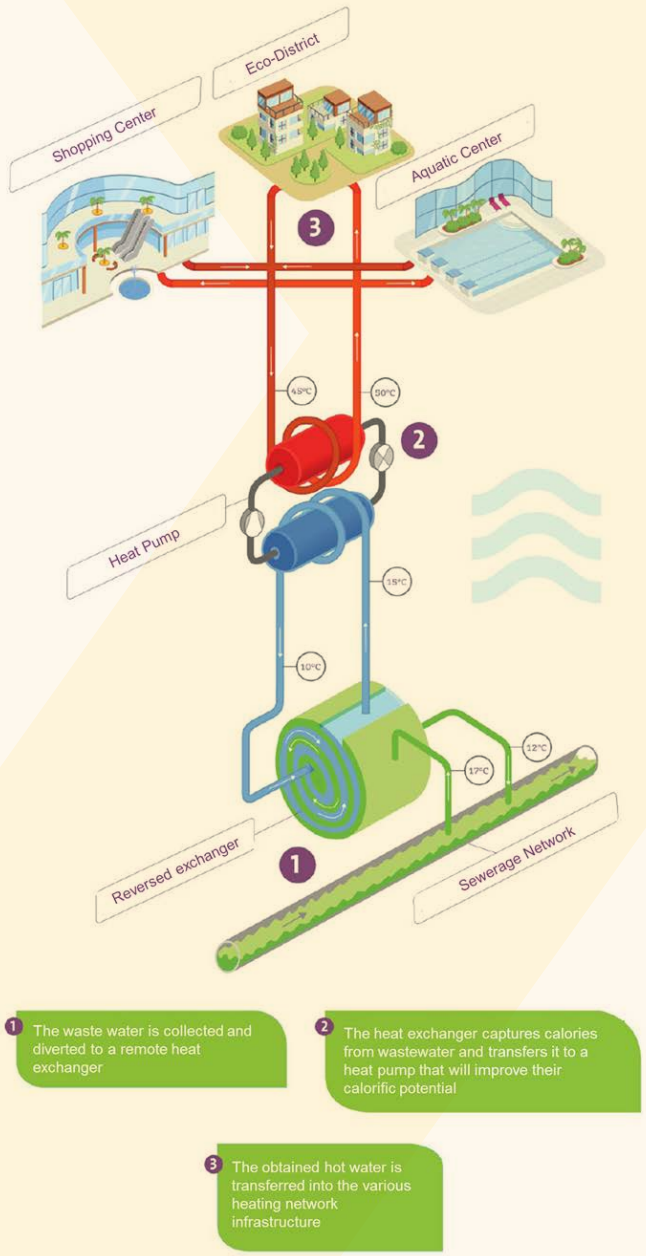


Figure 17. Energido operating principle, Veolia

Where is the solution in operation?

In France: Aix-Les-Bains, Marseille, Toulouse, Roquebrune, Arras, Saint-Laurent du Var, Aulnay-Sous-Bois, Saint-Chamond

Positive impacts:

- Innovation: consists of the use of a remote heat exchanger to transport the heat produced by the sewage system to a reversible heat pump that transfers energy from the water feeding either the heating system or cooling system. The system is innovative and patented.
- Sustainability: values a local, renewable and available source of energy, helps develop the energy efficiency of a site by reducing greenhouse gas emissions and easily integrates into the existing urban landscape
- Reliability: ensures high energy efficiency throughout the year and does not disturb the operation of the sewerage network.
- Competitiveness: the solution can adapt to the future development of an area or facility.

Barriers/Challenges:

- Technical requirement: at least 500 MWh of energy production needed by Energido
- Public buildings need to be careful as the temperature of the heat is often too high: up to 60°C
- CAPEX and OPEX can be high if the project is not partially publicly funded

Indicators:

- Production of heat between 30 and 60°C
- Global Coefficient of Performance (COP) > 3
- Power: 200 to 800 kW

In the Aqualac aquatic center in Aix-les-Bains, Veolia uses the heat from the collective sewage networks to cover more than 90 % of the complex's heating needs.

Urban development and the circular economy

THE URBAN HEAT ISLAND CHALLENGE

The Urban Heat Island (UHI) effect, defined as "an area or locality which has a higher temperature than its surroundings," is a phenomenon triggered by different events such as heatwaves, urban morphological parameters and human-related factors. It negatively impacts the general living environment in cities, causing thermal stress, discomfort, and loss of attractiveness. Heat islands often trigger public health crises, affecting the most vulnerable city dwellers driving up morbidity and mortality rates. The increasing urbanisation rates and more frequent episodes of heatwaves are accelerating this problem, affecting many cities not only in Europe, but also worldwide. As an example, the summer of 2003 strongly hit the whole of Europe causing an economic loss of almost EUR 15 billion (European Environment Agency, 2019).

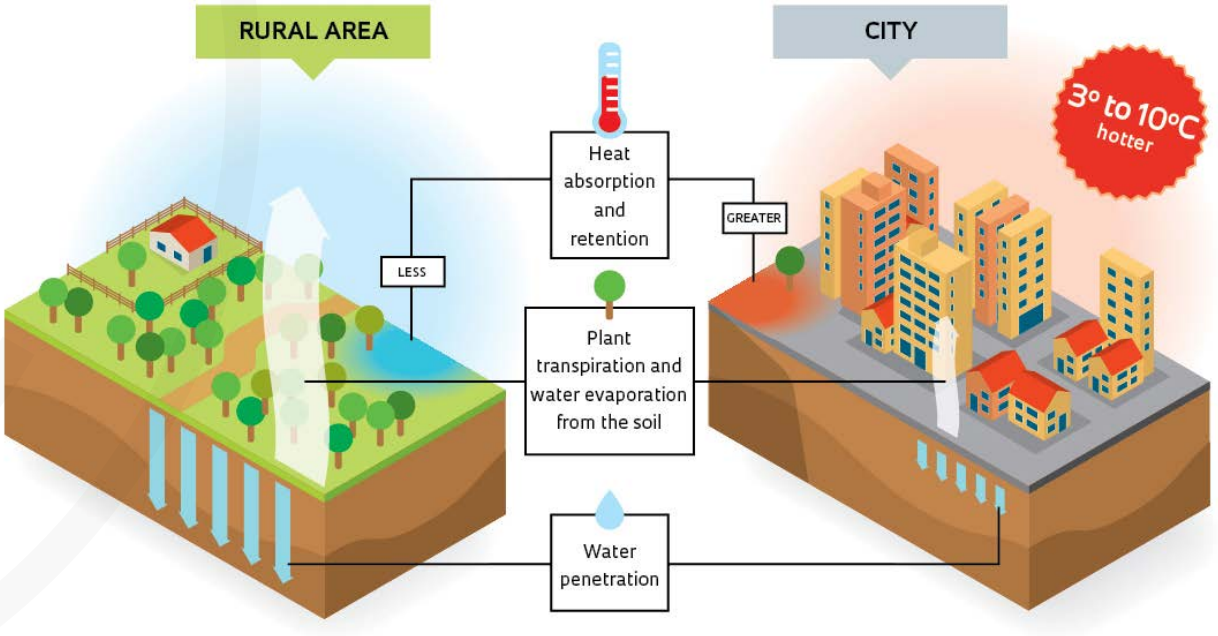


Figure 18. The urban heat island phenomenon, Alexandre-Affonso.

Activity:
Level of implementation: District, neighborhood
Maturity level: Innovation, demonstration stage
Actors involved: City and private actors

Urban Cool Islands Solution:

Evaporative pavement blocks with automation system

What is the project?

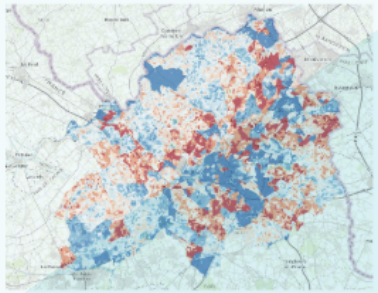
Urban Heat Islands (UHI) are created by the over-heating of dense and mineral city centers which store solar radiation and produce discomfort for citizens and health problems for people vulnerable to heat stress.

In this context, through the use of evaporative pave-ments supplied by non-drinkable water, urban cooling islands aim to reduce the temperature of public spaces and improve inhabitants' comfort and well-being. This technical solution is the first to cool public spaces using evaporative pavements and depolluting road gullies.

Description of the solution:

A 4-step approach to implementing urban cooling solutions:

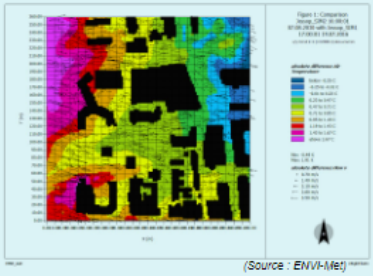
1. City scale : Urban risk mapping



(Source : 2EI)

→ *Risk : UHI exposition * Vulnerability*

2. District scale : Urban thermal comfort modeling *(ENVI-Met software)*



(Source : ENVI-Met)

→ *Assess urban specifications with the local microclimate*
→ *Design different solutions*
→ *Assess their impacts on thermal comfort*

3. Urban fresh island relevant solutions

(Source : Google)

→ *Assess a technical-economical comparison of innovative solutions*
→ *Use a multi-criteria analysis methodology (EVA)*

4. Solutions using **non potable water** can be designed, implemented and monitored :
Road humidification, Evaporative pavement blocks

Here is how the evaporative pavement blocks with an automated system work:

Installation of the injection network and evaporative pavements

The weather station

→ *The management of water injection into the pavements is automated and monitored through a weather station and a real-time injection control system*

Pilot systems for evaporative pavements on public spaces at Nice and Toulouse

Nice

Toulouse

→ *The water injected into the pavement evaporates on the surface: the humidity generates a decrease in temperature !*

Where is the solution in operation?

Nice and Toulouse in France.

Physical demonstration site planned for Rimini (Italy) as part of the waterfront redevelopment.

Positive impacts:

- Increases the comfort of locals and protects the most vulnerable: a water-efficient and teleoperated process makes the temperature drop from 10 to 15°C on the surface and from 5 to 8°C in the ambient air
- Creation of new outdoor spaces for social interactions

Barriers/Challenges:

- OPEX investment
- Ease of implementation

Indicators:

- Universal Thermal Climate Index as a temperature equivalent. It represents the ambient temperature weighted with other local climate parameters (wind speed, humidity)
- Water consumption: volume of water used per day

Source: 2Ei Veolia

Urban development and the circular economy

CIRCULAR ECONOMY SOLUTIONS FOR URBAN DENSIFICATION

The densification of cities is projected to increase in coming years. By 2050, 70% of the global population will live in cities. It will require the development of new ways of thinking about living in cities. The following case shows an innovative way of living at the scale of a neighborhood in a major city like Amsterdam.

© Photo by Yasuhiro Yokota

Activity:
Level of implementation: Neighborhood
Maturity level: On-going (Scheduled for completion in 2020)
Actors involved: City, region, local actors, citizens

The most sustainable floating neighborhood in Europe:

Schoonschip, Amsterdam

What is the project?

The Johan van Hasselkanaal, a side canal from the Ij river in the north of Amsterdam is the location for the Schoonschip floating neighborhood project. The neighbourhood consists of homes for 46 households and a community center on 30 floating plots. The first of the water homes was realized in 2018, and by 2020 the most sustainable floating neighbourhood in all of Europe, with more than 100 inhabitants, will be finished. Schoonschip has managed to keep the group engaged and enthusiastic since 2009 and even to commit financially without the certainty of obtaining a lot, and therefore a home.

The main aspects of this innovative self-sustaining way of living within a large scale city are:

- Sustainability
- Social inclusion
- Open-source model

Description of the solution:

For all resources related management:

- The water homes are well-insulated (EPC = maximal zero) and will not be connected to the natural gas network.
- The heat will be generated by water pumps, which extract warmth from the canal water, and passive solar energy will be optimized.
- Tap water will be heated by sun boilers in warm water pumps; all showers are equipped with installations that recycle the heat (WTW).
- We are producing our own electricity with photovoltaic solar panels. Every household has a battery in which temporarily unneeded energy can be stored.
- All water homes are connected to a communal smart grid. This smart grid makes it possible to trade energy efficiently amongst the households. 46 households will share only one connection to the national energy grid.
- Gray water (i.e. washing machine) and black water (i.e. toilet) will be 'flushed' by a separate source of energy. Waternet will eventually include us in their pilot project, which delivers the toilet water to a bio-refinery in order to ferment it and transform it into energy.
- All homes will have a green roof covering at least one third of the roof's surface.

Positive impacts:

- Living together in Schoonschip terms means sharing resources, experimenting with the newest sustainability techniques and solutions. In order to achieve this, we work together with innovative companies and share our experiences.
- Creating an attractive living environment for the neighborhood of Buiksloterham.
- Environmental and circular innovative solutions moving towards self-sufficiency at a neighborhood scale.

Barriers/Challenges:

- Regulations: it took seven years to change some specific regulations to be able to continue the project.
- High costs for citizens

Indicators:

- Green and renewable energy production
- Materials use
- Energy efficiency

Urban development and the circular economy

WATER STRESS ADAPTATION SOLUTIONS

Access to safe water and sanitation and sound management of freshwater ecosystems are at the very core of sustainable development and the circular economy. This is the objective set by Sustainable Development Goal 6 (SDG 6) by including water management approaches and elements, such as integrated water resources management, wastewater treatment, water-use efficiency, environmental flows requirement, international cooperation, capacity-building and stakeholder participation. SDG 6 addresses water-use efficiency and water stress, pursuing the following: "By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity".

The world's average water stress stands at almost 13 per cent, although evidently there are significant differences among world regions, a fact that a global assessment hides. Worldwide, 32 countries are experiencing water stress of between 25 and 70 per cent; 22 countries experience it above 70 per cent and are considered to be seriously stressed; in 15 countries, this figure rises to above 100 per cent, and of these, four have water stress above 1,000 per cent. In the latter four, the demand for freshwater is largely being met through desalination. (Source: UN Water 2018)

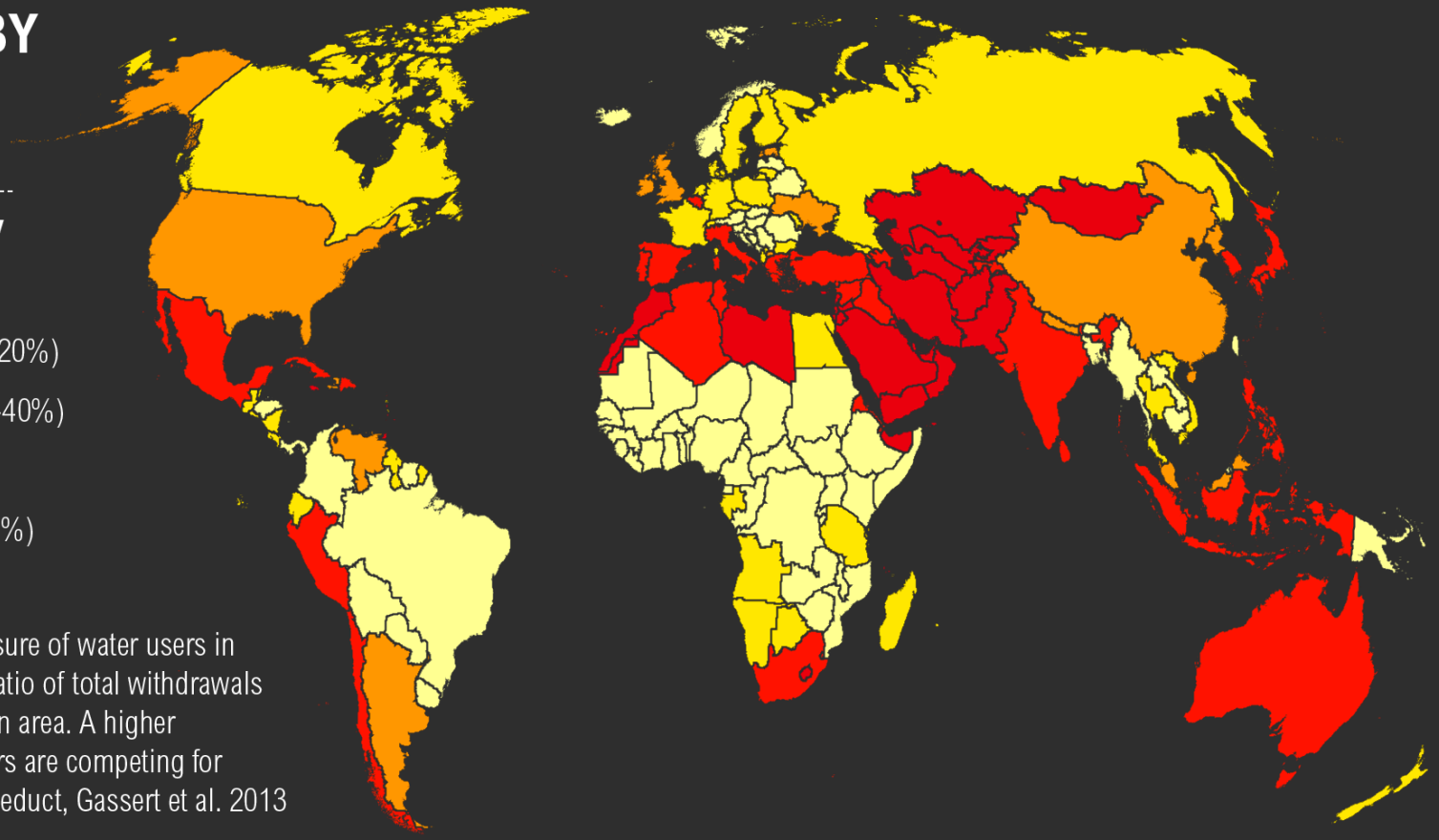
Water stress measures the ratio of total water withdrawals to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies and considers the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users. (Source: WRI Aqueduct 2019)

Figure 19. The Baseline for water stress index, Aqueduct Water Risks Atlas.

WATER STRESS BY COUNTRY

ratio of withdrawals to supply

- Low stress (< 10%)
- Low to medium stress (10-20%)
- Medium to high stress (20-40%)
- High stress (40-80%)
- Extremely high stress (> 80%)



This map shows the average exposure of water users in each country to water stress, the ratio of total withdrawals to total renewable supply in a given area. A higher percentage means more water users are competing for limited supplies. Source: WRI Aqueduct, Gassert et al. 2013

AQUEDUCT

WORLD RESOURCES INSTITUTE

Activity:
Level of implementation: City, region
Maturity level: Advanced (since 2013)
Actors involved: Public Private Partnerships

Industrial Symbiosis to Adapt to Water Stress:

Tarragona, Spain

What is the project?

The region had been relying on water transfers from the Ebro river to meet domestic and industrial needs for decades, but increasing demand from industries and a growing population had outpaced the shared supply system capacity. The region was in a high water stress situation. The water requirements cover 61 municipalities and 29 industries. Tarragona Petrochemical Park represents 25% of Spanish chemical production in a seasonal water scarce area. Due to the UNESCO-protected Ebro River, it could not ensure full municipal and industrial supply anymore.

In this context, the project objective was to reuse high quality reclaimed water from two nearby urban wastewater treatment plants (coming from municipality use) to supply local petrochemical industries.

Description of the solution:

An enhanced physicochemical pretreatment process was developed to address high water quality variability and meet the high water quality criteria required by industrial end users. The solution comprises 3 phases; the plant will grow from 6.8 hm^3 /year to 10.5 hm^3 / year and to a final maximum flow of 20 hm^3 /year.

Instead of being discharged, household water found a new usage after being cleaned, giving an alternative to the "end of pipe" approach.

Where is the solution in operation?

Similar urban to industrial water reuse solutions are in operation in Durban, South Africa and Freeport, Texas.

Positive impacts:

- Reduce river water withdrawal
- Reduce wastewater pollution

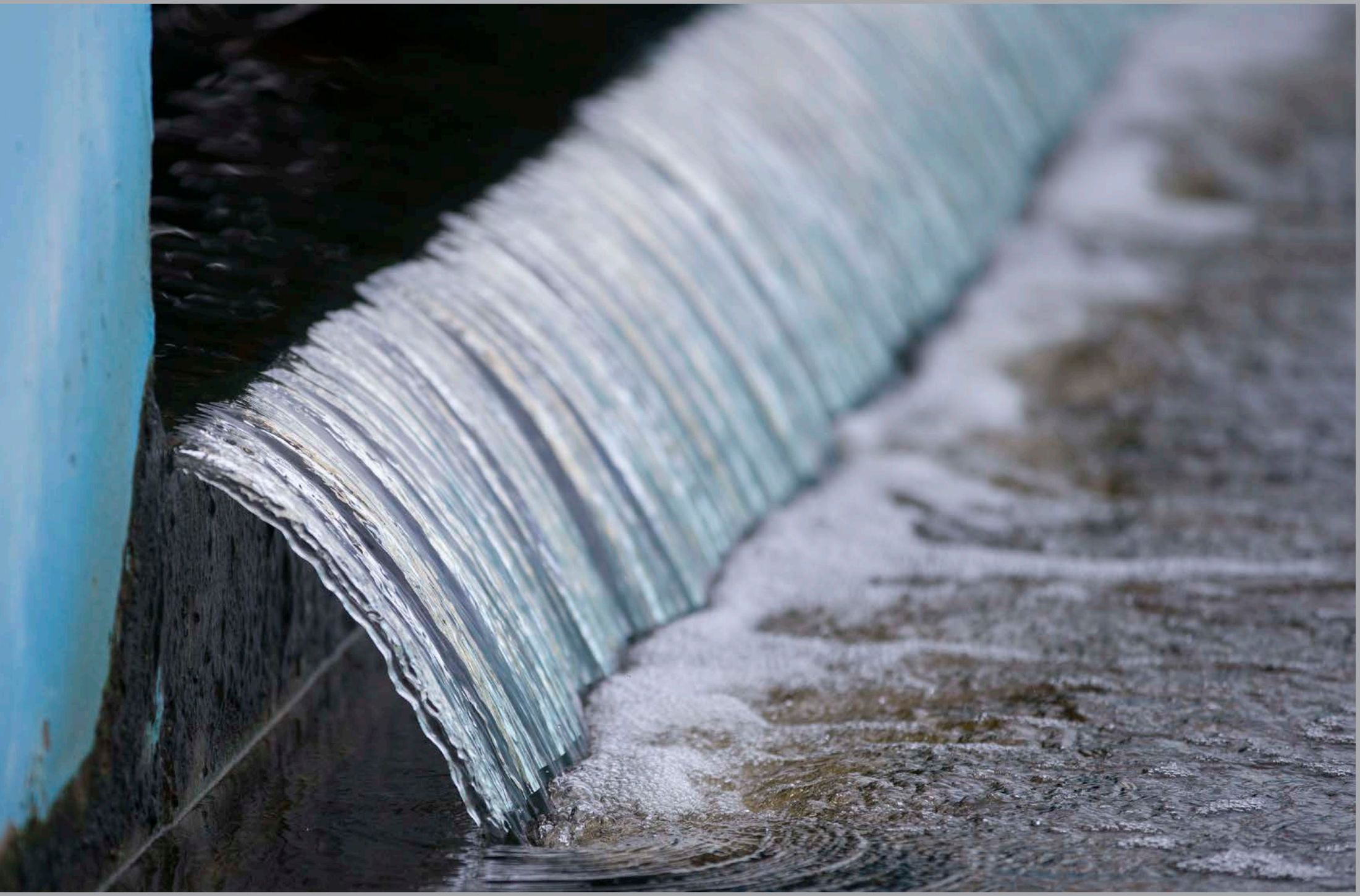
Barriers/Challenges:

- Public/private partnerships are not always easy to put in place.

Indicators:

- Quantity of water withdrawal
- Quality of wastewater rejected

Industrial symbiosis is the process by which wastes or by-products of an industry or industrial process become the raw materials for another. Application of this concept allows materials/resources to be used in a more sustainable way and contributes to the creation of a circular economy.



Waste to resources: integrated management

Waste management is one of the primary services that city governments provide and is a sector over which cities exercise significant authority. The amounts of waste generated globally are growing fast and cities are part of the problem.

Most initiatives at the urban level focus on managing municipal solid waste more efficiently, that is waste collection, separation at source, and recycling. However, today only a small amount of collected waste and residue materials can and will be recycled while retaining their original value. Much of the collected household plastic recyclables, for instance, are of such low quality that they are shipped to low income countries in Asia for further sorting and recycling. This problem surfaced when China decided to stop waste imports from western countries in 2018.

Only a combination of avoiding waste and making the most of the resources that are already in circulation will make a difference in reducing the amount of municipal solid waste. The mindset needs to shift from efficient waste management to resource management. In circular urban economies waste must primarily be seen as feedstock and practices like reuse, refurbishment and recycling should be close to 100 percent. Cities can be at the forefront of supporting sustainable lifestyles and promoting practices of sharing, reuse, recycle and repair through policies, campaigning and communication, and support to civil society actors and entrepreneurs who mobilize around these issues. Cities can support acceleration and business creation in this area to harness innovation and knowledge from businesses.

COLLECTION AND SORTING OUT

Zero waste initiatives and pay-as-you-throw schemes provide powerful incentives to avoid waste and nudge better sorting at source, both in industry and private households. In addition, being paid for feeding back high-quality secondary materials instead of having to pay general waste fees can help to reframe waste as a resource and create financial incentives.


City of Westminster
CLEAN STREETS

Activity:
Level of implementation: Individuals, Buildings, District
Maturity level: Innovation – Start-up (Since 2017)
Actors involved: Local actors

Yoyo

the first collaborative digital platform rewarding sorting

What is the project?

Yoyo is a collaborative platform which rewards inhabitants to encourage better sorting habits.

As things stand today, 8 million tonnes of plastic is discharged annually in our seas. By 2050 there will be more plastic than fish. Collecting and recycling waste is the most efficient barrier against plastic pollution but waste collection is stagnating: only 14 % of plastic packaging materials produced worldwide are recycled.

The main goals of Yoyo are to:

- Recycle more in urban areas; where people consume the most but recycle the least
- Recycle more plastic; the material whose production is increasing the most and remains the least recycled

Description of the solution:

At Yoyo one can subscribe online either as a **"Sorter"**, or as a **"Coach"** who will accompany sorters and create a Yoyo community of "Sorters". A coach can be an inhabitant, but also a local association, or a local supermarket …

For each YoYo bag filled with empty PET plastic bottles, users receive YoYo points. They can then be exchanged for rewards such as cinema tickets, reductions on concerts, football game tickets, access to municipal swimming pools, etc …

YoYo adds a social dimension to waste sorting. Through the website the start-up mobilises a local network of Sorters, driven by Coaches (neighbors, building managers, shopkeepers, etc.). They explain the sorting instructions included for the other than Yoyo waste streams, and receive and store the bags until they are collected.

YoYo guarantees the traceability of the collected bags. Each bag has a unique code and is registered on the platform. Thanks to that, they can follow the bags and make sure each plastic bottle is recycled, so that each Sorter has a proof of his/her action's efficiency.

Where is the solution in operation?

In six main cities in France: Paris, Reims, Mulhouse, Grand Lyon, Marseille, Bordeaux

Positive impacts:

- Direct impact on people's lives. Citizens can actively participate in the process of waste collection and get rewards for it.
- Creation of a community
- Bags are transported to the nearest local recycling infrastructure (100 % short-loop)
- The process is also aimed at municipalities and companies

Barriers/Challenges:

- Promotion: it takes time and manpower to engage citizens in the process

Indicators:

- Number of bags in circulation: they have a code
- Number of plastic bottles recycled


AVEC YOYO,
JE RECYCLE EFFICACE!


LE MOUVEMENT DU YOYO
YO YO
Zéro déchet et tout le monde y gagne
AVEC YOYO,
+DE RECYCLAGE
- DE POLLUTION

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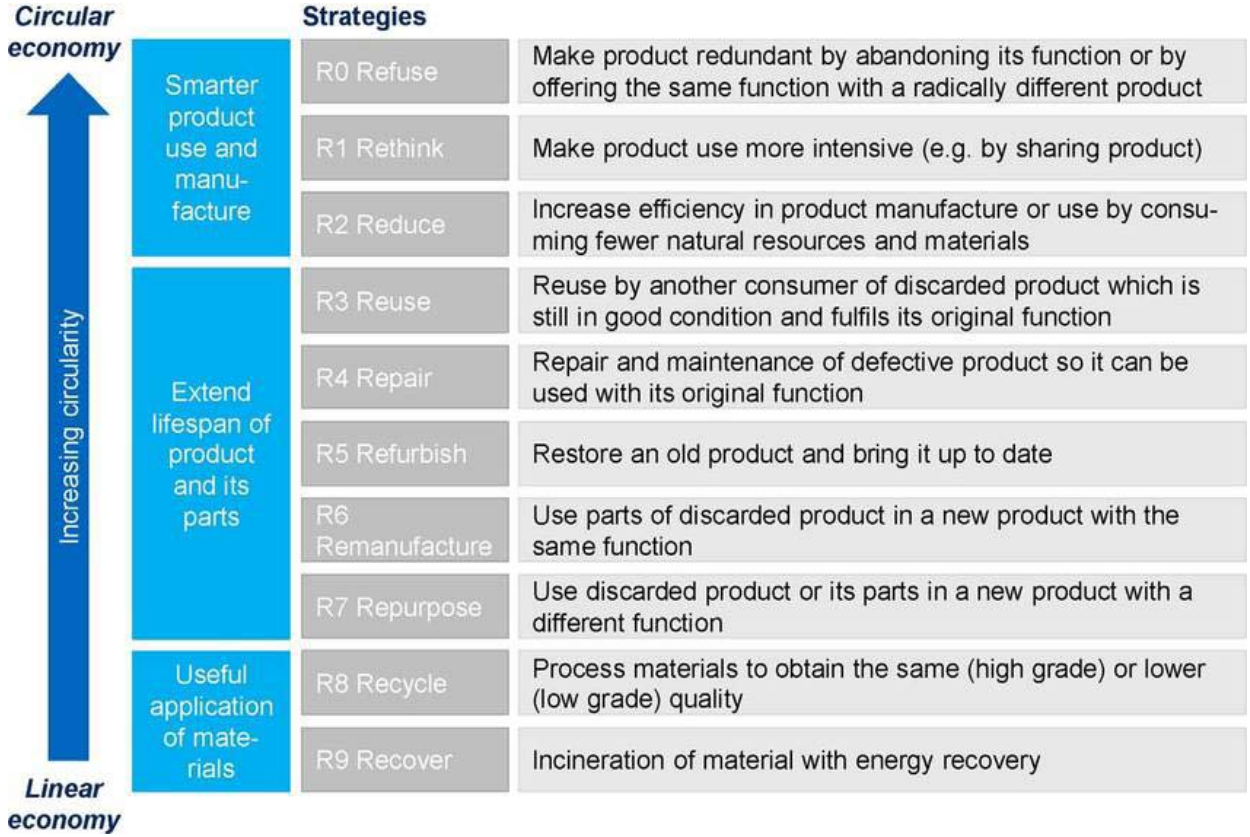
Waste to resources: integrated management

RECYCLE AND RECOVER

Many authors view the various R frameworks as the 'how-to' of the circular economy and thus a core principle of it. All varieties of the R framework share a hierarchy as their main feature with the first R (which would be 'refuse' in the following 9R framework by Kirchherr and Al.) viewed to be a priority to the second R "Rethink" and so on.

"Recycle" and "Recover" are the most linear options within the circular economy transition. When "Recycling" is an option, the second-hand material processed should be the same "high" quality as the input material. When "Recovering", or put to incineration, energy has to be recovered. Waste should be going to incineration only if it cannot be well sorted before. The real issue within these two options is the regulation of waste management. Very often the priority is given to the incineration of waste at the expense of reuse and recycling. It is in many cases more expensive to collect and sort waste for material recycling than to simply collect it as residual waste and send it to energy recovery. Today, the regulation of the waste management sector has resulted in excess incineration capacity, and local authorities often have an incentive to assign waste to their own incineration facilities in order to fill up the plants, despite the fact that some of this waste could have been reused, refurbished or recycled.



Source: Kirchherr, et al., 2017

Activity:
Level of implementation: City
Maturity level: Advanced
Actors involved: Private and Public actors

"Bottle to Bottle"

Recycling in Rostock, Germany

What is the project?

Germany is one of the world's most advanced countries in the area of recycling. Every year, in Rostock,1 billion PET drinks bottles are converted into so-called recyclate from which bottles can again be manufactured. PET drinks bottles from deposit systems are transported to the processing center where they are pre-sorted according to their colour. Closures are then separated and drinks residues are removed. In Rostock Veolia has developed a recycling method for PET (polyethylene terephthalate) bottles that allows direct reuse of the recycled material for new food packaging, e.g. a new drinks bottle.

Description of the solution:

The pre-sorted bottles are crushed into flakes and washed at a high temperature. After a mechanical-chemical process, the processed flakes are again suitable for use in the food industry (hybrid UnPET process of the American company United Resource Recovery Corporation (URRC)). In a final step all flakes are resorted and their purity is increased. They are then filled in big bags for transportation to the packaging manufacturers. "New" PET bottles can now be manufactured.

Positive impacts:

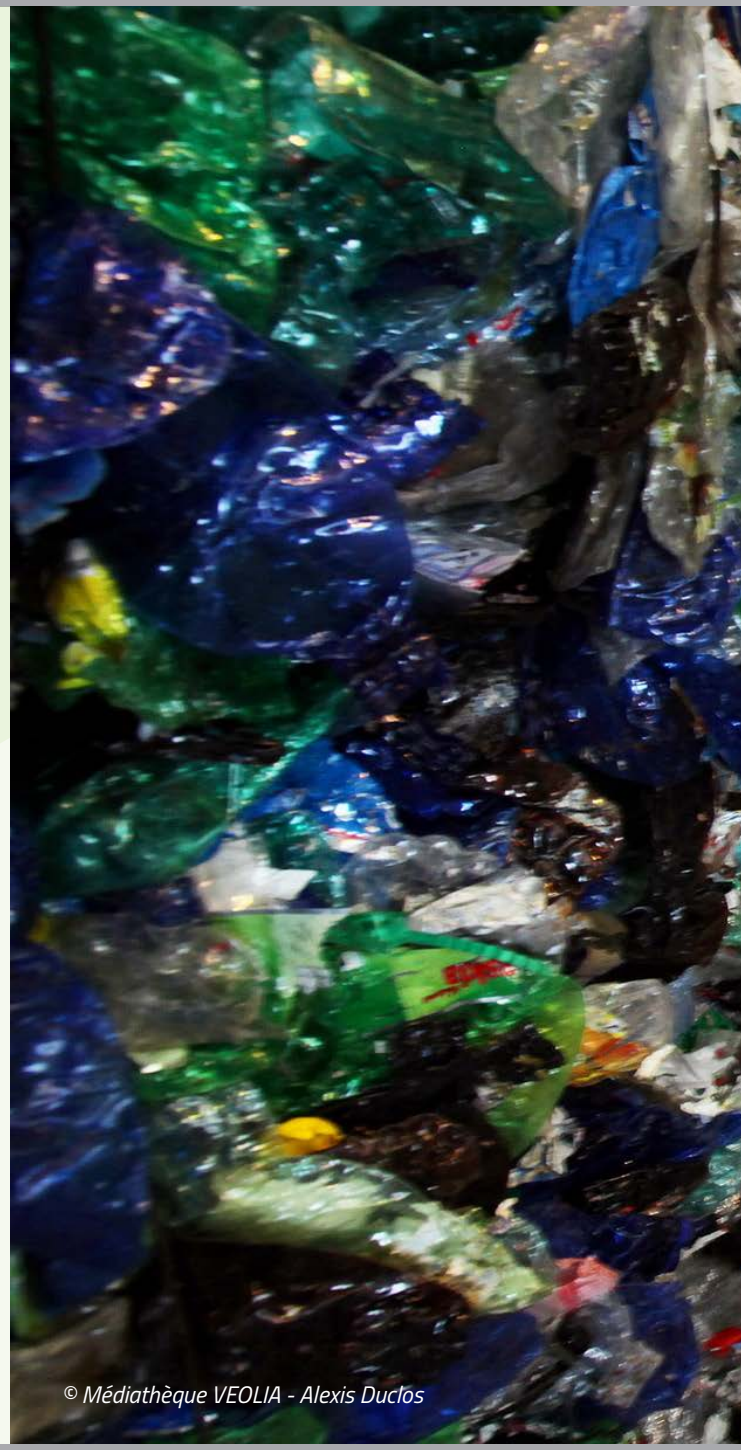
- Health safety
- Improved waste recovery
- Significant carbon footprint reduction: using recycled PET allows a more than 70 % decrease in CO_2 emissions compared to virgin PET

Barriers/Challenges:

- CAPEX investments

Indicators:

- Roughly 31 000 tonnes of oil saved
- Reduction by 113 000 t CO_2 equivalent per year
- 1 tonne of PET bottles recycled roughly equates to 1,5 T of CO_2 avoided.



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Activity:
Level of implementation: Region
Maturity level: Advanced Innovation (Since 2015)
Actors involved: Public and private actors

T-Park Self-sustained Sludge Treatment Facilities in Hong-Kong

What is the project?

In Hong Kong, about 3 million cubic meters of sewage are produced every day, which results in approximately 1,200 tonnes of sludge. It is estimated that the amount of sludge will grow to 2,000 tonnes per day in 2030. In this context, adding the fact that there are no crops to spread this sludge on and to avoid transportation to another country, a state-of-the-art incineration technology appeared as the best viable solution for such big amounts of sludge. Veolia has been appointed by the Environmental Protection Department of Hong-Kong to:

- Design, build and operate a sludge treatment facility.
- Provide a viable and sustainable solution tackling the challenges of sludge disposal in Hong Kong.
- Build the Environmental Education Centre to provide public education and recreational facilities for public engagement.

Description of the solution:

In 2016 the largest sewage sludge treatment plant in the world opened in Hong Kong. **This plant has its own independent water and energy supplies**, and treats sludge from eleven sewage stations in Hong Kong, covering 7.2 million inhabitants. This sludge incineration plant integrates a modern incineration plant with leisure facilities through exceptional architecture, which demonstrate the city's determination to go green and sustainable.

The use of a proven and highly reliable fluidized bed incineration technology to treat the sludge considerably reduces the volume of waste to be disposed of in landfills by up to 90 %.

Major treatment steps for sludge treatment:

- Deodorization
- Incineration
- Flue Gas Treatment
- Heat Recovery and Power Generation

For water treatment:

- Seawater Desalination
- Wastewater Treatment and Reclaimed Water Treatment

Positive impacts:

- Sustainable waste management: A self-sustained facility that combines a variety of advanced technologies in a single complex.
  - Total water management: Self-sufficient in potable and process water which is supplied by the on-site seawater desalination plant. Rainwater is collected for non-potable use. Wastewater from the facility is treated and reused on site to achieve "zero effluent discharge".
  - Waste to energy: Heat energy recovered from the incineration process is turned into electricity to support various operation needs of the facility. Up to 2MW of surplus electricity is available to be exported to the public grid when running at full capacity.

- A new standard in architecture and ecological design for this type of industrial facility. "T PARK " was designed to symbolise the "journey from waste to energy" and is among the city's green goals. The site comprises:

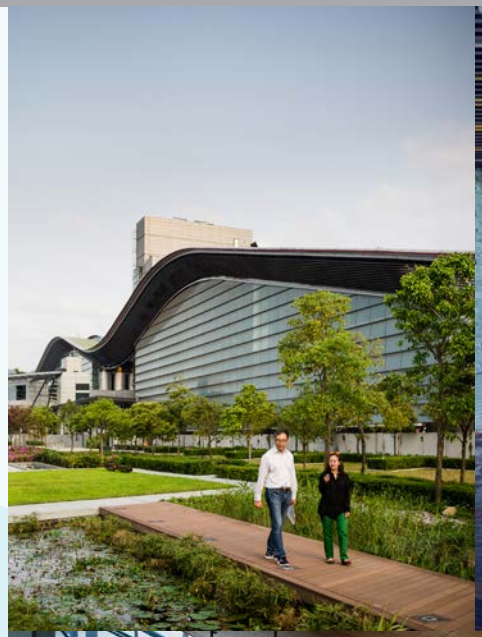
  – a recreational and educational center for the general public, with a 2,800 m² interactive exhibition on sludge treatment;
  – a landscaped and ecological garden covering 9,800 m² for leisure and restoration and preservation of biodiversity;
  – a theatre, a café, a spa with three heated pools, and a patio on the roof all look out over Deep Bay and Shenzhen.

Barriers/Challenges:

- CAPEX and OPEX investments
- Solution adapted to a specific context nonetheless, a replicable one

Indicators:

- Sludge Treatment: 2,000 tonnes/day
- Power Generation: 14 MW of electricity
- Seawater Desalination: 600 cubic meters per day
- Education: number of people visiting the center and/or going to the SPA



Developing a roadmap through a bottom up participatory process

On February 5th and 6th 2019, organized by 2EI Veolia, multiple stakeholders working on circular cities and utilities gathered in Sofia, Bulgaria, to discuss how to fast track a zero waste city. During this two-day event participants took part in three workshops using participatory methods and were divided into five groups: air quality, sludge, water, solid waste and energy. The results of this participatory process can serve as an inspiration to manage complexity in a city transformation, and provide elements for the creation of a circular utilities roadmap. The methods have been developed by the Transitions Hub of EIT Climate-KIC and are included in the Visual Toolbox for System Mapping.

- Mapping stakeholders, priority areas and opportunities
- Finding resources for your vision
- Actioning your vision


PERMANET

Key figures

3
workshops

80
participants

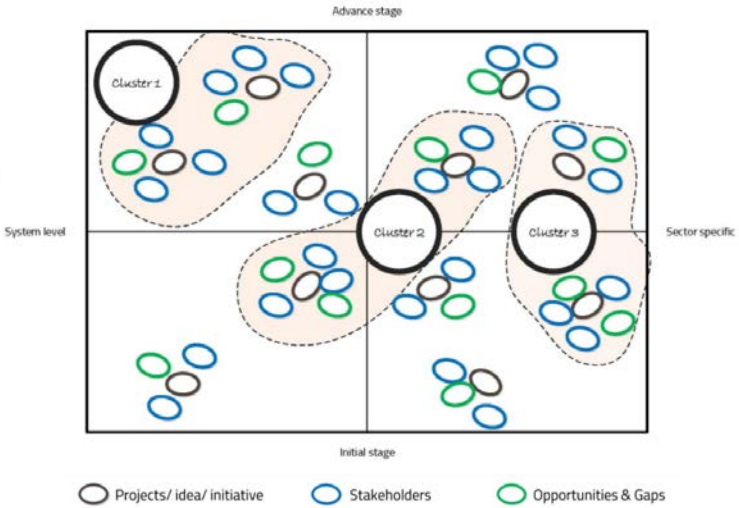
15
countries

5
groups

1105
data inputs

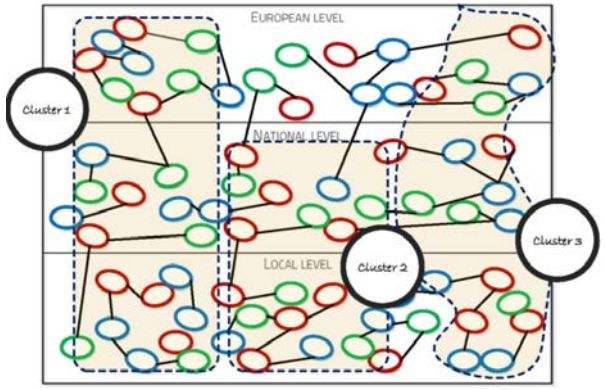
Ocean of Opportunities

Workshop 1



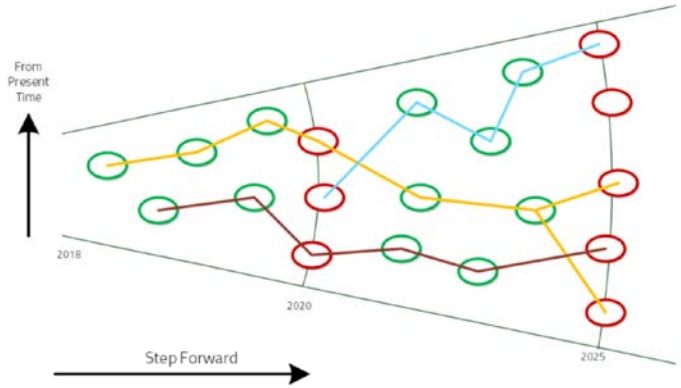
Socio Technical Roadmap

Workshop 2



Forecast

Workshop 3



Throughout the three workshops, participants worked in five main groups related to utilities: air quality, energy, sludge, solid waste and water.

In total, participants provided 1105 inputs of information (see details in Figure 19).

The groups on solid waste and energy were the most populated. Participants also identified different types of elements from existing actions to new opportunities regarding the aforementioned topics (see Figure 20).

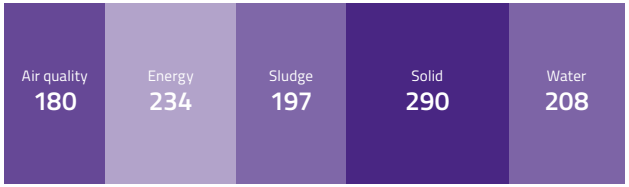


Figure 19: Group' themes

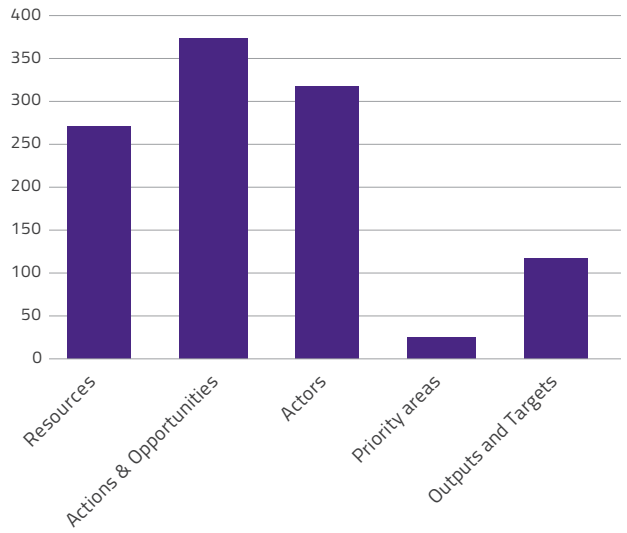


Figure 20: Types of data inputs

Workshop 1:

Mapping stakeholders, priority areas and opportunities

In the first workshop, participants took part in the exercise "ocean of opportunities". The aim of this exercise is to create a snapshot of the current state of play in European cities and the utilities sector. As a result, stakeholders, priority areas and opportunities were mapped at the EU, national and city level. Mapping and analysing stakeholders is key to understanding the power dynamics and framing appropriate governance structures.

Using a participatory approach eases decision making and priority setting

Participants clearly identified the private sector as a key stakeholder in the circular economy in the utilities sector. More specifically, businesses providing financial services and instruments, consultants and land owners. Civil society is also a key stakeholder in achieving a circular city.

Additionally, participants identified **priority areas** at the local level (see Figure 22). Cities must enact new legislation that defines positive and punitive incentives for responsible consumption and production. They also need more funding as the closest governance unit to citizens. This requires higher stakeholder engagement and networking. The lack of political will at the national level is often depicted as the real reason for the regulatory and legislative scarcity.

ACTIONS & OPPORTUNITIES ON AIR QUALITY

In the workshop in Sofia, participants used the "ocean of opportunities" exercise to display ongoing actions and opportunities. Many cities are working on actions to become smarter and to make their mobility systems more sustainable. They are also increasingly working on the design of new circular economy strategies. In contrast, very few new opportunities were identified.

ACTIONS & OPPORTUNITIES FOR SOLID WASTE

Participants working on solid waste identified more opportunities. The design of circular strategies is perceived as a great opportunity, especially because the management of solid waste is considered a potential source of raw material. Trainings regarding the use of solid waste as an energy source and the valorization of solid waste through art are also identified as opportunities.

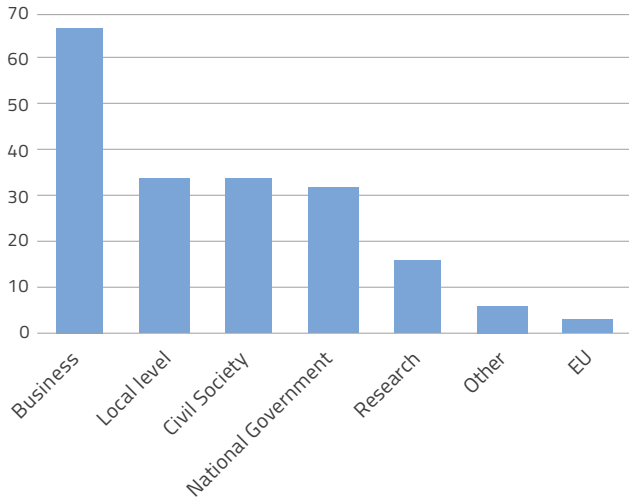


Figure 21: Key stakeholders according to participants

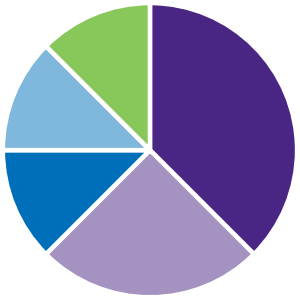


Figure 22: Priority areas at local level

Figure 23: Actions and opportunities for solid waste

Workshop 2:

Finding resources for your vision

In the second workshop, participants used a socio technical roadmap exercise. The aim of this exercise is to depict a desirable scenario for a certain topic, in this case circular utilities in cities. In relation to this scenario, resources such as knowledge, infrastructure or funding are identified.

Greater budgetary efforts to build new infrastructure of infrastructure need to be made to further transformation. This is the case of energy generation infrastructure in urban and rural areas, as well as the creation and expansion of waste recovery facilities. Participants also identified biomass and pipelines as potential sources of demand. New ways and improved access to funding were demanded to enable public-private partnerships.

A paradigm shift requires knowledge to become a resource. While formal education is an important part of enabling change, there are other aspects that need to be considered. More collaboration between research and public institutions are relevant for policy making. Additionally, new concepts such as open agriculture arise.

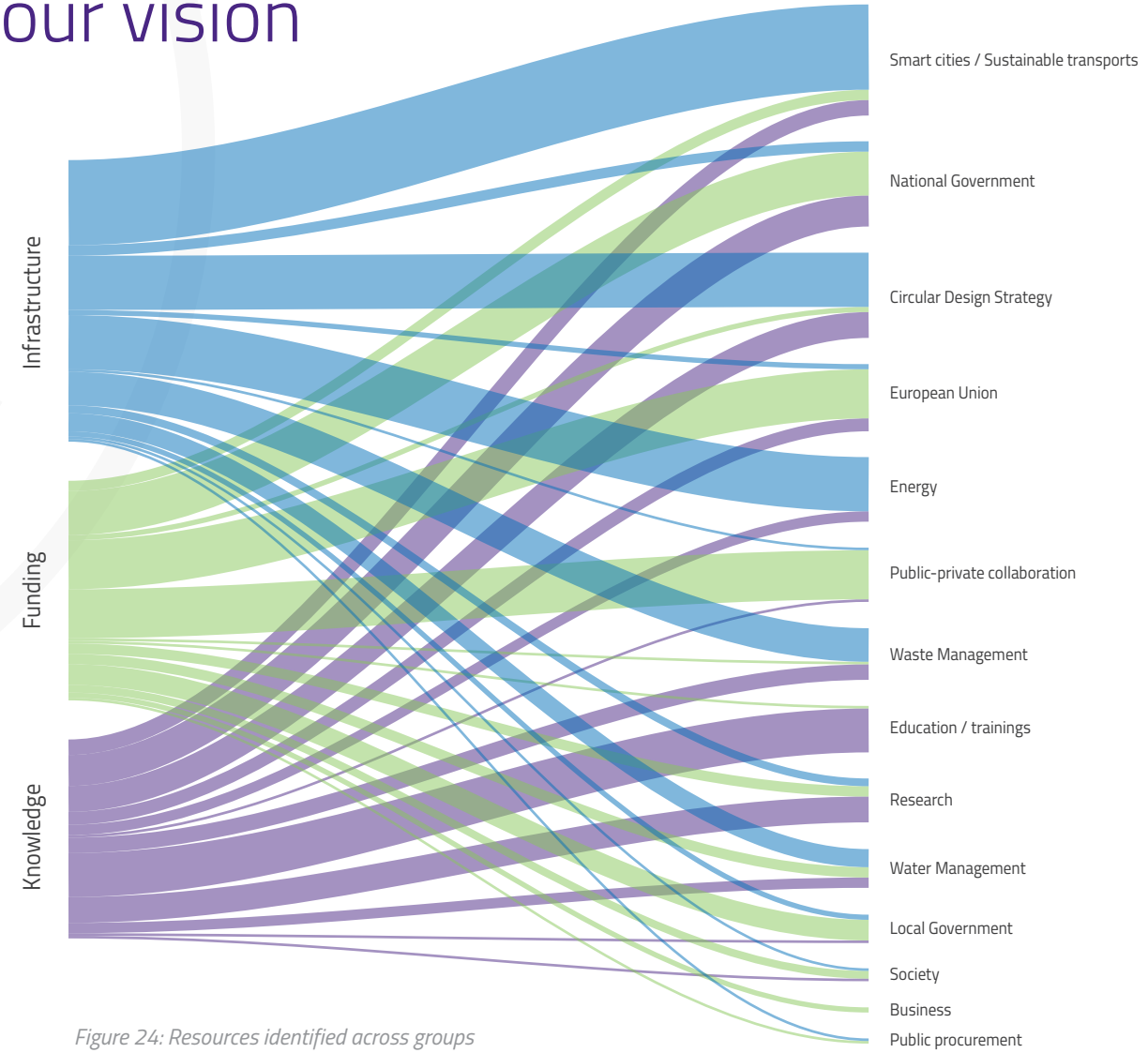


Figure 24: Resources identified across groups

Figure 25: Resources needed for an energy transition in the utilities sector

The energy group identified different types of resources. Participants were especially concerned with policy aspects and the management of resources, more specifically, the capacity of public utility companies and the need for new legislation and expert knowledge in municipalities.

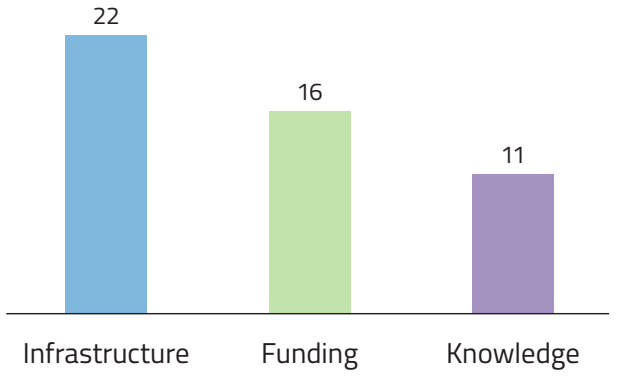


Figure 26: Number of inputs per type of resource

Workshop 3:

Actioning your vision

In the third workshop, participants used the exercise Future Radars, creating a roadmap of different actions and desired outcomes in the short-medium and long term. The short term actions (present- 2022) focus on regulatory and funding mechanisms that boost entry of new business models and medium term ones (2022-2030) note the importance of public private collaboration. Despite the fact that long term actions and outputs (2030-2033) do not prevail, they highlight deep urban transformations.

Air Quality: Participants perceive air quality as a public health issue and prioritize changes in the local legal framework in the near future, especially the creation of negative incentives such as sanctions. This course of action is followed by awareness-raising campaigns. These actions will expand to the national level in the medium term.

Energy: Finding EU incentives to foster energy transitions in mature sectors such as transportation is a short term course of action. Participants think that there is a need for more research, i.e. batteries, before establishing restrictions on polluting energies. These improvements will be implemented in the design of cities in the long term.

Solid waste: It is perceived as a nuclear issue in the transition to a circular economy. In the short term, using waste as a raw material, and implementing sanctions against bad solid waste management practices are a clear demand. It is expected that corrective measures will have a reinforcing effect on the use of non biodegradable waste as a raw material. Funding channels will be strengthened by institutions at both European and national level in the medium term. This is intended to foster the creation of new businesses and to strengthen the capacities of existing companies.

Water: Research on the interlinkages between water and energy is a priority in the short term. Stronger EU sanctions are expected to extend to the local level in the short-medium term. There is a need to generate and visibilize channels of funding that make public-private collaboration easier in the medium term. The role of water in intelligent city models, especially greywater, is also noteworthy,

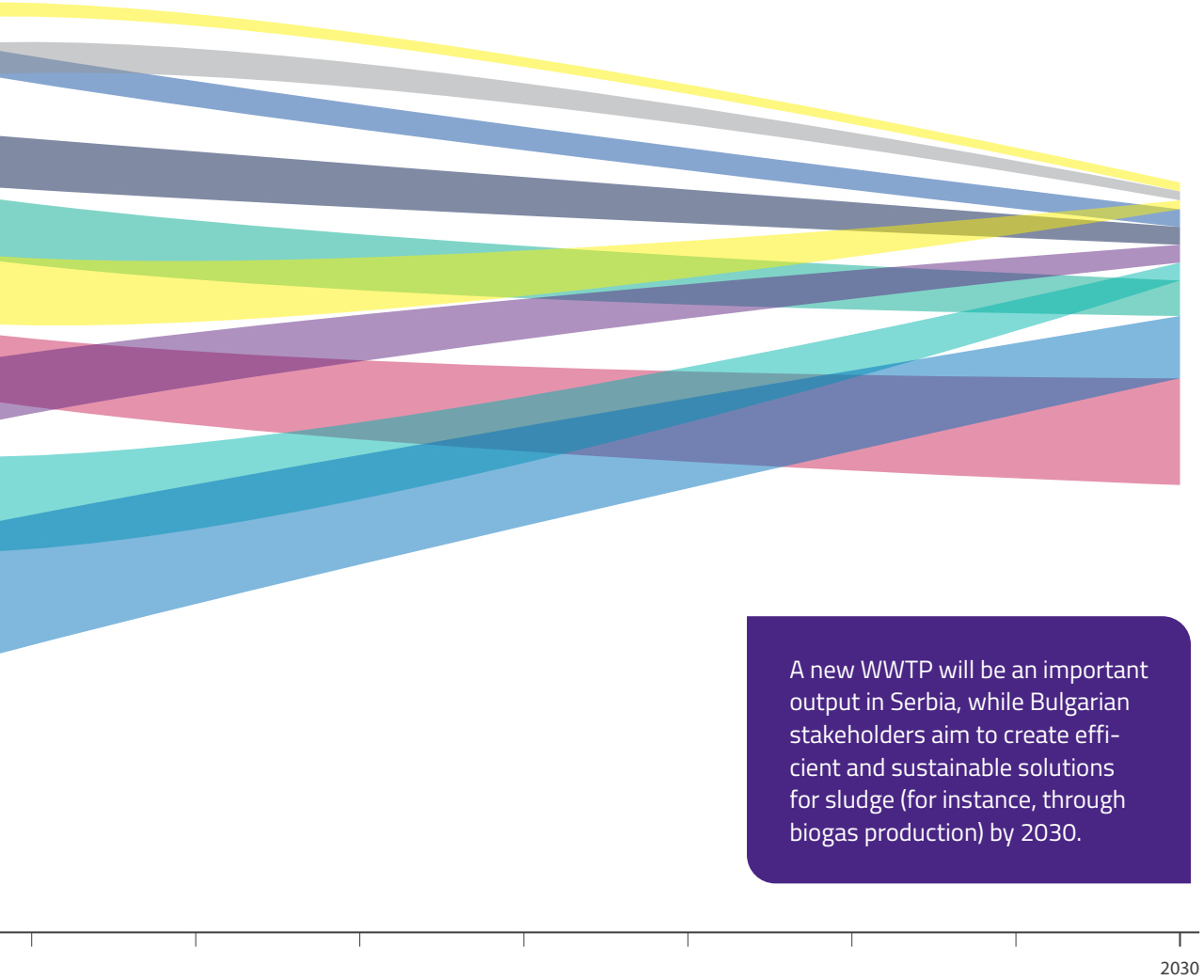


Figure 27: Future actions across groups

Sludge: Research on the potential of using sludge as a raw material, together with new fiscal incentives and awareness raising campaigns, are actions to be developed in the short term. The expected outcome in the long term is a shift regarding water management and how to include waste in the value chain in a more efficient way.

Types of action	By 2022	By 2030
Education & training	1	
Funding	2	
Infrastructure		1
Research and innovation	3	1
Incentives		1
Regulation	2	
Stakeholder engagement	1	
Strategy and planning	4	1
Total	**13**	**4**

Figure 28: Identified future action in the sludge group

Looking at the future

The Circular Cities project has allowed 2EI Veolia and EIT Climate KIC to work together with other key stakeholders in one of the key topics of our time: addressing the European climate emergency. There are multiple lessons learnt from the project and from this white paper that cities can take into account when thinking about the circular economy and transition, and which can be summarised in three main reflections.

A COLLECTIVE VISION

A strong vision and knowledge of all networks in one area is important. Interconnections and systemability are two words that should be part of the strategy and solutions to be implemented. No matter from top-down or bottom-up, the vision will allow the transition to start from within and expand.

PRIVATE & PUBLIC SECTOR FLEXIBILITY

Most of the time innovations are moving forward to the unknown. Implementing an innovation can be a challenge and oftentime a risk. It is indeed part of the "game" in order to activate a real transformation but also difficult for the solution implementer to move forward as barriers to change come along. Private and public stakeholders should be more flexible and reactive to an innovation implementation and success to help it grow and sometimes even help change a regulation. Resistance and persistence are key to success.

EDUCATION & INCLUSIVENESS

The future and the development of solutions are not only about finance. People are the main source of change and education should be THE priority in all societal and economic transformation. Any sectors or stakeholders can include education in their circular, and more broadly, sustainable development strategy. More than ever we need a more JUST TRANSITION!

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Definitions

Organic waste:
Organic waste contains materials which originated from living organisms. There are many types of organic waste found in municipal solid waste, indistrial solid waste, agricultural waste, and wastewater. Organic materials found in municipal solid waste include food, paper, wood, sewage sludge, and yard waste. (Source: Encyclopedia.com)

Bio-waste:
Bio-waste is defined as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood. It also excludes those by-products of food production that never become waste. (Source: Ec.europa.eu)

Water-wise cities:
'Water-wise' behaviour means that leadership culture, governance arrangements, professional capacity and innovative technology are all aligned with the objective of maximising sustainable urban water outcomes.

Sustainable Urban Water:
Sustainable urban water management means that all water within the city (including reservoir and aquifer water, desalinated water, recycled water and stormwater) is managed in a way that recognises the connection between services, urban design and the basin, with an approach that maximises the achievement of urban liveability outcomes, and resilience to unexpected social, economic or bio-physical shocks, while replenishing the environment.

Zero-Waste City:
The Zero Waste Cities approach is a continuous effort to phase out waste – not by burning or landfilling it – but instead by creating and implementing systems that do not generate waste in the first place.

Industrial Symbiosis:
Industrial symbiosis is the process by which waste or by-products of an industry or industrial process become the raw materials for another. Application of this concept allows materials/resources to be used in a more sustainable way and contributes to the creation of a circular economy.

Climate Change Mitigation:
It contributes to the objective of stabilisation of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration.

Climate Change Adaptation:
Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. It has been shown that well planned, early adaptation action saves money and lives later.

Decoupling:
Decoupling is part of the circular economy definition. It is one of the main outputs of the circular economy; decoupling economic activity from the consumption of finite resources, and designing waste out of the system.

Rebound effect:
The Rebound Effect is characterized by the difference between the maximum economy possible and the real economy realized. According to Franck Dominique VIVIEN, "The rebound effect can thus be defined as the increase in use or consumption of one or more products that follows a gain in energy efficiency, materially, temporally, etc. - in the production, supply or use of a good or service.

Water stress:
Baseline water stress measures the ratio of total water withdrawals to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies and considers the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users. (Source: WRI Aqueduct 2019).

A practical approach to develop a city roadmap focusing on utilities