RE-CITY
INTERNATIONAL PLATFORM
FOR SOCIAL SUSTAINABILITY

07/19

RAPPORTEURSHIPS "FACING CLIMATE CHANGE"

"CIRCULAR ECONOMY: A SHIFT IN THE PRODUCTIVITY MODEL"

SESSION WITH **SLADJANA MIJATOVIC.**

FUNDACIÓ
CATALUNYA
EUROPA

CIRCULAR ECONOMY: A SHIFT IN THE PRODUCTIVITY MODEL

Invited Speaker: Sladjana Mijatovic Sustainability & Circular Economy Manager at Bouwfonds Property Development (BPD), Amsterdam

Contents

This report is a synthesis of the debate carried out with Sladjana Mijatovic in the conference series 'Facing climate change', organised by Catalunya Europa Foundation in the context of the Re-City project. This session, entitled 'Circular economy: a shift in the productivity model' consisted of a public lecture, a seminar with participants from the academic sector of Catalonia and a lunch-debate that brought together personalities from the economic, social, political and business sector of Catalonia. The activities mentioned were held in Barcelona at the Antoni Tàpies Foundation on April 2019. The content order along the report is thematic and does not represent the order in which it was presented by Mijatovic. The conference series 'Facing climate change' is developed in collaboration with BBVA, Generalitat de Catalunya, Àrea Metropolitana de Barcelona and Barcelona City Council.

Biography

Sladjana Mijatovic is the Sustainability & Circular Economy Manager at Bouwfonds Property Development (BPD) Gebiedsontwikkeling, in Amsterdam. As one of Europe's largest area developers, BPD endeavours to create sustainable living environments in the Netherlands and Germany.

Mijatovic was born in the former Yugoslavia. When she was 5 years old, the Yugoslav war started and Mijatovic and her family had to leave their town. They eventually settled in the Netherlands, where she lived in a number of refugee centres. In those centres, people were not allowed to work. Consequently, many refugees started their own informal businesses; crafting their own products or offering services. They were in fact creating a collaborative economy within their local community. In this context, Mijatovic learned about circular economy and how-to re-purpose the existing products before having any experience with the linear economy.

Many years later, in 2010, Mijatovic obtained her Bachelor of Built Environment focused in Architecture and Urban Planning, in Amsterdam. Two years later, she obtained a Master of Architecture, focused on Urban Design and Spatial Planning at Delft University of Technology. In 2014, Mijatovic worked as an Assistant Project Manager at Zuidas Amsterdam Development Office. This office is responsible for the development of the Zuidas area, a rapidly developing business district in the city of Amsterdam. She then worked at Amsterdam Marketing as a Business Marketer, rolling out a development strategy for a suitable investment climate for foreign companies to settle in Amsterdam. In 2015, she became the Circular Innovation Officer of the City of Amsterdam. Her job consisted of working with market parties and knowledge institutes to accelerate the transition to a circular model, through innovation and new developments, using the city as a living lab. A year later, Mijatovic also started as the Urban Innovation Manager at Amsterdam Smart City. In August 2018, she left those positions to become the Sustainability Manager at the BDP Gebiedsontwikkeling.

Summary

In the natural world, waste does not exist, but humans generate toxic waste that makes this world unsustainable.

According to forecasts, 70% of the population will live in cities by 2050 (World Economic Forum). This will be accompanied by an increase in the concentration of waste, energy consumption and greenhouse gas emissions in cities. The only way to face it is to think of a new way of consuming and producing, which the circular economy provides. This requires a change of mentality in governments, companies and citizens. A new production system that replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.

Mijatovic explained the advantages of an economic model that promotes reduction, repurpose, repair, reuse and recycling of products in a circular fashion. In this way, today's goods can become the products of tomorrow.

In the Netherlands, the government has set the goal of 100% circularity by 2050. In this context, Mijatovic spoke about her experience in Amsterdam, when she was the head of the Office of Innovation Technology Circular of the City Council and developed many circular economy projects. She also spoke about her experience in the Dutch company BPD, where she continues to promote sustainable and circular construction processes in the Netherlands from the private sector.

According to a study conducted by the local government of Amsterdam (CE, TNO, & FABRIC. (2016).), the most dynamic sectors for circular economy action, in the metropolitan area, are the construction and the organic residual sectors. The implementation of material reuse strategies and efficiency improvements in the construction sector has the potential to create a value of €85 million per year, while high-value processing in organic residual sector has the potential to create an added value of €150 million per year. The study further showed that, in a circular system, greenhouse gas emissions are estimated to decrease by 500 thousand tonnes of CO_2 per year in the construction sector (which is equivalent to 2.5% of the current annual CO_2) and 600 thousand tonnes of CO_2 emissions per year in the organic residual sector (which is nearly 3% of the current annual CO_2 emissions of Amsterdam). Finally, the improvement of the reuse of materials would lead to material savings of 500 and 900 thousand tonnes per year in the construction and organic residual sector, respectively. For this reason, recycling and reuse actions are already being taken in these sectors.

This document explores the experiences and lessons learned from the Dutch national and Amsterdam local governments as they transition to a circular economy.

Circular economy: a shift in the productivity model

Throughout its evolution and diversification, the industrial economy of the European Union has hardly moved beyond the linear model of resource consumption established in the early days of industrialisation. In this model companies harvest and extract materials, use them to manufacture products, and sell those products to consumers—who then discard them when they no longer serve their purpose. In terms of volume, in 2010 approximately 65 billion tonnes of raw materials entered the global economic system. This figure is expected to grow to about 82 billion tonnes in 2020 (Figure 1).

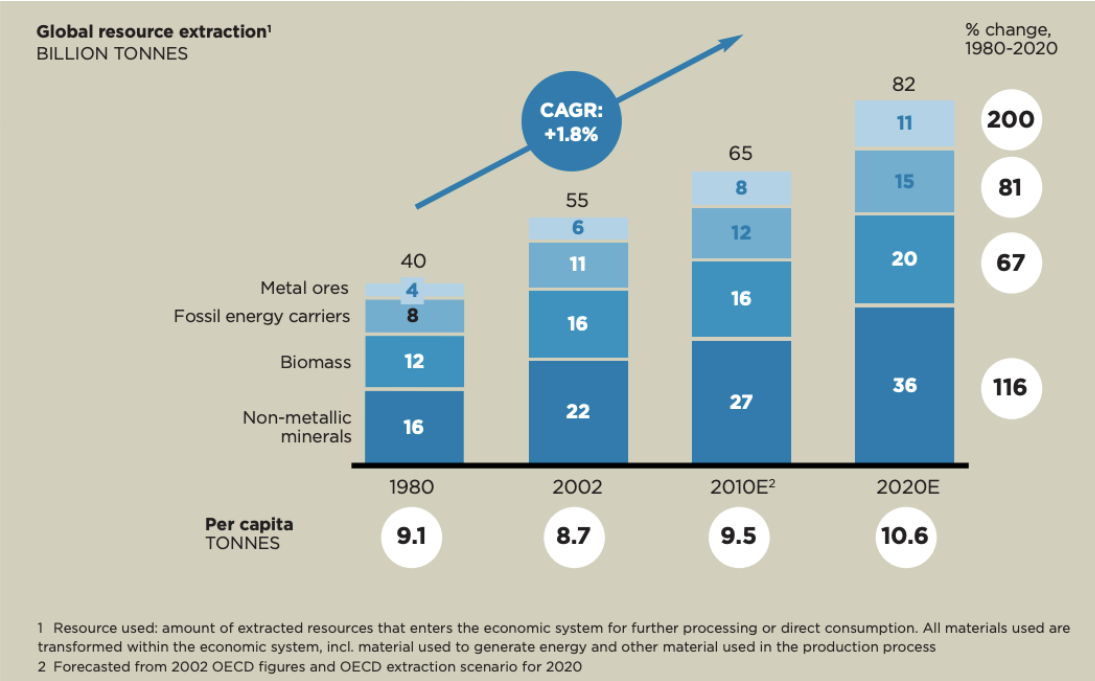

Figure 1. Global resource extraction is projected to double from 1980 to 2020.
Retrieved from: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf

It is well documented that urban areas currently account for 60-80% of global energy consumption, 75% of carbon emissions, and more than 75% of the world's natural resource consumption. According to the World Economic Forum over 70% of the global population will live in urban areas by 2050, producing increasing amounts of trash. These global challenges are symptoms of the current 'take, make, dispose' linear economic model of resource consumption. **The need for a change of this system is increasingly evident, with cities bearing the consequences of inaction**.

The circular economy offers an opportunity to respond to these social, economic and environmental challenges by rethinking how society uses materials and creates value to, as Mijatovic put it, induce a significant 'cultural shift' in society.

Circular economy is an economic system that is regenerative by design. It replaces the linear **'end-of-life'** concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste and retention of value through the superior design of materials, products, systems, and, within

this, business models. This economic model encourages reduction, reuse, repurpose, repair and recycling to extend product lifetime and recirculate all materials. Mijatovic noted that recycling is the least desirable restoration approach in this model, since it is the least resource efficient - most materials lose value every time they are recycled (Figure 2).

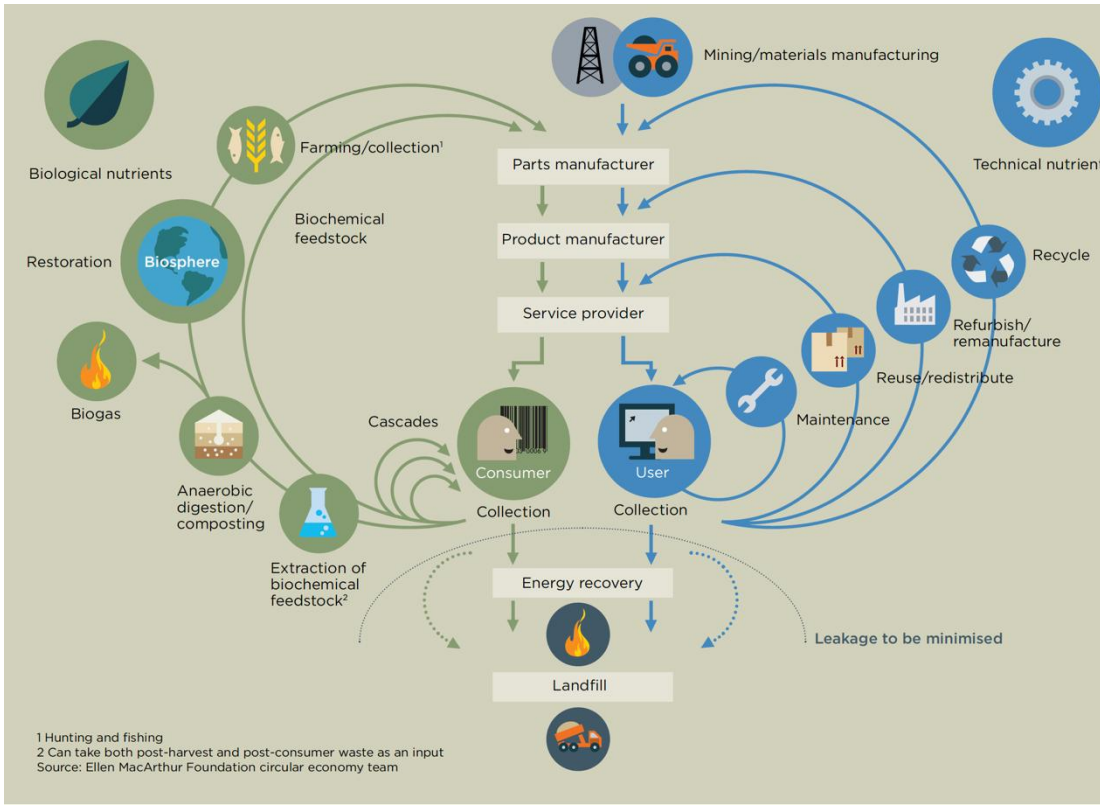

Figure 2. The circular economy — an industrial system that is restorative by design.
Retrieved from: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Towards-the-circular-economy-volume-3.pdf

The following are the **seven principles of the circular economy** which can induce this 'cultural shift':

1. Closed loop.

Products are designed and optimised for a cycle of disassembly and reuse. There is no room for disposal and even recycling, where large amounts of embedded energy and labour are lost**.** Hence, all materials enter an infinite cycle.

2. Reduced emissions

All energy comes from renewable sources to decrease resource dependence and increase system resilience (e.g., to oil shocks).

3. Value generation

Resources are used to generate (financial or other) value.

4. Modular design

Modular and flexible design of products and production chains increases adaptability of systems.

5. Innovative business models

Circular economy replaces the concept of a consumer with that of a user. This calls for a new contract between businesses and their customers based on product performance. New business models for production, distribution and consumption enable the shift from possession of goods to (use of) services. For example, unlike in today's 'buy-and-consume' economy, durable products are leased, rented, or shared wherever possible. If they are sold, there are incentives or agreements in place to ensure the return and thereafter the reuse of the product or its components and materials at the end of its period of primary use. Mijatovic spoke extensively about the different business cases for circular products and services being closed at the EU, National and city level.

6. Region-oriented reverse logistics

Logistics systems shift to a more region-oriented service with reverse logistics capabilities.

7. Natural systems upgradation

Human activities positively contribute to ecosystems, ecosystem services and the reconstruction of 'natural capital'. The implementation of circular economy in cities can bring tremendous economic, social and environmental benefits (see section "Circular Amsterdam: A vision and roadmap for the city and region").

From circular nations to circular citizens

The transition to a circular society requires a society-wide effort to change the way urban systems are planned, designed, financed and managed. It requires measures in all phases of the use of raw materials; from extraction and production to consumption and waste management. Therefore, and noting that such a system extends beyond the boundaries of municipalities, the active involvement and efforts of governments, consumers, companies, scientific institutes, financers and non-governmental organisations at local, regional, national and international levels is indispensable.

Mijatovic provided examples of circular economy initiatives aligned with the seven principles of the circular economy that are being actualised. The next sections discuss these initiatives in the context of the **visions, strategies and actions (intervention instruments)** developed and implemented at the national and city level.

Using an example from the waste sector, she also highlighted the significance of **economies of scale** in the circular economy. The scale at which the loop of a material or product can be closed depends on the material, product or sector. For example, while the business case for treating household waste materials can extend beyond the household or even national level, the business case for waste heat recovery is closed at the city or neighbourhood level. Mijatovic stated that the appropriate economy of scale must be considered for every business case developed for every material stream.

A circular economy in the Netherlands by 2050 – A Government-wide programme for a circular economy

Mijatovic noted **the important role that national governments play** in garnering and galvanising broad public, civil and private support for the transition to a circular economy. She explored this using the example of the Dutch government. In 2016, The Dutch government outlined its plans for the transition to a circular economy in a programme called: **'A circular economy in the Netherlands by 2050 - A Government-wide programme for a circular economy'**. The national programme outlined a vision of "a future-proof, sustainable economy and a liveable earth for future generations". In line with the seven principles of the circular economy, the programme specified the following strategic objectives:

- Extend the lifetime of products and product components and recycle materials to produce high-grade secondary materials (in other words, improve the natural resource efficiency in existing product chains)
- If new natural resources are needed to produce new materials, use renewable and commonly available natural resources as substitutes for critical, not sustainably extracted or processed abiotic resources
- Design new products, develop new production methods and encourage new ways of consumption (in other words, invest in new product chains).

The stated ambition of the Dutch government is to realise, together with a variety of stakeholders, an **interim objective of a 50% reduction in the use of primary raw materials from minerals, fossils and metals by 2030. The target for 2050 is a transition to a fully circular economy**.

This transition requires a government that presents itself as more than just the market regulator. When necessary, the government should serve as a director to steer a course, to monitor progress and interconnectivity with other policies, and to deploy effective instruments it has available, such as legislation and funding. The government should also serve as a network partner in the implementation and actively collaborate with stakeholders in product chains, in sectors and at various scale levels.

The programme showed that the transition to a circular economy calls for a change in strategy specifically adjusted to each sector or raw materials value**. As such, the transition agendas of the Dutch government are focused on five priorities: Biomass and Food, Manufacturing, Plastics, Construction, and Consumer Goods.** These priorities were identified for their alignment with the circular economy priorities and ambitions of the European Commission (EC), their potential for economic impact, for involving considerable environmental pressure and opportunities through the efforts already initiated by a variety of stakeholders.

The Dutch government has focussed its efforts specifically on the following **interventions instruments: fostering legislation and regulations, intelligent market incentives, financing and knowledge exchange.** The instruments, some of which were presented by Mijatovic, are as follows:

1. Fostering legislation and regulations

Legislation and regulations can promote, as well as hamper innovation**. Although the goal is to remove regulatory barriers, the primary objective is to develop legal frameworks that drive**

or encourage innovation, promote dynamics and support investments. Legislation is still often based on current technology or operates from the basis of linear insights – in that it **is not always tailored to the new relationship between the supply side and the demand side of products and services.**

However, to encourage innovation, the legislation should create room to experiment, without any imprudent risks being taken. A good example of such a legislative initiative is the 'Smart Regulation' programme. In this programme, the Dutch government cooperates with entrepreneurs to look for greater room for experimentation within current legislation – to support circular initiatives in their development. The **programme was initiated following indications from entrepreneurs who felt restricted by existing legislation**. The Smart Regulation programme delves into the nature and background of these barriers, brings the relevant parties together and helps them to search for solutions.

Additionally, the existing European framework for the concepts of waste, by-product and end-of waste status is unclear in practice and also leads to considerable legal uncertainty. **The Dutch government is clarifying this framework in order to promote reuse** and, at the same time, further reduce the amount of dangerous substances in the cycle.

2. Intelligent market incentives

Mijatovic stated that **the transition to a circular economy requires radical system and behavioural changes – a 'cultural shift'.** The positive effects that these social changes have on the environment are often not reflected in the market price, which leads to a significantly higher investment risk. Intervention by the government can counteract social underinvestment and stimulate the market for repaired, refurbished, remanufactured, repurposed and recycled materials and products. There are possibilities to tailor the current set of instruments of tax law, levies and subsidies to incentify and intensify the transition to a circular economy.

An example of an incentive-based instrument is the government changing its purchasing behaviour. The Dutch government wants greater attention to be given to a product's environmental performance and social costs during and after the life of a product to be purchased: the so-called **total costs of ownership**. It is promoting this by **engaging in circular procurement itself**. Mijatovic stated that the government's engagement encourages companies to rethink their linear products and services and creates new markets for circular products and services. The government has set the goal of 10% circular public procurement share by 2020. An example of this is incentive-based waste management tenders and contracts. Through these contracts, sorting and processing systems can be brought to a higher level of performance – in 2015 Dutch waste sorting companies sorted up to 90% of plastics instead of 50%.

In addition to the public sector, the private sector can also make use of Intelligent market incentives to develop new business cases for circular products or services. Mijatovic gave the example of **Philips Lighting's 'pay-per-lux intelligent lighting service**', in which clients no longer invest in light bulbs and maintenance but pay a subscription fee for the lighting service. The first case study for this lighting solution was Schiphol Airport.

3. Financing

It is important that national governments engage with private financers to ascertain what is necessary to increase the knowledge of sustainable financial products and risk management and how the national government can support it. An example of this is the ''Green Deal'' approach. A Green Deal is an accessible way for companies, other stakeholder organizations, local and regional government and interest groups to work with central government on green growth and social issues. The Green Deal aims to remove barriers to help sustainable initiatives get off the ground and to accelerate this process where possible. This approach is particularly suitable when innovations are put into practice, a phase during which projects often encounter barriers.

Furthermore, within the EU budget for R&D (Horizon 2020), an amount of 650 million euros was reserved for the years 2016-2017 for projects focused on the circular economy. For the period 2018-2020, the EC intends to set aside a comparable amount (up to a total of approx. € 1 billion). The Dutch government has committed to the maximum use of Horizon 2020 by Dutch companies. The government is ensuring that small and medium-sized companies, that Mijatovic noted, play an important role in this transition, benefit from the available resources as well.

4. Knowledge exchange

Mijatovic stated that data and knowledge gaps often create uncertainty that can delay and hinder investments in circular innovations. **It is therefore important for stakeholders to have easy access to knowledge infrastructures, with the aim of placing the relevant issues on the research agendas**. To facilitate this, the Dutch government, in collaboration with scientific institutes and other stakeholders throughout the product chains, set down a government-wide 'Knowledge and Innovation Agenda' (KIA) in 2017. It also wants to enhance the overall attention given to the circular economy in relevant parts of the Dutch National Research Agenda.

In addition, platforms such as 'Netherlands Circular', which collect practical tools and publications about the circular economy (including new business and revenue models and other forms of chain cooperation) provide a space **for the dissemination and exchange of good practices.**

5. International cooperation

The Dutch government wants to contribute to **creating the proper international conditions for the transition to a circular economy**. It has set up Holland Circular Hotspot, a private public platform in which companies, knowledge institutes and (local) authorities collaborate internationally with the aim of exchanging knowledge and stimulating entrepreneurship in the field of circular economy.

Circular Amsterdam: A vision and roadmap for the city and region

Separately from the national government, city governments are uniquely positioned in the transition to a circular economy since they are closer to the initiatives. They can engage key stakeholders from across the public and private sectors, using the wide range of policy levers and measures at their disposal. The implementation of a circular economy in cities can bring

the emergence of 1) a **thriving city** in which economic productivity increases through reduced congestion, eliminated waste, and reduced costs, and where new growth and business opportunities can support skills development and jobs; 2) a **liveable city** with improved air quality and urban health, reduced carbon emissions and pollution, and with enhanced social interactions; 3) and a **resilient city,** keeping materials in use and reducing virgin material pressures, working with both local and distributed production capacity, and harnessing digital technology.

Building upon the commitments made by the Dutch Government, the city of Amsterdam, one of the leaders in the application of circular economy concepts, has committed to becoming fully circular by 2050. To achieve this ambitious goal, the city has set clear and progressive targets for the city to reach: 65% of all household waste must be separated by 2025, and there must be a 50% reduction in the consumption of primary raw materials (minerals, fossils and metals) by 2030.

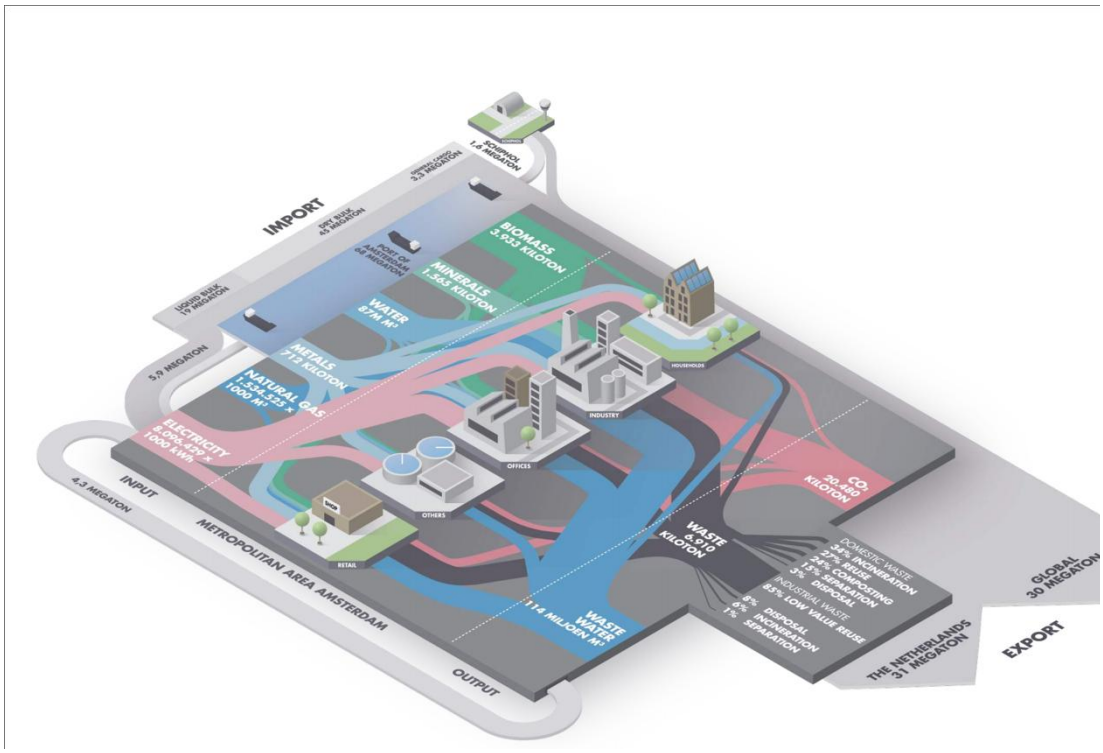

Figure 3. The current state of materials and energy per sector used in the metropolitan region of Amsterdam. Further, the waste flows are shown by sector in the metropolitan region of Amsterdam (Megatonnes stands for millions of tonnes).
Retrieved from:
https://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf

As a pillar of Amsterdam's sustainability policy, creating a circular economy is high on the municipality's agenda, as is evidenced in its Sustainability Agenda adopted on 11 March 2015. Mijatovic noted that to create a circular economy, **we must first understand what is not circular in our current economy**. The city affirmed its commitment to accelerating the transition by commissioning Circle Economy (CE), Netherlands Organisation for Applied Scientific Research (TNO) and FABRICations (Architecture firm) to do an in-depth study on the benefits of a circular economy for the city. The project was the first large-scale research study in the world that uses the **'City circle scan'** methodology (Figure 3). **The Circle Scan consists of**

four phases: Mapping of material flows and added value, evaluation and selection of chains, visioning and project selection and formulation of action points. The scan identifies the areas in which the most significant progress can be achieved in realizing a circular economy and establishes a vision and action agenda for its realisation.

The results of the scan showed that Amsterdam has the potential to reduce greenhouse gas emissions and material consumption while, at the same time, realising economic growth and stimulating employment opportunities. The analysis also showed that the import, processing and transport of materials and goods was an important economic activity in the metropolitan region of Amsterdam. From the perspective of logistics, the analysis showed that the metropolitan region was highly dependent on imports of resources. Hence, the supply of materials was vulnerable to strong price fluctuations and distortions in the geopolitical context.

The scan identified the building & construction sector, and the organic & biomass industry as the two main value chains for the city, through which the greatest circular impact can be achieved (Figure 3). Material reuse and efficiency improvements in the construction sector can lead to an added value of 85 million euro per year, while high-value processing of organic residual streams can lead to an added value of 150 million euro per year (Figure 4 and 6).

The action agenda drawn up a planning and implementation strategy for starting relevant circular projects. All were projects in which governments, research institutes, companies, entrepreneurs and citizens work together to make the construction and organic chains circular. The actions were assessed on four main effects: **value creation**, **CO_2-reduction**, **material savings** and **job growth** (Figure 4 and 6).

The following sections explain the visions that were developed for both chains, and the impact that the implementation of these would have on the economy and the use of materials; in terms of the opportunities, barriers present and actions formulated.

A circular construction chain in Amsterdam

With growing urban populations comes the need for cities around the world to build more infrastructure. According to Global Infrastructure Basel, 75% of the global infrastructure required by 2050 is not yet in place today. The International Resource Panel estimated the cost of refurbishing old and building new urban infrastructure through to 2030 at $41 trillion. Highlighting the importance of the construction sector in terms of resource use, Mijatovic noted that the sector alone accounts for 40%, 30% and 20% of the total raw material, energy and water usage in Europe respectively. In addition, according to Circle Economy and Ecofys (international energy and climate consultancy), building materials account for around 40–50% of an office building's carbon footprint.

Considering the extent of resource consumption in the construction sector and its carbon footprint, Mijatovic lamented its conservatism towards sustainability. **If the construction sector continues to use traditional methods, it could devastate the environment, atmosphere, natural resources, health and the economy.** Therefore, cities need to provide incentives to builders to take a more holistic systems approach to the design, construction, maintenance, operation and after-life use of buildings. These are the challenges that the city of Amsterdam sought to turn into opportunities in their vision described below.

In an ideal circular construction chain, buildings are designed in such a way that materials have the longest possible lifespan through reuse or repurposing. By organising the building chain in a circular way, while fulfilling the growth ambition to realise 70 thousand new homes by 2040, it is estimated that the city of Amsterdam can achieve a 3% productivity increase worth 85 million euro per year. Mijatovic highlighted that this economic growth is realised in large part by value retention due to material reuse and efficiency improvements. Growth in productivity results in increased employment opportunities. With 75 thousand people currently employed in the Amsterdam building sector over time, **about 700 additional jobs can be created**. In turn, the improvement of the reuse of materials leads to **material savings of 500 thousand tonnes**, which is significant when compared to the current annual import of 1.5 million tonnes of materials. Furthermore, **greenhouse gas emissions are estimated to decrease by half a million tonnes of CO_2 per year - equivalent to 2.5% of the current annual CO_2- emissions of the city of Amsterdam** (Figure 4).

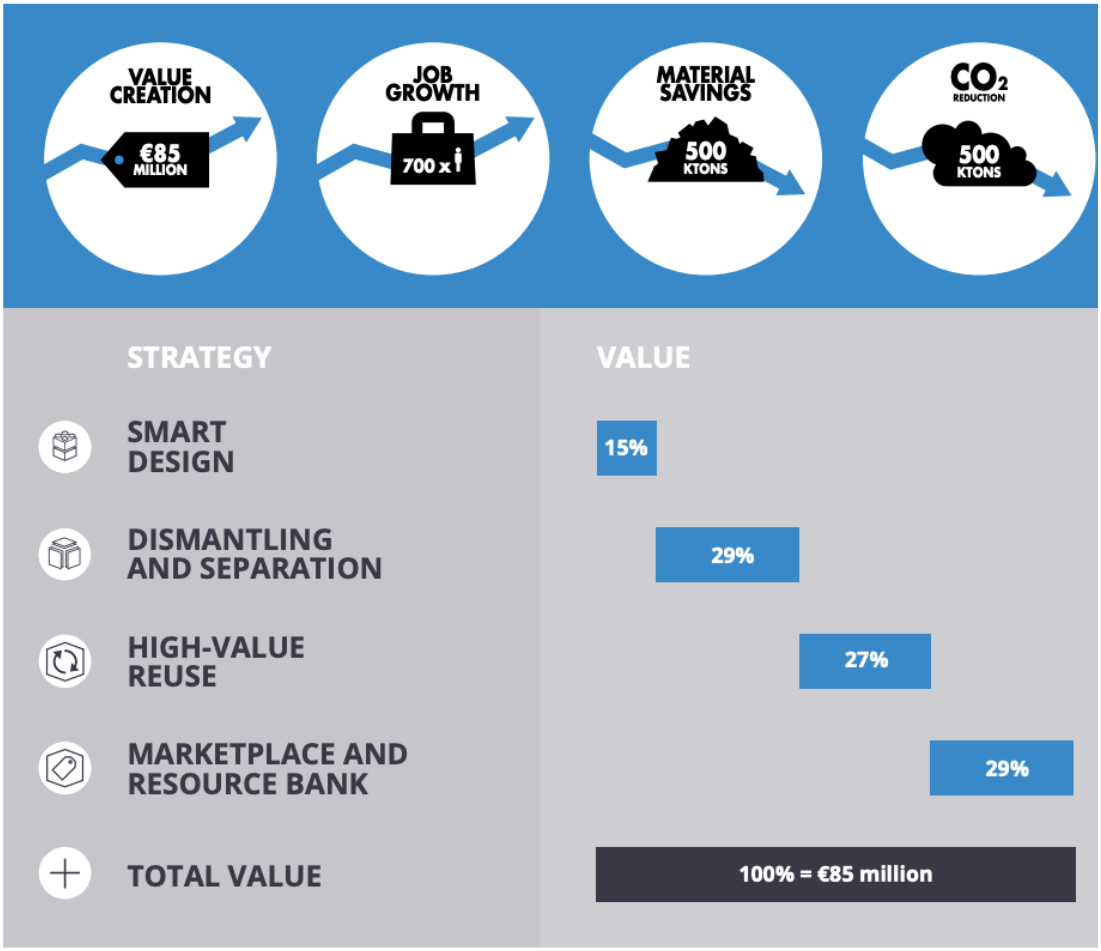

Figure 4. The potential economic and environmental impact of a circular construction chain compared to a linear scenario is calculated for Amsterdam. The impact will be realised over a period of five to seven years. Four indicators have been used in determining impact: (1) net added value in millions of euro, (2) net job growth in Full Time Equivalent (FTE), (3) material savings calculated by value retention in domestic material consumption and (4) reduction in CO_2 -emissions. The values for the four indicators are shown in the four circles. The bar chart shows the distribution of added value.
Retrieved from:
https://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf

From the vision described for the construction chain, the city developed four impacts strategies and action items which enable the municipality to close the material cycles in the construction chain (Figure 4). These strategies and action items, shown below, make use of **market, technical, technological and administrative instruments**:

1. Smart design: Smart design of buildings in order to make them more suitable for repurposing and for the reuse of materials.

2. Dismantling and separation: efficient dismantling and separation of waste streams to enable high value reuse.

3. High-value recycling: the high-value recovery and reuse of materials and components. Mijatovic stated how **the city authority stimulated high-value reuse by being a 'launching customer' via its own purchasing policy and contributing to the development of circular procurement guidelines and initiatives -** when developing or renovating its municipal building portfolio for example.

4. Marketplace and resource bank: the exchange of resources between market players to enable the reuse of materials in new buildings. Mijatovic explained one action included in this strategy - the city **facilitating resource and material storage.** The city plays an important role in directing the land allocation and the definition of locations for temporary storage of materials. It can also facilitate innovation by creating a material repository that is backed by a wide range of stakeholders. To support this, a materials database linked to an online marketplace, where buyers can easily exchange these 'smartly demolished' materials based on quality and quantity is required. In the Netherlands, an increasing number of companies are setting up their own physical resource banks.

It is notable that although the strategies are formulated separately, they are partially intertwined. Successful implementation of high-value reuse, for example, is dependent on efficient dismantling and separation techniques.

Circular organic residual streams chain in Amsterdam

In the ideal circular future of organic residual streams in Amsterdam, organic flows such as food and water of the highest quality are delivered to consumers. Organic residues are recovered in a high-value manner and reused in innovative applications. Core to this circular vision is integrated food production, food processing and biological processes, where nutrients and water flows are efficiently directed, and residual flows are valorised. This leads to a more varied chain for organic residual streams that requires less energy, nutrients, water and resources and achieves significant economic, environmental and social benefits.

This future organic residual streams circular scenario is based on a variety of adopted measures, including source separation of organic waste in all 430 thousand households in Amsterdam. **Separate collection makes it possible to direct the organic waste stream to new uses, such as the production of protein for animal feed, biogas and building blocks for the chemical sector, such as bioplastics**.

The organic waste streams from the food processing industry also offer opportunities for higher quality processing, contributing to additional value creation. The high-value processing

of organic residual streams for the city of Amsterdam can, over a period of five to seven years, lead to an **added value of 150 million euro per year**.

In the long term, this scenario is estimated to **create an additional 1200 jobs in Amsterdam**, on top of the current 10 thousand jobs in the agriculture and food processing industry. Some of the jobs created will arise from the required adjustments to the waste infrastructure, including the installation of underground containers, pick up services for the separate waste streams and the more complex processing of waste flows. In addition to direct employment effects in the agricultural and food industry, the study showed that there are chances for indirect increases in the number of jobs in areas such as engineering and logistics.

The material savings that can be achieved may add up to nearly 900 thousand tonnes per year, a significant amount compared to the current annual import of 3.9 million tonnes of biomass for the entire metropolitan region. The material savings consist mainly of materials that can be replaced by the higher-value processed waste flows. **For example, the production of high-quality protein from organic waste can replace protein imports such as soy for animal feed**, and the production of bioplastics could replace oil-based plastic production. As a result, **the expected reduction in greenhouse gas emissions is in the order of 600 thousand tonnes of CO_2**, nearly 3% of the annual CO_2-emissions of the city of Amsterdam (Figure 5).

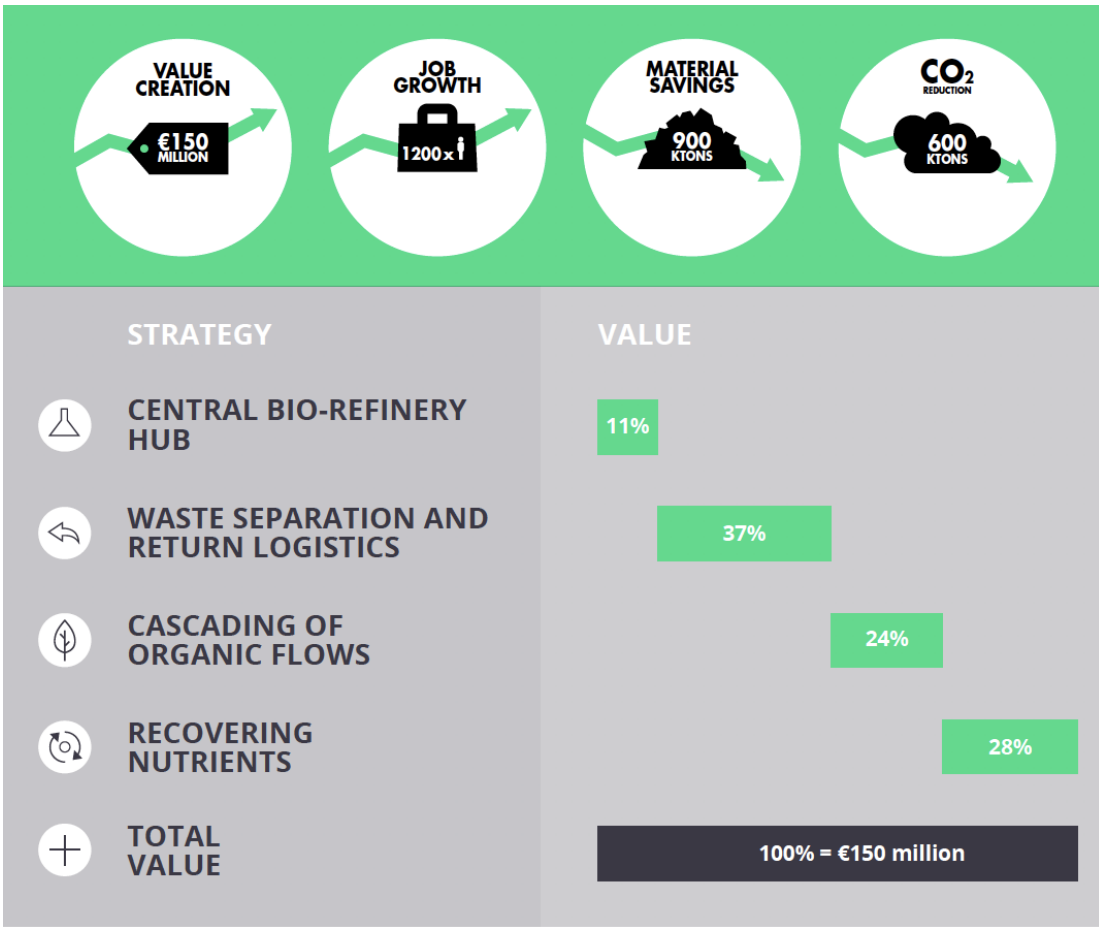

Figure 5. The potential economic and environmental impact of organic residual streams in Amsterdam compared to a linear scenario is calculated for Amsterdam. Here, the impact will be realized over a period of five to seven years. Four indicators have been used in determining impact: (1) net added value in millions of euro, (2) net job growth in Full Time Equivalent (FTE), (3) material savings calculated by value retention in domestic material consumption and (4) reduction in CO_2 emissions. The values for the four indicators are shown in the four circles. The distribution in added value is shown in the bar chart.
Retrieved from:
https://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf

From the described vision for high-value recycling of organic residual streams, the city developed strategies and action items, such as land allocation and purchasing, to close material cycles in the organic residual streams chain (Figure 5). The strategies were:

Central hub for bio-refinery: a central hub for the valorisation of organic residue streams from household and industrial waste and waste streams from the industry. Laws and regulations currently represent an existing barrier for bio-refining technologies. Cities can initiate circular free zones which can take away certain legislative barriers that currently hinder innovation, such as the ban on the use of nutrient-rich digestate (especially phosphate) on agricultural land (see **Buiksloterham** urban development below).

Waste separation and return logistics: smart waste separation and return logistics to deploy the logistics hub of Amsterdam in a smart way and to increase the value of residual flows. The foundation for this strategy is the city creating **a virtual resource platform** to develop specific **geo-data about demand and supply of organic residual streams in the city and region**. This

platform would be publicly accessible. In addition, the Amsterdam Institute for Advanced Metropolitan Solutions (AMS) program 'Urban Pulse' has initiated planned activities to map resource streams such as organic residual streams into spatial maps.

Retrieving nutrients: retrieve essential nutrients to close the nutrient cycle.

Cities as Living Labs to achieve circularity

With the City Circle Scan, Mijatovic showed how the city wanted to translate the research outcomes into a dedicated innovation programme that pools together resources from both private sector and research institutes. **This ambitious objective can only be created through 'on-the-ground' action.** To facilitate implementation of practical and scalable strategies, the city of Amsterdam has created several programmes to encourage innovation, experimentation and learning. One such programme is **'Learning by doing'**, **which aims to prove in practice that the circular economy is profitable**, and allows the city to speed up the transition towards a circular economy**.**

Mijatovic stated that **such programmes give cities opportunities to learn in practice about circular economy and about the role local governments should play**. It has had an impact on Amsterdam city's administration – processes and ways of working have been modified. Mijatovic also noted that the implementation of circular economy initiatives has also bolstered the international position of the city. Amsterdam is perceived as a front-runner in the circular transition. This attracts companies and start-ups, which consider the city as a '**living lab**' to expand their business.

The city is playing an active role in encouraging circular development, such as by prioritising circular initiatives when granting land for development. In this section some examples of circular initiatives developed in the area of Amsterdam are presented.

1. Harbour City

The city of Amsterdam integrated the principles of circularity in the urban planning strategy of the city's largest transformation area – **'Harbour City'**, which will feature between 40,000 and 70,000 new homes.

2. Industrial neighbourhood of Buiksloterham

Another example is the old industrial neighbourhood of **Buiksloterham** in Amsterdam, which is expected to grow from 250 citizens to 6500 citizens in the next years. In Buiksloterham, residents, businesses and the municipality work together on energy-neutral new buildings, a smart energy network, sustainable heat cooling system, making the existing buildings sustainable, waste separation, reusing land and materials, sustainable mobility, rain resistance and the application of new sanitation.

3. De Ceuvel urban development

One of the projects that emerged in Buiksloterham is the **'De Ceuvel'** urban development**¡Error! No se encuentra el origen de la referencia.**, also known as 'the Cleantech Playground'. The former industrial plot has been transformed into a sustainable residential area. It is considered to be one of the most sustainable and unique urban developments in Europe. Since the start of the initiative in 2012, it has become a circular economy hotspot and

thriving community of entrepreneurs, artists and citizens from Amsterdam and all around the world. As a hub for innovation and experimentation, De Ceuvel has become a genuine living lab, where new concepts and technologies can be validated before scaling up for wider implementation (Figure 6).

Figure 6. A birds-eye view image of the De Ceuvel which consists of 16 office buildings, a greenhouse, a restaurant, and a bed and breakfast – all connected to a private, behind-the-meter smart-grid.
Retrieved from: https://spectral.energy/news/jouliette-at-deceuvel/

Mijatovic showcased some examples of the sustainable technologies being implemented and experimented with in De Ceuvel and the greater Buiksloterham neighbourhood:

Water and New Sanitation. Domestic wastewater is a valuable resource as it contains valuable raw materials (including phosphate) and energy (biogas and heat). To extract the energy and raw materials from domestic wastewater, it is necessary to separate the black and grey water streams at the source. This new form of waste water disposal, where raw materials and heat are reused as far as possible, is referred to as **'New Sanitation'**. In this system, the traditional gravity sewer is replaced by a multiple pipe system: a vacuum pipe for black water with a vacuum toilet and a gravity sewer for grey water. The separate collection of black and grey water makes it possible to recapture low-temperature heat from the grey water using drain water heat recovery systems. It also allows for the recapture of biogas and raw materials from the black water (including phosphate) using up-flow anaerobic sludge blanket reactors (UASB, Figure 7). De Ceuvel makes use of new sanitation systems for its waste water treatment and the water authority in Amsterdam is experimenting with new sanitation in the greater Buiksloterham, with the intention of scaling.

Grey water. De Ceuvel processes grey water from kitchen sinks in decentralized **helophyte filtration systems** placed adjacent to each office-building. Helophyte filters are simple constructions built using different layers. Sand, gravel, and shells help remove solids, and a mix of special plants consumes organic matter like nitrogen and phosphorus**. Once purified, the clean water is then reused by the office or discharged into the ground to refill aquifers.**

Black water. Organic waste streams including food and human waste contain nutrients necessary for plant growth. The effective use of these nutrient streams as fertilizer for urban agriculture can help close the nutrient cycle on local and urban levels. De Ceuvel is investigating methods for recovering nutrients from urine. Separated urine is collected from urinals, from which phosphate is recovered by using a **struvite reactor**. These **phosphate crystals can then be combined with other local inputs and used as a fertilizer for local food production**.

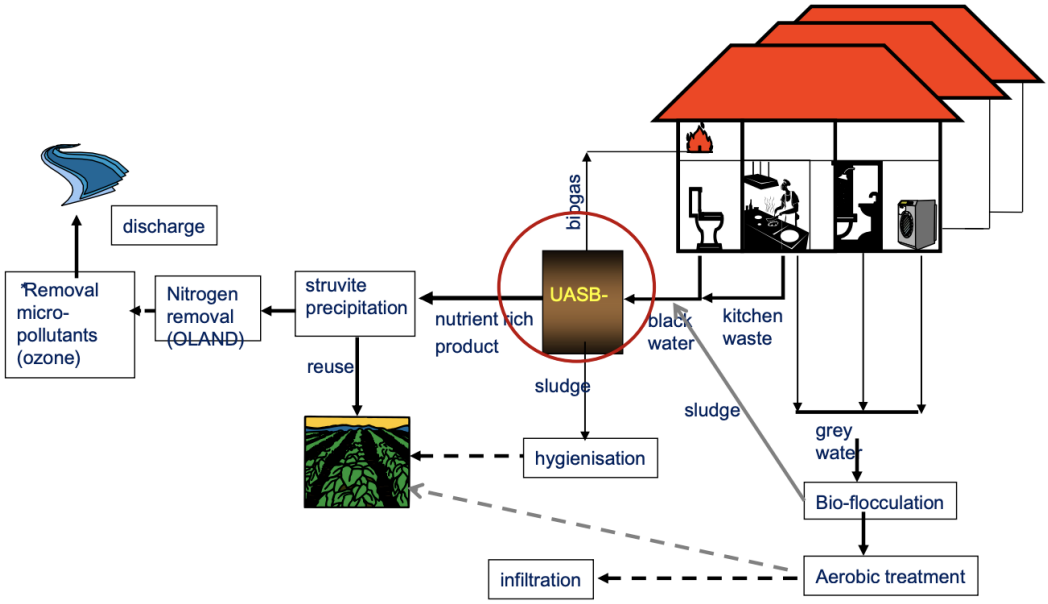

Figure 7. 'New Sanitation' concept.
Retrieved from: http://run4life-project.eu/wp-content/uploads/2018/06/10-180517-R4L@IFAT-Grietje-Zeeman.pdf

Heating System. Each office building has a heat pump and an air-to-air heat exchange ventilation system. As warm air leaves the boat, over 60% of the heat is captured and circulated back inside. The heat pump also extracts heat from the surrounding air to heat up each boat. These simple technologies allowed the community to circumvent the need for a gas connection and use renewable electricity to power the heating needs of each building.

Energy. De Ceuvel is equipped with over 150 Photovoltaic (PV) panels that generate energy from the sun. The panels are installed on most of the office boats and produce around 36.000 kWh of power yearly. This covers the electricity demand of the heating systems of the offices, along with a part of the remaining electricity needs. The rest of the power is supplied by a green energy supplier. In September 2017, Spectral Utilities launched **a new blockchain-based energy sharing token named the 'Jouliette'**. The Jouliette uses energy production as a starting point. Mining existing crypto currencies such as Bitcoin consumes a lot of energy, while the Jouliette is generated by the user producing excess solar energy. The Jouliette, the first such initiative of its kind in the Netherlands, stimulates the local production and exchange of renewable and so contributes to the energy transition and the local economy. It encourages solar panel owners to exchange energy locally, instead of selling surplus power to the grid. The creation of new Jouliette's is simple, transparent and based on smart meters. Through

blockchain technology, points are generated and distributed among De Ceuvel community, and users are rewarded for smart and efficient usage of power and solar panels. The Jouliettes can then be traded for power when needed, or for other things as well. The goal is to connect all of the Buiksloterham neighbourhood to create a local smart grid and to become a landmark example of how to harness the capabilities of blockchain technology to create greater social value and to support a bottom-up transition towards a more distributed, robust, and transparent economy, underpinned by 100% renewable energy.

4. Urban redevelopment of Zeeburgereiland (KOMST)

Mijatovic further used BDP projects to show more circular strategies in action. BDP is involved in the urban redevelopment of Zeeburgereiland, a former industrial neighbourhood in Amsterdam. The project, known as KOMST, sees BPD building nineteen large single-family homes using circular principles – mainly smart design and high value recycling. The houses are built using reused and recycled building materials, such as bricks, wood, stained glass panels, shutters, ornaments, stairs, roof tiles, etc. (Figure 8).

Figure 8. Project KOMST at Zeeburgereiland built with low carbon footprint and with the goal of creating consumer awareness.

5. DGTL music festival in Amsterdam

Mijatovic gave the example of **the DGTL music festival in Amsterdam** as a good initiative for testing circular food flows (intertwined with technical flows) at a controlled scale – acting **as a living lab to introduce the circular economy**. Innovation is an important part of the festival and by showcasing these innovations, the festival creates awareness for the possibilities and necessity of a waste-free society. The 4 main initiatives they tested in 2018 were: to use as much green energy as possible; to provide hard cups instead of one-use plastic cups to reduce waste; to convert plastic (non-PET) bottles in oil that is used to produce new plastic; to create a circular system; and to show the festival's resource management to the visitors to provide transparency and create awareness. DGTL has also introduced an ecological currency, the "ECO Coin". With this new digital currency, DGTL plans to reward all visitors for their sustainable actions. By participating in one of the many Revolution projects or workshops, DGTL's festivalgoers will now earn ECOs. In turn, their ECOs will unlock special rewards like free sustainable food, music-downloads, unique products, and discounts. Mijatovic explained

how this concept can be scaled to the neighbourhood or city level. Residents can be rewarded with digital currency or points for sustainability actions like recycling. In turn, the local economy can be stimulated by limiting the use of the currency to the local economy.

Mijatovic specifically highlighted that the entire festival is powered by green energy. The use of generators was reduced by carefully planning and minimizing the amount of electricity needed, logging the usage, and using the in-place electricity grid wherever possible. In case generators were needed, they run on biodiesel made from reclaimed cooking oils.

6. Building material passport

Mijatovic also stated that the city can contribute to the **development of a building material passport** and apply it to its own portfolio**.** If all material data of a building is recorded in a material passport, then the materials can be recovered during the renovation and demolition processes for high-value reuse. By doing so, the dumping or burning of demolished materials (in which their value is wasted) is prevented. A building ready to be demolished thus, becomes a storage for useful material. Some construction companies in the Netherlands are currently experimenting with material passports. **Park 20/20**, a building complex near Amsterdam, is a great example. With Building Information Modelling (BIM), or information management systems, the buildings in the complex have been identified and defined based on where materials have been used, how much material has been used and how they can be removed again. The **buildings are materials banks** and have received materials passports. In this way the future residual value of the buildings is determined.

7. Companies that reclaim high-quality materials

Stonecycling, for example, works together with construction waste companies to recycle stone and ceramic waste to bricks. Moreover, **Struyk Verwo Infra** recycles old concrete pavements into new products that consist of 70% recycled or reused concrete. Furthermore, **CO-Green** is an ongoing project where 95% of high-quality material is reused locally after demolition. Mijatovic noted that as the construction sector becomes increasingly circular, the lack of high-quality secondary resources becomes more and more of a problem. In the next ten years, the Netherlands will only be able to meet 25% of the high-quality secondary materials demand. This means that not only will new materials need to be sourced but innovation in material use and in reducing the amount of material required will need to be stepped up.

8. Bio-refinery

It is important that new projects are linked with pre-existing pioneering activities in their region. One such example is the Greenmills site, a consortium of six companies active in the further development of bio-refinery concepts and the optimal reuse of organic residual streams.

9. 3D Printing

New production methods, including the use of 3D printers, can actualise the local production of goods and buildings. Mijatovic showcased the '3D Printing in the Circular City' project, which provides an innovative way to reduce the municipal waste volume through recycling household plastics waste locally, with large scale 3D-printing. The project explores designing 3D printed furniture in public space, with participation of local communities and residents. In

this way, 3D printing enables local production, local recycling and local participation in the design process (Figure 9).

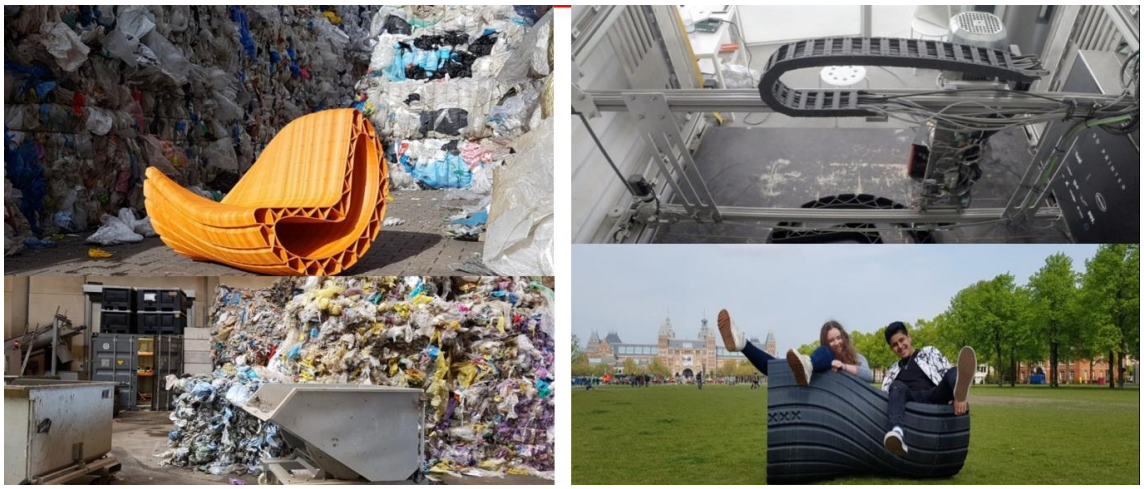

Figure 9. New technologies to learn and experiment circular economy. The project 3D Printing in the Circular City explored circular possibilities to expand the applications of recycled plastic.

10. Rainbeer

Mijatovic provided an interesting example of **Rainbeer**, an Amsterdam-based brewery making beer brewed from rainwater. The company sees their product as a unique and engaging way to change the narrative of rain water as waste water.

Mijatovic also shared some barriers associated to circular economy that she is facing. BDP thought to transform the former Campina milk factory into a new vibrant urban area using circular economy principles (i.e high value materials reclaiming/ 'urban mining'). However, the reality was that the materials in the existing buildings were either contaminated with toxic materials or inefficient to separate/disassembly and, hence, not able to be used as raw material for the new building.

As at the national level, platforms and networks for knowledge dissemination are crucial (see 'Netherlands Circular' and Holland Circular Hotspot for national platforms). With this purpose, the City Council has created an open platform named 'Amsterdam Smart City' (ASC). ASC is an innovation platform that brings together proactive citizens, innovative companies, knowledge institutions and public authorities to share knowledge. Through collaboration, they come up with innovative solutions for metropolitan issues of a social, economic and ecological nature. They focus on four societal transitions: Energy, Digital City, Circular City and Mobility. The community, of more than 5500 innovators are connected via an online platform and offline events. These provide an overview of what is happening in the Amsterdam Metropolitan Area, connects communities to share expertise and strengthens new projects.

Citizens are the drivers of change

You cannot change cities if you do not involve and inspire your citizens to be part of these new type of systems. Mijatovic said that a circular city aims to generate prosperity and economic resilience for itself and its citizens, while decoupling value creation from the consumption of finite resources. She believes that the only way to do that is with a strong

network of businesses and governments, but most importantly, with its residents. As consumers, they are drivers of change, along with the private sector. However, **one of the main challenges for cities has been to translate the concept of circular economy into the daily lives of citizens**. At a time of global access to information and new forms of democracy, they have a newfound power to shape public policies and deliver their own solutions for the future.

Mijatovic stated that the generational difference in consumerist and sharing values is accelerating the adoption of circular products and services amongst the younger generation. For example, with the growth of car sharing, BDP now provides 20 cars in all its new buildings for shared use by the homeowners. While it has its spatial limitations, this initiative has been well received. BDP also take advantage of shared common spaces to create central hubs for delivery and collection of goods and products by homeowners.

Circularity measured

Mijatovic emphasised the importance of measuring the progress being made in the transition to the circular economy. This helps both the national and local government and its partners to make sure the transition is on course, while it also enables course corrections to be made. Both the Dutch government and the city of Amsterdam have created measuring and evaluation frameworks as presented below.

Circularity measured at national level

The Dutch Government developed a monitoring system and baseline assessment. The aim of this system is to monitor the transition efforts made by government authorities and other societal partners, and to show the effects of these efforts. As Mijatovic explained, the monitoring system can be used to analyse "**what we want to know, what we can already measure, and which elements of monitoring components require further development.**"

This monitoring system specifically makes a **distinction between monitoring the transition process and monitoring the effects.** Transition dynamics monitoring identifies what is actually taking place in specific product groups, such as in terms of product design, and whether the proportion of circular products is increasing (and therefore the proportion of linear products is decreasing). The two components to the monitoring of the transition process are monitoring the transition dynamics and monitoring the actions. Effect monitoring shows the effects of the transition process on natural resource consumption, environmental pressure and socio-economic development (e.g. economic growth and jobs, **¡Error! No se encuentra el origen de la referencia.**10).

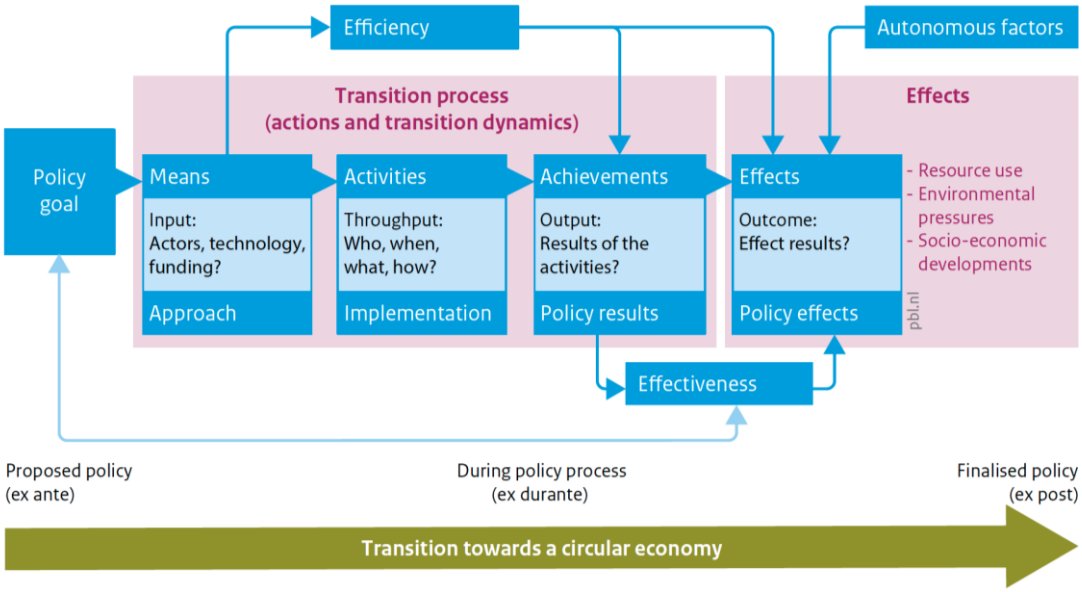

Figure 10. Policy assessment framework for measuring the progress of the transition towards a circular economy
Source: Netherlands Court of Audit 2005; adaptation by PBL.
Retrieved from: https://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2018-circular-economy-what-we-want-to-know-and-can-measure-3217.pdf

Circularity measured at city Level

A key recommendation and follow-up step from the 'Circular Amsterdam: A vision and roadmap for the city and region' study involves **making circularity of the city, region and sectors more measurable in order to monitor progress.** The 'Circular Indicators Framework' offers a good starting point. The framework describes four main indicators that provide insight into the essential aspects of circularity – value retention, economic impact ecological impact and transition potential. The first three indicators were evaluated using quantitative data. The indicator for transition potential was investigated by means of interviews and qualitative reviews of specific companies, organisations and other stakeholders within their respective chains (Figure 11).

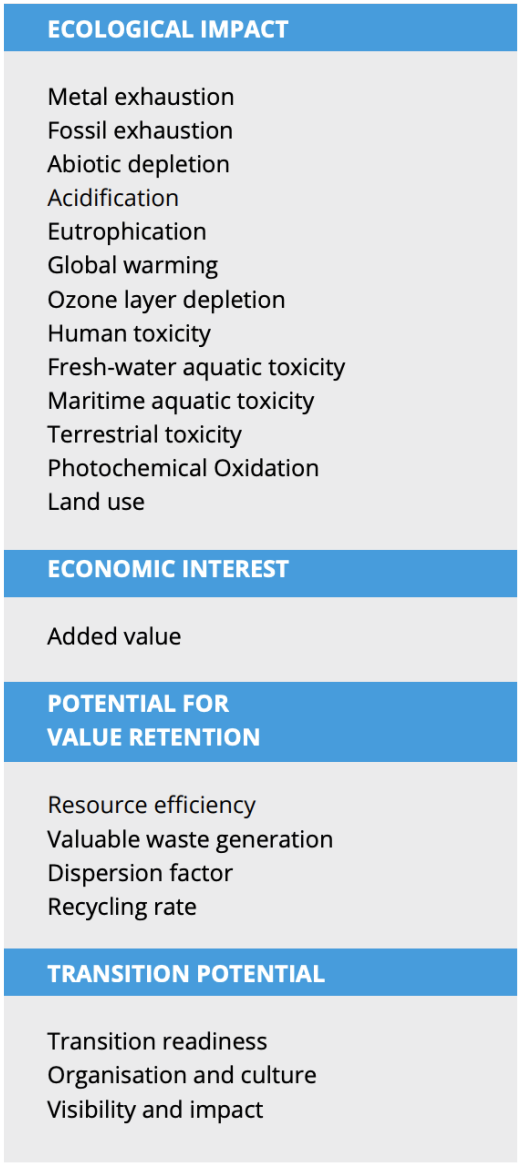

Figure 11. The Circular Indicators Framework from Amsterdam with the four key indicators, with each specific sub indicator. Retrieved from: https://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf

In addition, an evaluation of '**Circular Amsterdam**', '**Learning by doing**' and the complementary '**Circular Innovation Programme**' was carried out by the city in 2018. This evaluation (Amsterdam Circular: evaluation and action perspectives) focused on the 73 projects and more than 100 private companies that are accelerating Amsterdam's circular economy. The aim of the programmes was to demonstrate that the circular economy is a realistic and profitable concept. The evaluation showed that this is indeed the case. The evaluation also provided guidelines for future action.

Development of alternative ways to measure growth beyond GDP

Gross domestic product (GDP) is used to measure economic growth in a linear model. GDP considers economic output, including all goods and services produced. So, the greater the output of goods or services, the higher the GDP and in turn the economic growth. By using resources more effectively, a circular economy aims to decouple economic growth from the use of natural resources and ecosystems. As such, circular economy doesn't pursue to produce the more the better.

The concept of decoupling is represented in the figure below, which shows increasing trajectories for economic performance (measured by GDP) and human well-being, that would expand consumption and investment to include, for example, the achievement of the SDGs. However, the figure also shows resource use increasing at a much slower rate than GDP (relative resource decoupling) and environmental impacts actually declining (absolute environmental decoupling). This conceptual figure therefore indicates the ideal goal of resource efficiency through the notion of decoupling – that economic output and human well-being shall continue to increase, at the same time as rates of increasing resource use and environmental impact are slowed, and in time brought into decline, thereby sustaining resource use and the delivery of ecosystem goods and services for current and future generations. (Figure 12).

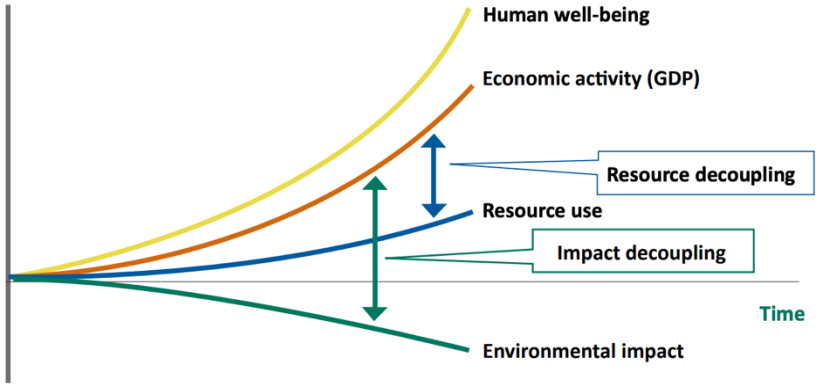

Figure 12. Decoupling of resource use and environmental impacts from GDP growth
Source: UNEP (2011a), Figure 1, p. xiii Retrieved from: https://www.researchgate.net/publication/306290805_Resource_Efficiency_Potential_and_Economic_Implications_Summary_for_Policymakers/link/57b7026c08aea2f4aec3a514/download

In addition, sustainability relates to three key areas: economy, environment and society. By basing transition policy on GDP, initiatives are measured in economic terms only, while environmental and social factors are excluded. Mijatovic stated that it is necessary to define metrics able to measure the 'real' added value of transitioning to a sustainable and circular economy. These indicators should show the effects of the transition process not only on socio-economic development (e.g. both economic growth and jobs) but also on natural resource consumption, environmental pressure and human well-being. Some examples of how to measure this type of 'smart growth' are detailed in "Beyond GDP: Measuring What Counts for Economic and Social Performance" from Jean-Paul Fitoussi, Joseph Stiglitz, and Martine Durand or "Beyond GDP: Measuring Welfare and Assessing Sustainability" from Didier Blanchet and Marc Fleurbaey).

Additionally. Salvador Rueda, Director of Barcelona Urban Ecology Agency, stated that to reduce the consumption of the natural resources, a new urban model is required. He presented the Charter for the Ecosystemic Planning of Cities and Metropolises which provides the principles of a more sustainable urban model.

Concluding remarks

Mijatovic concluded her session emphasising that circular economy offers an opportunity to respond to current challenges such as the use and abuse of natural resources, the generation of waste, the greenhouse gas emissions and the energy consumption. She further highlighted the importance of a strong network of businesses, governments (national and local) and citizens in order to achieve the transition to a circular city.

Mijatovic stated that Amsterdam region already has many entrepreneurial and innovative businesses, citizens, start-ups, organizations and knowledge institutions that are already working within the framework of a circular economy so it can be used as an example that circularity is already happening, to encouraged other cities and citizens to start the cultural change.

Bibliography

- **Papers**

City of Amsterdam (2018). Amsterdam Circular: evaluation and action perspectives. Retrieved from https://www.circle-economy.com/wp-content/uploads/2018/10/amsterdam-evaluation-EN-20180328.pdf

Amsterdam Smart City (2018). Future perspectives for Amsterdam as a circular city. Retrieved from https://crowded-smartcity.s3.eu-central-1.amazonaws.com/page_file/c_36451_419b3e76-e490-4537-b490-c5574303960b.pdf?X-Amz-Expires=108000&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAISN3NRCXKS4FKLRQ/20190903/eu-central-1/s3/aws4_request&X-Amz-Date=20190903T134828Z&X-Amz-SignedHeaders=host&X-Amz-Signature=ace2019afe020647f3b574bba7a5b9fc3d1874c59edbcced1a028ebc03ba66bc

CE, TNO, & FABRIC. (2016). Circular Amsterdam: A vision and action agenda for the city and metropolitan area. Retrieved from https://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf

CLICKNL (2017) Knowledge & Innovation agenda - Top sector creative industry 2018-2021 Retrieved from https://assets.ctfassets.net/h0msiyds6poj/4eenv39jLOac08SuCgSy20/be4fe26bfb68399c3b0f97b2750b2191/CLICKNL_KIA_2018-2021-2_EN__1_.pdf

Ekins, Paul & Hughes, Nick & Bringezu, Stefan & Clarke, Charles & Fischer-Kowalski, Marina & Graedel, Thomas & Hajer, Maarten & Hashimoto, Seiji & ield-Dodds, Steve & Havlík, Petr & Hertwich, Edgar & Ingram, John & Kruit, Katja & Milligan, Ben & Moriguchi, Yuichi & Nasr, Nabil & Newth, David & Obersteiner, Michael & Ramaswami, Anu & Westhoek, Henk. (2016). Resource Efficiency: Potential and Economic Implications Summary for Policymakers. 10.13140/RG.2.2.18978.43204.

Ellen MacArthur Foundation (2013) 'Towards the Circular Economy: Economic and business rationale for accelerated transition', Journal of Industrial Ecology. doi: 10.1162/108819806775545321.

Ellen MacArthur Foundation (2013) 'Opportunities for the consumer goods sector', Towards the circular economy, 2, pp. 1–112. doi: 10.1162/108819806775545321.

Ellen MacArthur Foundation (2014) 'Towards the Circular Economy Vol. 3: Accelerating the Scale-up Across Global Supply Chain', Ellen Macarthur Foundation, 3, pp. 1–41. Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Towards-the-circular-economy-volume-3.pdf

Ellen MacArthur Foundation (2015) 'Why the circular economy matters', Delivering the Circular Economy: A Toolkit for Policymakers.

Ellen MacArthur Foundation, SUN and McKinsey (2015) 'Growth within: a circular economy vision for a competitive Europe', Ellen MacArthur Foundation, p. 100. Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf

Ellen MacArthur Foundation (2019) 'Circular Economy in Cities: Project Guide', p. 11. Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/CE-in-Cities-Project-Guide_Mar19.pdf

EUROCITIES (2017) FULL CIRCLE 'cities and the circular economy. Retrieved from http://nws.eurocities.eu/MediaShell/media/2017cities_and_circular_economy-web-spreads.pdf

European Commission. Implementation of the Circular Economy Action Plan. Retrieved from https://ec.europa.eu/commission/sites/beta-political/files/report_implementation_circular_economy_action_plan.pdf

Global Infrastructure Basel Foundation, 2014. Retrieved from http://www.gib-foundation.org/content/uploads/2014/11/Summit-Report_ext_Fin_sml.pdf

Government of Netherlands (2016) 'A circular economy in the Netherlands by 2050', pp. 1–72. Retrieved from https://www.government.nl/documents/policy-notes/2016/09/14/a-circular-economy-in-the-netherlands-by-2050

Ministry of Infrastructure and the Environment, 2016).

(Ministry of Infrastructure and the Environment, 2016).

(Government of Netherlands, 2016)

PBL Netherlands Environmental Assessment Agency (2018). Circular Economy: what we want to know and can measure. Framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands. Retrieved from https://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2018-circular-economy-what-we-want-to-know-and-can-measure-3217.pdf

Pieter van Duijn Projecten bv (2018) Port-City IJpoort: Development Strategy. Retrieved from http://havenstadijpoort.com/wp-content/uploads/2018/06/Havenstad_IJpoort_English.pdf

R2π Project Consortium (2018). Enablers and Barriers to a Circular Economy. Retrieved from http://www.r2piproject.eu/wp-content/uploads/2018/08/R2pi-stakeholders-report-sept-2018.pdf

World Economic Forum White (2018) 'Circular Economy in Cities Evolving the model for a sustainable urban future', World Economic Forum White Paper, p. 29. Retrieved from: http://www3.weforum.org/docs/White_paper_Circular_Economy_in_Cities_report_2018.pdf

Jean-Paul Fitoussi, Joseph Stiglitz, and Martine Durand. OECD 2018. "Beyond GDP: Measuring What Counts for Economic and Social Performance".

http://policydialogue.org/files/publications/papers/FINAL-Beyond-GDP_-Measuring-What-Counts-for-Economic-and-Social-Performance.pdf

Didier Blanchet and Marc Fleurbaey. 2013. "Beyond GDP: Measuring Welfare and Assessing Sustainability"

- **Websites**

Amsterdam Institute for Advanced Metropolitan Solutions. 3D Printing in the Circular City. Retrieved from https://www.ams-institute.org/urban-challenges/circularity-urban-regions/3d-printing-circular-city/

Amsterdam Smart City. Retrieved from https://amsterdamsmartcity.com/

CBS (2015a). Gemeentelijke statistieken afval verzameling. Retrieved from http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=7467&LA=NL

City of Amsterdam. Policy: Circular economy. Retrieved from https://www.amsterdam.nl/en/policy/sustainability/circular-economy/

(City of Amsterdam)

City of Amsterdam (2015). Sustainable Amsterdam. Retrieved from https://www.amsterdam.nl/bestuur-organisatie/organisatie/ruimte-economie/ruimte-duurzaamheid/making-amsterdam/measures/?PagClsIdt=10827895#PagCls_10827895

CO-Green. Retrieved from https://www.eracontour.nl/specialismen/co-green

De Ceuvel. Sustainability Retrieved from http://deceuvel.nl/en/about/sustainable-technology/

DGTL. Sustainability. Retrieved from https://dgtl.nl/sustainability

Emis. Small-scale Wastewater Purification. Retrieved from https://emis.vito.be/nl/node/22504

Gemeente Amsterdam. Buiksloterham: circulaire stadswijk. Retrieved from https://www.amsterdam.nl/projecten/buiksloterham/circulair/

Green Deal. Retrieved from https://www.greendeals.nl/english

Greenmills. Amsterdam: Greenmills anaerobic composting plant. Retrieved from https://www.orgaworld.com/more-about-our-business/our-locations/amsterdam-greenmills

Nationale Wetenschapsagenda. https://wetenschapsagenda.nl/national-science-agenda/?lang=en

Nieuwbouw-Zeeburgereiland. Wonen op KOMST. Retrieved from https://www.nieuwbouw-zeeburgereiland.nl/wonen-op-komst

Nieuwbouw-Zeeburgereiland. Zeeburgereiland, een bruisend nieuwbouw gebied. Retrieved from https://www.nieuwbouw-zeeburgereiland.nl

Park 20/20. Retrieved from http://www.park2020.com/

3D Printing in the Circular City. Retrieved from https://printyour.city/

Spectral. Retrieved from https://spectral.energy/news/jouliette-at-deceuvel/

StoneCycling. Retrieved from https:// https://www.stonecycling.com/

Struyk Verwo Infra. Klimaatadaptatie door groenbestrating. Retrieved from https://www.struykverwoinfra.nl/oplossingen-actuele-themas-or-groen.html

Run4Life (2018). 'Resource-Oriented Sanitation' Options of Decentralised Nutrient Recovery. Retrieved from http://run4life-project.eu/wp-content/uploads/2018/06/10-180517-R4L@IFAT-Grietje-Zeeman.pdf

World Economic Forum https://www.weforum.org/

AMB LA COL·LABORACIÓ DE:

BBVA
Creant Oportunitats

AMB EL SUPORT DE:

Ajuntament de Barcelona

AMB Àrea Metropolitana de Barcelona

Generalitat de Catalunya
Departament de Territori i Sostenibilitat