

Green City



Strategy of Circular Economy for BMO Metropolitan Hinterland

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Abstract

The circular economy is a production and consumption model that involves sharing, lending, reusing, repairing, reconditioning, and recycling existing materials and products for as long as possible. This extends the life cycle of products, contributing to minimizing waste generation. The concept of the circular economy is increasingly replacing the linear economic model.

This study first analyzes the phenomenon and then makes a review of institutions in various European and non-European countries, how waste management is regulated, and which self-governing entities are involved. Through a series of various international case studies and by analyzing the national, regional, and municipal background, an attempt is then made to develop proposals for the improvement of waste management in the Brno Metropolitan Area, all from a circular economy perspective.

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We are planning to make use of the unused land in the municipalities or even the gardens or the small pieces of land around buildings and houses. The idea is to motivate people to produce more and consume less... the question stays :.....	Chyba! Záložka není definována.
Who should plow the field and make it ready for farming and planting?	Chyba! Záložka není definována.
Who should maintain the land/garden and is responsible for it ?	Chyba! Záložka není definována.
How should the whole thing start?	Chyba! Záložka není definována.
Option 1.....	Chyba! Záložka není definována.
The municipality goes to a building and offer them support to start farming the garden .. the municipality would offer help or counseling for the people how to ready the land for farming ..the idea is to plant veggies trees and other crops that can be seasonally planted and freshly used by the tenants there or even sell them on the market if there's a surplus	Chyba! Záložka není definována.

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1. Literature review of phenomenon - Circular Economy

History of the Circular Economy

Forms of the circular economy have always existed, as historical works attest. Repair, recycling, reduce and reuse were common practices until the mid-20th century. Even in nature, circularity was the guiding principle that allowed the flow of materials to circulate and therefore enabled the birth of diverse biodiversity (Stahel & MacArthur, 2019). Everything changed with the industrial revolution, which represents an important milestone that empowered significant growth of the quality of life. The application of the linear economic model globally, enabled to overcome scarcities of food, shelter, and clothing. However, the linear economic model became dominant with the rise of the consumer society and mass production, that is to say, after the Second World War.

The term waste, explains the philosopher François Dagognet (*Des détritux, des déchets, de l'abject. Une philosophie écologique*, 1997), that was not introduced in France until the 15th century. At that time, everything was reused or left to natural degradation. As well as, a parallel economy, organized around the rag pickers, recovered rags and bones for reuse. The historian Sabine Barles (*L'invention des déchets urbains*, 2005) writes that until about 1870 there was a spontaneous circulation of matter between the city, industry, and agriculture. Several developments explain the gradual disappearance of this first circular economy: the technical progress that allows development of new materials with more performance, the development of hygiene at the end of the 19th century, which considers waste as the cause of epidemics. Later, from the second half of the 20th century onwards, the development of marketing, design and the acceleration of product renewal. As stated earlier, the idea of circularity of the material and energy flows is not new. However, the interest in the concept of circular economy did not increase until the late 1970s (Geissdoerfer, 2017). The idea of circularity can be found as early as 1966 in the book by Kenneth Boulding 'The economics of the coming spaceship Earth' (Boulding, 1966) which recommends that man must find his place in an ecological cyclic system capable of continuous reproduction of all material forms.

Boulding, describes the earth as a 'closed and circular system' (1966) and concludes that the economy and the environment should coexist in balance.

According to the findings, no clear evidence has been found about the originator of the concept – circular economy (Winans, 2017). The circular economy emerged from the idea to reduce 'the consumption of inputs for industrial production' (Arruda, 2021). However, the very notion of the circular economy appeared for the first time in a book on environmental economics in 1989, written by Pearce, D.W and Turner called '*Economics of natural resources and the environment*'. The authors could have been inspired by Rachel Carson's '*Silent Spring*' or the '*Limits to growth*' thesis of the Club of Rome in the 1970s and many other significant papers (Winans, 2017). Nevertheless, it was in the 2000s that this concept became a public success thanks to the combination of three concomitant events that created an environment receptive to its diffusion: the boom in commodity prices that quadrupled between 2000 and 2010, the Chinese embargo on rare metals and finally, the growing ecological crisis.

Since the first appearance in the literature of the phenomenon, current understanding of the circular economy has evolved to incorporate many contributions from different concepts that share the same idea of a closed loop (Geissdoerfer, 2017). Several authors, who were inspired by Boulding (1966), for instance Andersen (2007), Ghisellini et al. (2016), and Su et al. (2013), started to analyze the characteristics of contemporary economic system. The authors described the importance of the natural resources and its influence on the economic production and consumption mechanism model. They emphasized the key role of natural resources, that is to provide inputs. Ellen MacArthur Foundation is known for framing the new definition of the circular economy. The renowned definition states that circular economy is 'an industrial economy that is restorative or regenerative by intention and design' (Ellen MacArthur Foundations, 2013). The work of the Ellen MacArthur Foundation and McKinsey highlights that new repair business models, reusing or recycling is possible and that would generate thousands of billions of dollars if they were common while significantly reducing environmental impacts. The famous 'butterfly diagram' was also developed by the foundation. This diagram illustrates the differences between a linear economy that operates with the linear flow of materials and a circular economy that is significant for its continuous

flow of materials. This approach defines circular economy by using various criteria, for instance loops or policy areas.

CIRCULAR ECONOMY - an industrial system that is restorative by design

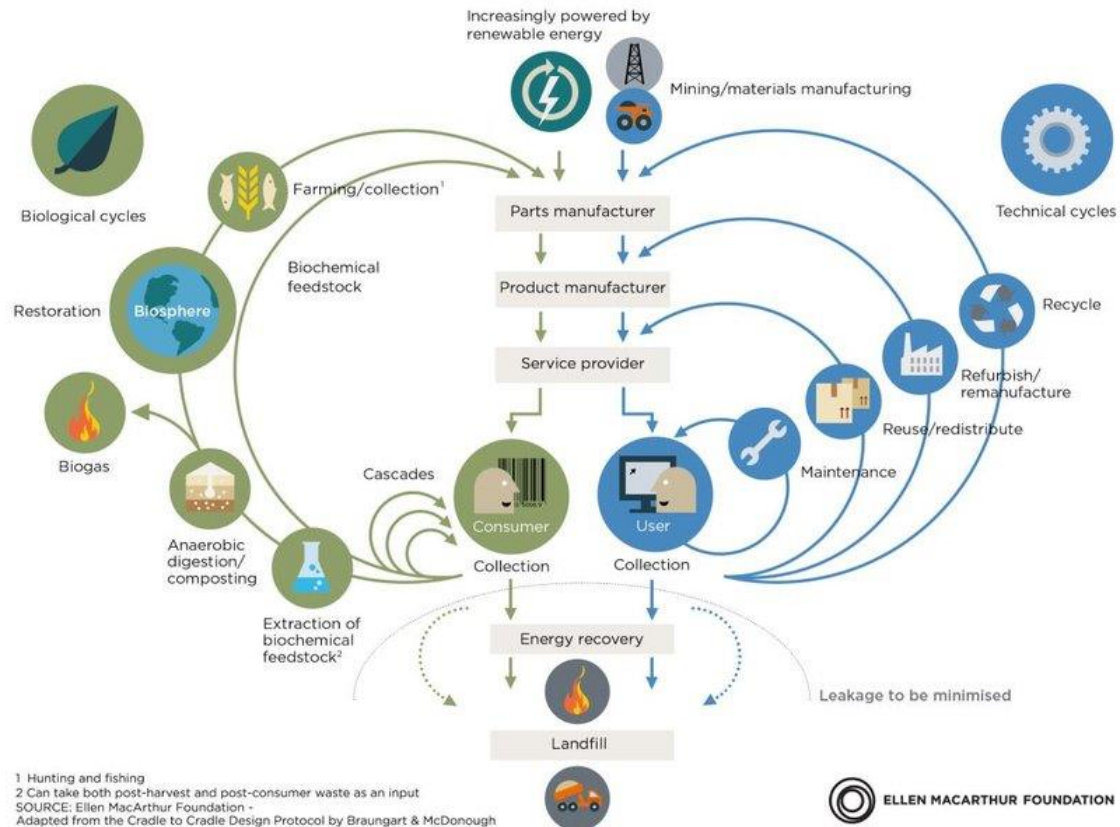


Figure 1 A typical example of circular economy

This approach is nowadays commonly used to address sustainability issues. The circular economy gained prominence in policy-making programs (Brennan, 2015), for instance the comprehensive European Circular Economy package (European Commission, 2015) or the Chinese Circular Economy Promotion Law (Lieder & Rashid, 2016). To sum up, although the roots of the emerging concept are European, recent increased interest in the topic begun in China due to introduction of regulatory controls in this country (Geissdoerfer, 2017).

Key discussion and findings of the researched literature

The previous sections summarized the history of the phenomenon and provided an overview of the important milestones towards the birth of the circular economy as a concept. This

section presents a short introduction to explain the basis of the concept as well as the key findings of the researched literature. On top of that, tries to identify challenges in application of the concept.

The circular economy is based on a double promise: the reduction of environmental impacts and the creation of economic value through the emergence of new circular business models.

- **The “3R”:** The circular economy integrates various strategies and tools that are based, among other things, on three principles known for limiting the impact on the environment: reduction at source, reuse, and recycling, commonly known as 3R. It moves all systems from finite linearity to a truly natural system (such as that of water in nature)
- **Finite resource:** The circular economy concept considers the fact that resources are finite.
- **Reintegration of wastes in the loop of the economy:** the flow of materials at both at company and territory level as well as their potential to be reintegrated into the economic system, thus preventing their final state from being dumped.
- **Functional economy**, also called performance economics, consists in selling the use of a product and not the product itself. Thus, this economy aims to optimize the use of goods and services with the objective to maximize their use for a long time using limited resources. This creates a sustainable space, considerably more dematerialized than the current economy focused on production. This leads to the decoupling of the added value and the consumption of energy and raw materials.
- **Collaborative economics**, also known as sharing economy, uses products and services to optimize resource consumption. The development of this economy has revolutionized many industries, the most popular being the transportation of people (the appearance of Uber and car-sharing applications), the hotel industry (the appearance of Airbnb), the retail industry (the emergence of e-commerce) through extended sales platforms like Amazon or eBay that allow anyone to become both seller and buyers
- **Reconditioning** consists in the refurbishment of a product by disassembly, cleaning, inspection, sorting, reconditioning, and reassembly. At the regional level, there are

different measures which require to some extent the implementation of strategies aiming to obtain a faster transition to a higher percentage of reuse.

The circular economy is based on three principles, driven by design:

1. Eliminate waste and pollution
2. Circulate products and materials (at their highest value)
3. Regenerate nature

The circular economy creates territorial economic value and jobs. Developing local repair, setting up short lines of collection and recycling, all this can contribute to the reindustrialization of urban areas in difficulty. For example, ADEME estimates that recycling is twenty times more job intensive than landfills. Local authorities and public authorities have clearly understood the challenge of developing territorial strategies aimed at capturing and developing this value creation and these activities. In France, for example, a goal of creating 500,000 jobs by 2025 in the field of recycling and repairing products is a major motivation.

According to the research, we identify several challenges that need to be addressed accordingly, as well as main findings that should be further pursued. On the one hand, one of the challenges is the lack of agreement on the definitions and terminologies of circular economy in the scientific community . The formulators of recent literature on the topic need to address this problem properly in the academic sphere . As well as distorted and fragmented relationship with other concepts in the field of sustainability, for instance green economy, clean production, or industrial ecology. At European level, measuring and further comparing the activities of the circular economy between countries is a problem (Mazur-Wierzbicka, 2021). This is due to the fact that some countries of the European Union have developed a system of indicators that only applies in their home country. This creates an inconsistency in data collection, leading to difficulties in comparing statistics. Examples of these countries are the Netherlands, France, the French Ministry of Ecological and Solidarity Transformation, Italy, and Portugal (Arruda, 2021). Because of the non-existence of single generally acceptable set of indicators for the circular economy in the European Union, the monitoring process now presents a difficult yet important role. However, monitoring of the circular

economy activities, at levels both macro, micro as well as meso, presents a crucial task in the transition process of the economies. On the other hand, one of the key findings that the recent work of the authors conclude is that the circular economy is a precondition to sustainability, a driving pillar of the transformation . As shows, Geissdoerfer, et al. work the key actor in the transition process are private companies (Geissdoerfer, 2017). According to several studies, in terms of legislation, implementation and public policies, the top-down strategy is the most desirable one for a successful economic transition due to the supply chains that will ensure the efficiency of economic circularity . Further research needs to be addressed concerning the applicability of the circular economy as the authors advised .

The most current findings in the field of study

The current challenge is obviously not to go back to the previous model of a circular economy but to invent a new one where the requirements of traceability, hygiene, less environmental impact, and quality are respected. To encourage the transition to a circular economy, the European public authorities are trying to bring together all the incentives, information, regulation and support for sustainable innovation.

For example, law no. 2020-105 on 10th of February 2020 on the fight against waste and the circular economy (known as the AGEC law in France) provides several provisions to achieve its objectives: removal of disposable plastic, better consumer information, or struggle for planned obsolescence.

→ Plastic 0 Policy: The zero plastic strategy put in place by European governments aims to phase out all single-use plastic packaging by 2040. The products concerned are: Plastic bottles; Disposable tableware; Cotton swabs; Plastic confetti; Balloon rods; Plastic overpacks; Plastic tea bags; Medical devices containing plastic microfibers; Cosmetic products containing microplastics. To achieve this, the circular economy wants to integrate the concept of recycling into the life cycle of all plastic products. The challenge for UE is to make it mandatory, through legislation, to eliminate these single-use plastic objects and to encourage innovation to find 100% recyclable alternatives.

→ Dealing with digital pollution: Today's high-tech industry produces billions of electrical and electronic devices every year, with disastrous environmental consequences. According to

Green Peace, digital pollution accounts for 3.8% of the world's total CO2 emissions. Several methods are already in place, such as reconditioning (refurbishing used appliances). Although this initiative helps to combat the overproduction of equipment already in use, it is not enough. Let's take a laptop: it requires dozens of metals from all over the world: Congolese tantalum, Bolivian lithium, Australian gold, Chinese rare earths. The extraction of these minerals is very expensive for the environment: it requires a lot of energy (fossil), water and resources. Added to this are the pollution of ecosystems and the human tragedies linked to mining activity. In the east of the Democratic Republic of Congo, we speak of "blood minerals" (tungsten, tin, tantalum, gold) because their illegal trade finances the civil war. In the Brazilian Amazon, the rivers of Waimiri-Atroari are permanently polluted by the tin and tantalum mining industry. In the Baotou region of China, rare earth extraction results in significant toxic releases to air, water, and soil. As for the end-of-life of this equipment, it is not any brighter. A UN report (2013) estimated that 75% of e-waste escapes legal recycling processes. They are illegally exported to China, India, or Africa, and end their lives in huge open dumps, like the one in Agbogbloshie, Ghana.

Innovation in the field of the circular economy must consider this new form of pollution. Especially since it is not only the manufacture of computer equipment that generates pollution. For example, video streaming alone accounts for 60% of data flows on the internet, due to the weight of video files. A film like Pulp Fiction, proposed by Netflix in very high definition (4K), weighs around 10 gigabytes, or 300,000 times more than an email without an attachment (30 ko). According to the think tank *The Shift Project*, the consumption of video streaming (VoD, pornography, YouTube, social networks, etc.) would emit nearly 1% of the global CO emissions. This is less than the carbon footprint associated with terminal manufacturing. But it's very concerning because of the rapid growth in video traffic.

2. Urban literature review

Definition of Metropolitan Core and Hinterland

In order to compare large metropolitan areas between them it is imperative to define what a metropolitan area is, what is the center and the hinterland. In this section we will later discuss the problems that a metropolitan area could generate.

Metropolitan is a term that is used to describe a relatively large urban area, both size of area, population, and the scale of economic and social activity (Wolfgang Loibl, 2018), it is specially used in those cities that reach high complexity levels. The etymology is derived from the Ancient Greek language, in which the word **meter** means mother, and the word **polis** means city (Webster, 2020). The metropolitan can also be defined as a large residential center that consists of a large city surrounded by towns, municipalities and villages that are economically and socially connected to the center so that it serves as a point of contact (hub) to the surrounding areas. Another characteristic that a metropolitan district possesses is its population in comparison to the surrounding countryside. That's why the term Metropolitan is used to give a more precise picture of the amount and concentration of the population in a large area, which in turn can show the magnitude of the centers of the main settlements in the country.

In addition to the total amount of population in a metropolitan city, economic activity is also considered an important aspect to define a metropolitan city. The metropolitan area is an urban area specialized in social and economic activities (UKEssays, 2018). The economic specialization takes place in the industrial and services sectors. Industrial activities and services are the dominant sector in the growing metropolitan region. Economic activities that take place in the metropolitan area are heterogeneous and have a role as a center for economic activities on a regional scale, both within the province or state and national scope. Growth and development of the urban economy are the driving factors behind the metropolitan and will continue to affect the prospects of the future metropolis (Cardoso & Meijers, 2020). In fact, metropolitan cities everywhere carry out the functions of the national economy, which is a very significant contribution to the whole country. On the other hand, a metropolis should be able to create jobs and income levels sufficient for people to be able to cover their wants and needs in the metropolitan environment (Moonen & Clark, 2016).

While population growth is a good indicator that a metropolitan area is attracting people and economic activity, it is unclear what determines such growth. In fact, metropolitan areas grow for a variety of reasons. Traditionally, the process of urban growth resulted both from push

and pull factors. Productivity gains in agriculture reduced employment in rural areas and pushed it towards metropolitan areas. The rise of industrial sectors – for example driven by enhanced international trade – pulled people towards metropolitan areas as those sectors stand to gain from agglomeration economies. In addition to strong economic incentives, metropolitan areas provide access to numerous amenities that are valued by people that are willing to move there, including favorable climate, access to healthcare, public transportation, education and cultural opportunities. Some metropolitan areas also grow because the regulatory environment is more favorable to urban expansion than in other metropolitan areas within the same country.

There is, in reality, no clear borderline between a city, its surrounding municipalities and the rural area in the hinterland: there is often a gradual transition between the urban and the rural Areas. Spatial planning science characterizes different types of land use patterns in the urban-rural context. They usually distinguish three categories of regions (Dallhammer et al., 2019).

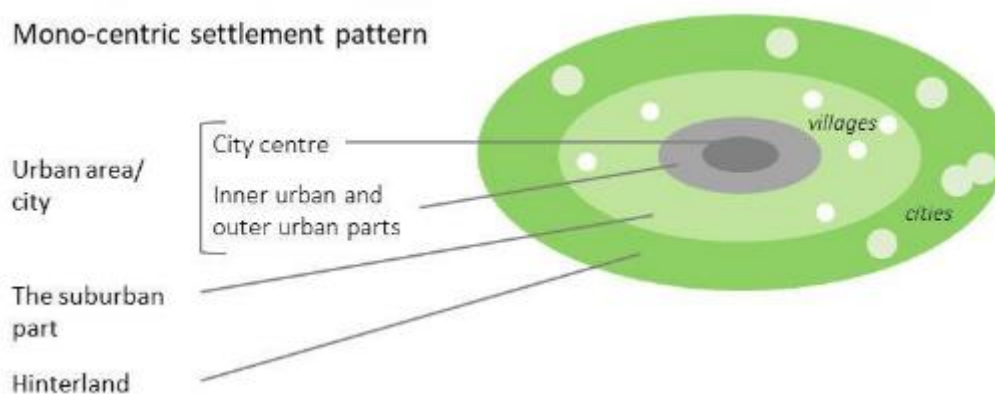


Figure 2 Land use patterns in metropolitan areas (Altmann et al., 2012)

City Center

It can be defined as a permanent and densely settled place with administratively defined boundaries whose members work primarily on non-agricultural tasks. It generally has extensive systems for housing, transportation, sanitation, utilities, land use, production of goods, and communication. Their density facilitates interaction between people, government

organizations and businesses, sometimes benefiting different parties in the process, such as improving efficiency of goods and service distribution. All those aspects help attract numerous commuters traveling towards the city center for employment, entertainment, and education.

According to the OECD process of identifying Functional Urban Areas this is the first step to take, we need to identify the urban center.

Suburban area

includes a dispersed and non-contiguous fabric of built-up and open spaces surrounding the urban core areas. Most inhabitants of urban areas have non-agricultural jobs. Urban areas are very developed, meaning there is a density of human structures such as houses, commercial buildings, roads, bridges, and railways. "Urban area" can refer to towns, cities, and suburbs. These more rural municipalities in the suburban zone of cities become an especially attractive residential alternative to the densely populated centers due to lower land prices and their proximity to open land.

Hinterland

The hinterland includes rural areas surrounding the peri-urban area as well as small and medium sized towns with potentials for linkages to the bigger urban Center with a low population density.

Its definition shifts depending on the global location, but typically in Europe, where urban areas are intensively managed to prevent urban sprawl and protect agricultural land, the urban fringe will be characterized by certain land uses which have either purposely moved away from the urban area or require much larger tracts of land. As examples: Roads, especially motorways and bypasses, Waste transfer stations, recycling facilities and landfill sites, Park and ride sites, Airports, Large hospitals, Power, water and sewerage facilities, Factories and Large out-of-town shopping facilities.

Despite these 'urban' uses, the fringe remains largely open, with most of the land used for agricultural, woodland, or other rural purposes. However, the quality of living in the

countryside around urban areas tends to be low, with severance between the area of open land and badly maintained woodlands and hedgerows.

According to the OECD definition of FUAs (Functional Urban Areas) “Hinterland” can be defined as the “worker catchment area” of the urban labor market, outside the densely inhabited core. If more than 15% of the working population of the urban hinterland works in the urban core, and that municipality is contiguous to the urban area, then it will be included in the FUA is not, it will be dropped.

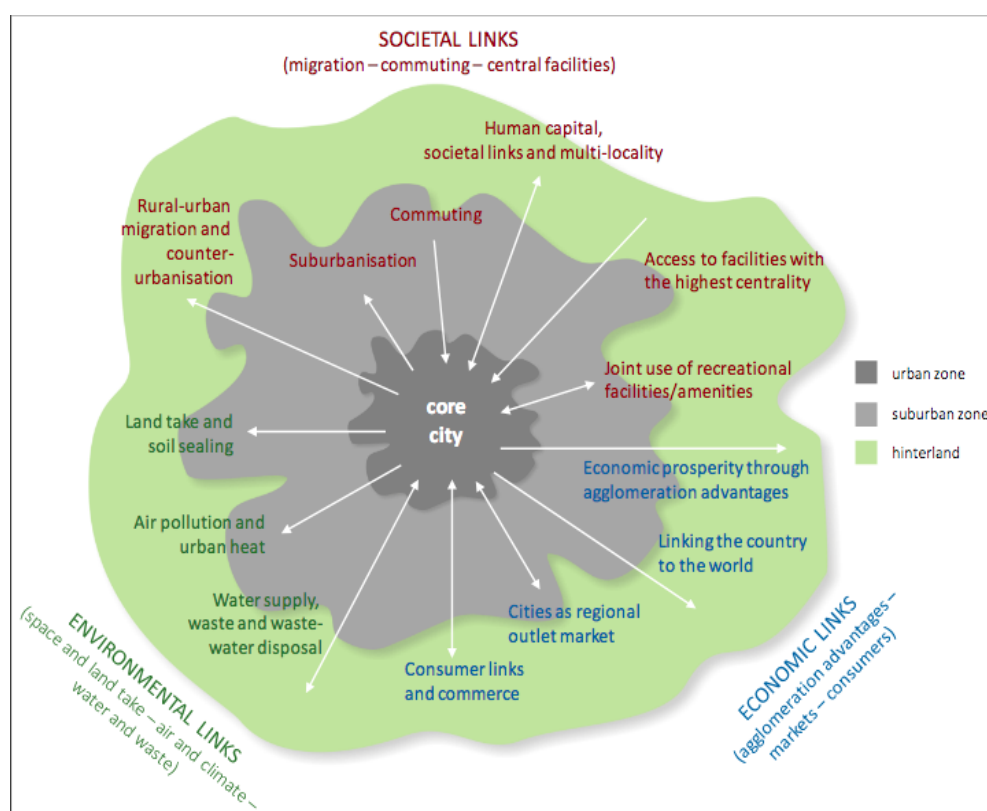


Figure 3 Linkages of spill-over effects within a metropolitan region and between a metropolitan region and its hinterland. (ÖIR, 2019)

Metropolitan areas are the “engines” of development and can spread positive effects from the core city to the suburban zone as well as to their surrounding areas. However, they are

also causing unintended negative effects. The main spill-over effects of metropolitan regions to their surrounding areas are:

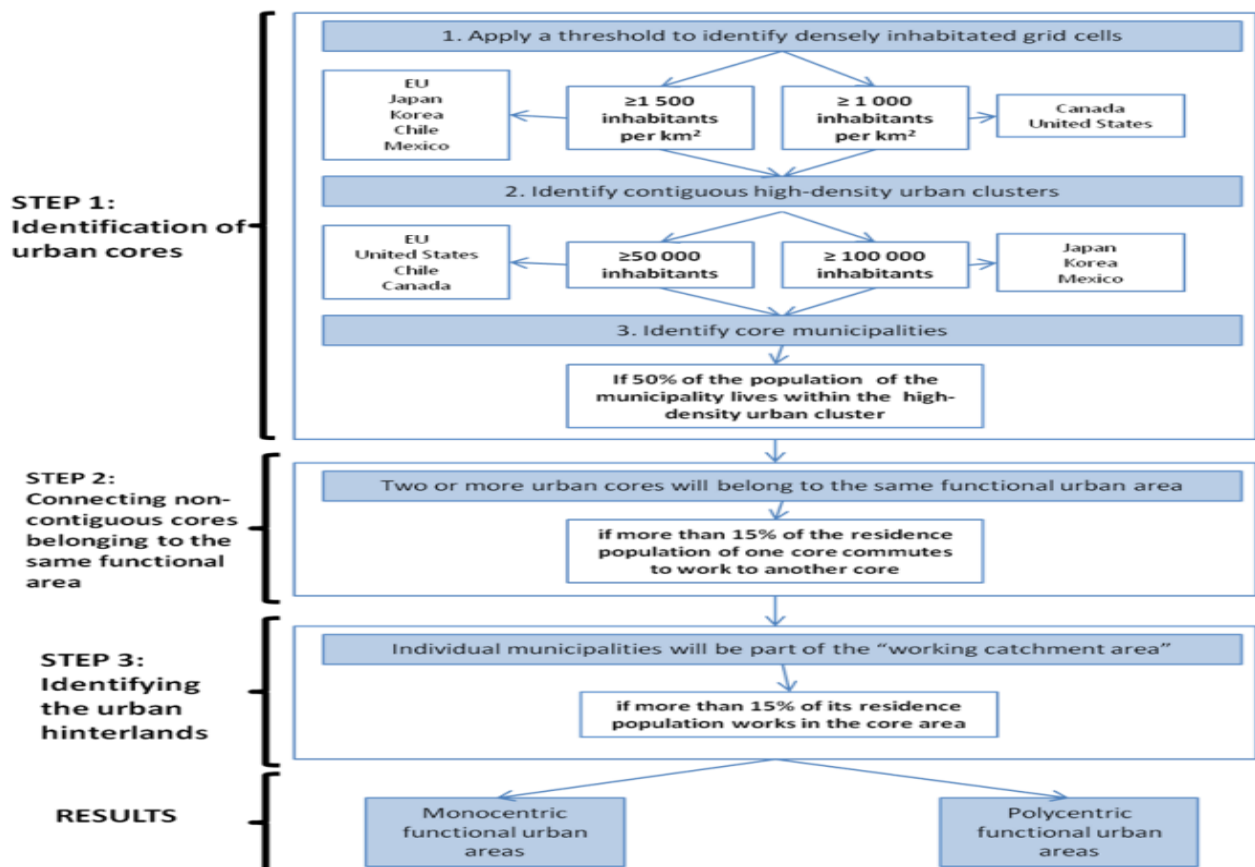


Figure 4 Procedure to define Functional Urban area in OECD countries.

1- Urbanization: Urbanization is the increase in the proportion of people living in towns and cities (ESPON, 2013). Urbanization occurs because people move from rural areas (countryside) to urban areas (towns and cities) mainly caused by the lack of resources that characterizes the rural areas. In addition to that, people are aspiring for better-paid jobs, more diverse, and may be less physically demanding. Many urban areas also allow for better living standards, including superior educational facilities, better access to healthcare, modern housing, and more recreational activities. All these "Push factors" lead to an increase of population in the urban area and a shrinkage in the number of residents in the rural areas. As people migrate, rural areas become more marginalized, economically underperforming, and unable to provide for the remaining residents. This contributes to more urbanization and loss of rural areas.

2- Counter-urbanization: is a demographic and social process whereby people move from urban areas to rural areas (ESPON, 2013). People have moved from urban to rural communities for various reasons, including job opportunities and simpler lifestyles. In recent years, due to technology, the urbanization process has been occurring in reverse. With new communications technology, people from rural communities can remote work because they can connect with each other via rural Internet, which means some employment opportunities no longer require moving to an urban community. Counter urbanization is about people being able to explore alternatives to living in the city, creating changes in living location preferences. People choosing to live in rural areas have found it more beneficial because of cleaner air, peace, and quiet, and plentiful space. Smaller towns have also been proven to be convenient for the inhabitants.

3- Suburbanization: refers to migration within the metropolitan region (ESPON, 2013). People are moving from the core city to the suburban zone within daily commuting distances. These more rural municipalities in the suburban zone of cities become an especially attractive residential alternative to the densely populated centers due to lower land prices and their proximity to open land. Many residents of metropolitan regions work within the central urban area and choose to live in satellite communities called suburbs and commute to work via automobile or mass transit. Others have taken advantage of technological advances to work from their homes. It's also worth mentioning that land take is increasing, and the originally rural municipalities become part of the suburban belt around the core cities leading to the (unwanted) effect of urban sprawl.

Problems of metropolization

Metropolitan areas are the main drivers of the economy of their country, for example, more than 80% of the industrial production in Brazil is concentrated in just the metropolitan areas of Sao Paulo, Rio de Janeiro and Belo Horizonte. They are economic centers. But at the same time, they are places of concentration of unemployed or underemployed persons, poverty and precarity, which leads to inequalities being formed. These precarious conditions and social differences are some of the reasons that push to movements of counter urbanization. (Jordan Fuchs, 1986)

On the other hand, it is true that they are culturally unifiers and provide cultural identity, which in many cases helps in social fights and social movements.

Big metropolitan areas are connectors, they provide territorial structure, they are at the center of cultural development through history, they are where the decisions are made and generate multiple interconnexions. But what problems do they generate? (Dijkstra, 2019)

Apart from social problems that can emerge in the cities, the different quarters, for rich and poor... Another problem generated is the lack of resources. Cities grow faster in population than they do in resources, many times those newcomers must “build their own city”. The demographic growth is often faster than the creation of new job offers, which is another source of poverty and inequalities.

We have seen very high levels of contamination due to the demographic and the industrial concentration, the number of vehicles... They are giant producers of waste which required to be treated. Many cities around the world are terrible to the health of the rivers that go through them. Agricultural soils around the city are also diminished in number. They pollute the air, the water, and soils.

We have a geometric growth in population with an arithmetic growth in resources, plus a growth in air pollution and high CO₂ concentration. The superficial waters now transport more bacteria coming from the sanitation system, making the water less likely to host life.

As we mentioned before these cities are giant producers of waste. Managing this waste is necessary, but it isn't done everywhere, and many are the cities in which illegal dumpsters are created without any recycling procedures. In addition to all these there is a lack of green spaces.

Even though metropolization creates all these problems, they can be dealt with. With an appropriate sustainability plan we can fight the social problems of inequality, generate economic growth which would create jobs, and develop an appropriate waste management system, accompanied by legislation could help in the reduction of waste. There are actions and strategies that could lead to a minimization of the deterioration. (Palacio, 2011)

Are large cities good for the planet?

Although cities are important sources of pollution, urbanization potentially has positive environmental consequences. Spreading city populations over a larger area would not bring any systematic ecological benefits. When considering the per capita contributions to soil sealing or climate change, larger cities perform better. Overall, the ecological effects of cities depend mainly on **how they are organized**. The choices made during the current wave of urbanization will therefore have a huge impact on the environmental sustainability of human activity.

Urban sprawl increases the detrimental effects of cities on the environment, and many countries have the policy objective to limit sprawl. Nevertheless, current policies in many cities incentivize sprawl through taxes and regulations. Consequently, people are pushed further apart than they would otherwise wish to be. Correcting such policies, including via the imposition of realistic carbon prices and congestion charges would make an important contribution towards improved environmental outcomes.

The challenges of 21st century urbanization

The important challenges connected to urbanization may explain why many countries still have policies in place that are aimed at or result in preventing or containing urbanization. Governments would be better advised to accompany and shape urbanization to ensure that it results in well-functioning and environmentally sustainable cities. Existing or emerging middle classes across the globe increasingly ask for cities not only to provide for good jobs and livelihoods, but also to become more livable. This includes less pollution and congestion, good access to the places where residents need or want to go, and a generally attractive and secure city environment with a good choice of leisure activities.

While in most of Europe and Northern America the largest part of urbanization has already taken place and is embodied in city forms and existing infrastructures, developing, and emerging countries currently have an unprecedented opportunity to shape their urban futures. The decisions taken by governments at national, sub-national and city levels now will have consequences for their cities for decades, if not centuries, to come.

3. Institutional & self-government review

The European legislative framework

To facilitate the transition to a circular economy, in December 2015, the Commission proposed measures to transform waste legislation. The aim was also to propose a detailed action plan for the circular economy to the Member States. This action plan defined measures to act on all phases of a product's life cycle: from production to consumption.

In 2018, this first set of measures was supplemented by the European Directive 2018/851 of 30 May 2018. This was a second list of measures including strategies to reduce the use of single-use plastics in Europe.

Through these two measures, a total of EUR 10 billion of public funds has been allocated for the development of the circular economy in Europe. (européenne, 2014)

These two reminders of texts are there to show that the promotion of an alternative model to the linear model appears for several decades in European texts, and that the European strategy include concrete objectives for the circular economy to be implemented at national level in EU member countries.

Bretagne (Brittany region), France

The French legislative framework

In order to transpose the European directives on its territory, France has implemented Law n°2020-105 of 10 February 2020 on the fight against waste and the circular economy, known as the « AGEC Law ». It reinforces and reforms extended producer responsibility (REP), which recognizes the “polluter pays” principle. Since then, 22 additional product families have been subject to the REP (tobacco, toys, sporting goods, chewing gum, tires, etc.). Before the AGEC law, in France, there was great importance for Article L. 541-10 of the Environmental Code, which requires only producers to contribute to the prevention and management of waste from their product. From now on, the AGEC law and the REP implies an eco-design of products, to design products in compliance with sustainable development, to include the

possibility of recycling or packaging, and to limit planned obsolescence. With this law, several financial aids were created to cover the costs necessary to achieve the objectives. (Gouvernement français, 2020)

The legislative framework of the Brittany region

Several measures of application of these texts at the regional level are created. One can mention the creation of the Regional Prevention and Waste Management Plan (PRPGD). This plan is effective in each region so that the regional territories meet European and national regulatory requirements. In Brittany, the PRPGD includes 5 main directives (Région Bretagne, 2015):

1. An overview of waste prevention and management.
2. A six-year and twelve-year outlook on the trend in the quantities of waste to be treated.
3. Objectives in terms of prevention, recycling, and recovery of waste, setting out national objectives in a way adapted to the specific territorial characteristics and the priorities to be adopted to achieve these objectives.
4. Planning for the prevention and management of waste at the end of six years and twelve years, including, in particular, the mention of installations which it seems necessary to create or adapt in order to achieve the objectives set and in compliance with the fixed limit.
5. A regional action plan for the circular economy

Prevention, as well as reducing the production and harmfulness of waste, are prerequisites for any action. The hierarchy of waste treatment methods is also a fundamental principle, which is then to favor the preparation for reuse, and then the recycling of waste, before any other recovery, including energy recovery; and finally, disposal. The Breton DMRP is based on meeting these objectives and this hierarchy.

In order to give concrete means of action to achieve these objectives, the Brittany region has created the Roadmap for a Circular Economy (FREC). It is a guide, a leaflet, a tool to help Breton stakeholders commit to the circular economy. FREC gives priority directions to the Bretons:

- Transform environmental objectives into economic opportunities (Business model, new offers and services, etc.)
- Profoundly transforming the territorial metabolism of Brittany
- Preventing and optimizing the use of resources in Breton territory
- Put innovation at the heart of the ecosystem while involving and mobilizing all stakeholders in the territory.

These four ambitions have been translated into 9 challenges for which a series of actions are planned over a period of 4 years. For the period 2020-2024, the challenges are:

1. Do some foresight on the transition to the circular economy in Brittany
2. Create a dynamic of animation in the territory
3. Communicate and network stakeholders
4. Support companies in setting up their “circular projects”
5. Training communities and businesses
6. Encourage the circular economy among building operators
7. Encourage the circular economy among tourism stakeholders
8. Developing inter-company synergies
9. Promoting innovation inspired by life

The FREC action programmed in Brittany for the period 2020-2023 includes six main guidelines:

1. To train all Breton actors in the challenges of the circular economy: to lead workshops on the circular economy, to create incubation structures for innovative projects in the circular economy, integrate a circular economy sequence into sustainable development trainings, etc.
2. Financially support the actors: communicate to the actors (public/private/associations) on the financing mechanisms in the circular economy, increase the financial support of the Regional Council for circular economy initiatives.
3. To set up specific actions for the building sector: to set up a technical day on the circular economy for the building trades, to take stock of the projects of Breton buildings engaged in the «cradle to cradle»

4. Implement specific actions for tourism: create a circular tourism action plan, increase funding for circular economy projects for tourism
5. Foster synergies: build and lead a regional working group dedicated to inter-company synergies
6. Increase the visibility of ongoing transformations: organize an annual meeting in Brittany on the Circular Economy, organize field visits to present concrete projects of circular economy, propose for the 2021 edition of the Sustainable Development Trophies (a regional competition for companies) the theme of the circular economy, make visible the circular economy to the consumer

Also, the Regional Council of Brittany launched in 2017 the Breizh COP which sets 38 objectives of sustainable development and circular economy. These objectives aim to make the Brittany region very ecological by 2040. Among these objectives, two are directly related to the need to develop the circular economy in the territory:

- Objective 13 “Accelerate the deployment of new business models”
- Objective 24 “Achieve Zero Landfill and Zero Waste”

In addition to this Breizh COP, the Regional Council made, in 2019, six priority commitments respectively on “eating well for all”, “energy and climate”, “responsible digital”, “biodiversity and resources”, “territorial cohesion” and “solidarity and low-carbon mobility”.

The preliminary stage for the drafting of these objectives was the realization of a diagnosis on the scale of Brittany. This took place over 9 months between September 2018 and May 2019. Here are the steps of this diagnosis:

- Map “key” actors (communities, companies, clubs and networks, innovation actors, educational institutions, public and para-public organizations, etc.),
- Identify the initiatives undertaken in the circular economy and provide qualified feedback,
- Identify the needs of the actors met to promote the implementation of circular economy actions in the territory,

- Identify the existing arrangements (technical, financial, communication support, etc.), to be maintained or developed,
- Identify the missing supports,
- Analyze the obstacles encountered (e.g.: lack of a value chain, or difficulty in modelling a business model, etc.)

Thanks to this diagnosis, the Brittany region has made sure to propose objectives that are both compliant with European and national requirements, but also achievable in practice on its territory. This approach provides Brittany with a good basis for developing sustainable and useful initiatives in favor of the circular economy. (McDowall, 2017)

Italy

Italy is a Parliamentary Republic. The state is organized based on significant regional decentralization.

The Italian political system is organized according to the principle of separation of powers: legislative power is attributed to Parliament, executive power to the government and the judiciary, which is independent of the executive and the legislative power, exercises the judicial power.

The fundamental law of the State is the Constitution of the Italian Republic. Title V, of Part Two, concerns the rules on local government.

The Republic consists of Municipalities, Provinces, Metropolitan Cities, Regions, and the State. Municipalities, Provinces, Metropolitan Cities and Regions are autonomous entities with their own statutes, powers, and functions according to the principles established by the Constitution [Art. 114]. Five Italian regions (Aosta Valley, Trentino-South Tyrol, Friuli-Venezia Giulia, Sicily, and Sardinia) are regions with a special statute, or rather enjoy special forms of autonomy. Compared to ordinary statute regions, these regions have legislative competence over a larger number of subjects and for some of these it is even exclusive.

The State has exclusive legislation in various areas, including the protection of the environment, of the ecosystem and of the cultural heritage, while other areas (such as scientific and technological research and support for innovation in productive sectors or the production, transport, and national distribution of energy) are matters of concurrent legislation between the State and the Regions.

Municipalities, Provinces, and Metropolitan Cities hold their own administrative functions and those conferred by state or regional law, according to their respective competences, and have financial autonomy in terms of revenue and expenditure.

The function of the provinces has changed over time. Since 2010, there has been a gradual transfer of competences and staff from the provinces to the regions. The current functions of the provinces include:

- provincial coordination territorial planning and the protection and development of the provincial territory
- the planning of transport services in the provincial area
- data collection and processing, technical and administrative assistance to local authorities
- the strategic development of the territory and management of services in associated form for mountain provinces.

Municipalities are autonomous territorial entities, with administrative and financial autonomy. Among other things, they are responsible for the administration of the territory regarding:

- definition and observance of the annual municipal budget
- definition and adherence to the municipal master plan
- municipal roads management
- public buildings management
- waste management
- management of critical situations related to adverse weather conditions and natural calamities.

For all its administrative functions, each municipality has an annual financial budget from the state.

The figure of the metropolitan city was introduced into the Italian constitution with the 2001 reform. In 2014, the first 10 metropolitan cities were established in ordinary statute regions, while special statute regions have autonomy in the establishment of this territorial entity. As of 2022, Italy has 14 metropolitan cities, of which Cagliari is the only one that was created following a metropolitan area logic, and not by simply changing the name of the old province. This territorial entity is governed by the metropolitan mayor, who is the mayor of the provincial capital city. Other administrative bodies are:

- the metropolitan council, which is the chief legislative body of the metropolitan city. It proposes laws and amendments to the metropolitan conference, and approves programs, regulations and rules submitted to it by the metropolitan mayor such as the budget. It is composed of the metropolitan mayor and several council members proportional to the population of the metropolitan city. The mayors and the council members of the individual municipalities constituting the metropolitan city are part of the active and passive electorate
- the metropolitan conference is composed by the metropolitan mayor and the mayors of the municipalities of the metropolitan city. It is competent for the adoption of the statute and has consultative power for the approval of budgets.

Italian legislation on waste

The first Italian law on waste regulation, which, however, only considered waste from households, was the Law 366/41. The legislation contained criminal sanctions to safeguard the prescriptions and prohibitions contained in it. In particular, Art. 46 punished with a financial penalty of 100 to 5,000 Lire offenders who violated the regulations on the performance of collection, transport and disposal services, while violations of the other regulations of the law, including the prohibition to throw and deposit waste in public streets (art. 17), were less severely penalized. (Guerri, 2010)

One of the most serious accidents in Italian history, which occurred in 1976 at the ICMESA company in Meda (MI), helped to change the situation and produced as its first result the

famous 'Seveso Directive' (European Directive 82/501/EEC, implemented in Italy by Presidential Decree No. 175 of 17 May 1988 in its first version), which required member states to identify their hazardous sites. On 10 July 1976, a highly toxic gas cloud containing around 10-12 kilos of dioxin (TCDD) leaked and dispersed over a large area of land in the neighboring municipalities of lower Brianza, particularly Seveso. The accident affected 158 workers of the plant, 37,000 inhabitants of the area, animals, seriously polluted the soil and extended its damaging effects to the genetic heritage of the people affected (ARPA Umbria, n.d.). This directive has now reached the version 'Seveso III (Directive 2012/18/EU)'.

The first regulation of waste management came with Presidential Decree 915/82 and subsequent amendments, which implemented EEC Directives 75/442, 76/403 and 78/319. This regulation, focused on the concept of waste disposal, classified waste into urban, special, and toxic/harmful by introducing, in Article 18, the waste identification form as a transport document.

Several years are necessary to arrive at the 'Ronchi Decree', the Legislative Decree 22/1997 that transposed Directives 91/156/EEC, 91/689/EEC and 94/62/EC and represents the first organic attempt to rationalize the entire discipline. One of the merits of this Decree is certainly that of having created a waste collection and recycling system, regulated by the single consortium CONAI and the various chain consortiums (COREPLA, COMIECO, RICREA, CIAL, RILEGNO, COREVE). From the beginning, the objective of this new system of consortiums is to work together with municipalities to optimize the delivery and disposal of waste.

With the purpose of setting the corpus of environmental legislation in order to make it more organic and rational, Legislative Decree 152/2006, called the "Environmental Code", was promulgated. This decree is divided into six parts and part four concerns waste management, in accordance with the principles of precaution, prevention, proportionality, accountability and cooperation of all parties involved in the production, distribution, use and consumption of goods from which waste originates, in compliance with the principles of national and EU legislation, with reference to the EU 'polluter pays' principle.

Legislative Decree 152/2006 is still in force, over the years it has changed and supplemented, including Legislative Decree 4/2008 and then Legislative Decree 205/2010 implementing Directive 2008/98/EC.

On 26 September 2020, the so-called 'Waste Decree', Legislative Decree 116/2020, which transposes two of the four European directives contained in the 'Circular Economy Package', more precisely 2018/851 and 2018/852 concerning waste, packaging, and packaging waste, into a single decree, came into force.

This decree substantially modifies Part IV of L.D. 152/2006.

The key points of Legislative Decree 116/2020 are:

- Some types of special waste ('similar waste') are assimilated to municipal waste only regarding the calculation of national recycling targets.
- Companies are not obliged to use a public operator to deliver their waste. Companies that choose a private operator must be de-taxed for the share of waste sent for recovery through this operator.
- Traceability: a new electronic waste register is introduced.
- Extended Producer Responsibility is reinforced, which is based on the principle that pollution has a cost that must be covered by the producer of the polluting product. According to this directive, producers can finance and possibly also organize recovery chains to encourage waste reduction and material recycling.
- Preparation for re-use, recycling, and recovery: an outline of a regulation was submitted to the European Commission on 24 February 2022 that establishes the operating methods and the minimum qualification requirements for operators, necessary for the exercise of preparation for re-use operations, the technical and structural equipment necessary for the exercise of the above-mentioned activities, and the maximum quantities that can be used, the origin, types and characteristics of waste.

On 29 September 2020, the reform on the regulation of landfills by Legislative Decree 121/2020, which transposes European Directive 2018/850, came into force.

The key points of this decree are:

- The prohibition, from 2030, of landfilling all waste suitable for recycling or other recovery, in particular municipal waste, except for waste for which landfilling produces the best environmental result. The regions will have to modify the permits allowing the landfilling of unacceptable waste to meet the 2030 deadline.

- New criteria for the admissibility/ non-admissibility of waste in landfills are defined.
- Target values are set for municipal waste recycling: 55% by 2025, 60% by 2030, 65% by 2035.

Two other decrees came into force on 27 September 2020: Legislative Decree 118/2020 concerning waste batteries, accumulators and WEEE (transposing EU Directives 2018/849 and 2012/19) and Legislative Decree 119/2020 concerning end-of-life vehicles (transposing EU Directive 2018/849).

Hungary

Before going into Hungary's waste management, it is important to look at Hungary's basic data, to know how the system is built up. It became a part of the European Union in 2004. The approximate population is 9.7 million people, but it slowly decreases with the years. The territory of Hungary is 93030 square kilometers, which means that the density of the population is around 105 person per square kilometer.

The structure of Hungary is very centralized. One reason for that is one fifth of the population lives in Budapest, where the density is 3347 capita per square kilometer. The next city's density only 438 capita per square kilometers (Népeesség, 2019).

Hungary is a part of the EU, that obligates the country to follow the main measures and trends that the EU made. In this matter, Hungary's government was cooperative. For 2030 the country set the targets for materials use and consumption footprint, which will help to achieve a total circular economy plan from 2050 (Press Releases, 2021).

Next to the other countries Hungary also lowered the amount of the waste during the years. From 2005 to 2016 the amount of waste per capita per year decreased from 471 kilograms to 379 kilograms. There was another aim that until 2025 the amount of municipal waste recycling should be more than 55%, in Hungary in 2017 it was just 35%, but even with the economic backwardness, it will be able to meet the limits until 2025. Another goal for 2035 was that the waste dumping should be under 10%, and in 2017 it was yet a rather high 49%. The only countries that have already reached these limits in 2017 were Austria and Germany. But to look at the big picture it can be harmful to small and not fully developed countries that

they are always measured in the same league as economically stable countries. With a different financial, economic background it can be a hundred times more challenging making these big changes in everyday life, when there are too many unsolved cases in these countries (News European Parliament, 2021).

Hungary belongs to the 14 countries that need to make big changes in the waste management system changes because they may not be able to meet the standards. The main problem could be that there was not enough information for the people to be able to recycle, and too many people were careless about the topic. Today, the number of recycled wastes is higher but in 2015 37,5% of the communal waste of Budapest contained recycled goods. This could have been easily helped with some information and materials.

To be a little more up to date in the statistics of Hungary concerning waste management the MEKH shared their data with the country in 2020. From 2019 to 2020 the amount of waste increased a little from 3 242 000 tons to 3 245 000 tons., but at the same time, the amount of recycled waste rose with 29,3% (Híradó, 2021).

What does the government do and how does the waste management system work?

In Hungary there is not one big waste management company, but a lot of small ones, which are responsible for their territory. There are 28 regions concerning waste management. All these companies are non-profit Ltd-s. There is a waste management plan whose acronym is OHKT. The small companies are controlled by a National Waste Management Coordinator, the NHKV Ltd. They prepare the National Waste Management Plan and monitor it during the years. They are the one making the proposal about the prices, allocation of public service charges and they make the information public.

The population pays for NKHV which pays for the companies in the regions. The NKHV also monitors the MEKH. And in this whole process the National Tax and Customs Office also takes part.

The role of the self-government in the process

In the waste management plan, the norms were set by the main national coordinators. However, the implementations of these rules are the task of the self-governments. They oversee the selection of the specific waste management company, signing the public service

agreement and setting side rules that apply to the residents under their control. The self-governments usually own one part from the waste management companies so in these cases they are obligated to finance the companies' wealth. One example is that in the case of the machines getting broken they must be the one in charge of fixing the machine or buying a new one (Nemzeti Hulladékgazdálkodás Koordináló és Vagyonkezelő Zrt., 2020).

Hungarian legislation on waste

Of course, the main motive of the rules is that with the help of this, Hungary can meet the circular economy goal. For environmental protection the basic rules can be found in the law of 1995. LIII. It contains information such as the user of the environment must take care of their own waste by disposal or recycling. The program of one settlement must be synchronized with the capability, economic opportunities. New acts were made concerning the topic in 2011, 2012 and 2013. The most important information about these laws contains the new aims and perspective of the protection of the environment and working together with the HKI. The National Prevention Program was made in 2015. This plan's other renewal happened in 2020 as it was a shorter plan.

What is recyclable waste? In this matter it is easier to eliminate what is not. The act that contains all relevant information about recycling states these materials. Waste that can be recycled does not include gases, radioactive waste, deactivated explosives, natural exploited lands, contaminated exploited lands, and fecal matter. For these there are separate laws.

One of the main principles is 'the extended manufacturers' responsibility', in which, not only the consumer is responsible for buying something, but the producing company also can make a difference by choosing environmentally more friendly feedstock and care about the afterlife of a product. Another principle is the 'principle of self-sufficiency', which is important when it comes to the process and buildings of the system. It states that Hungary must have all the needed institutions and buildings to be able to deal with waste management self-sufficiently, however it does not mean that everything must be owned by the country. The 'pollutant pays principle' means that when one makes a contamination, important in the case of companies, there are several environmental taxes they must pay. It is measured by the amount and

quality of the contamination. When it comes to recycling, all people know there can be some side products in the process. It is important that the side products also correspond to the law. Lastly, the law states when does the waste status finishes. There are several options for this to happen. Waste is not waste anymore, when it has a new market, when the use of the object does not harm the people or the environment, when the object or product falls under a mechanical category and corresponds to the law how to use each, and last but not least when they use the object for a specific usage aim (Net jogtár, 2022).

Germany

New challenges such as globalization, demographic change, changing climate and shortage of resources made it necessary to adapt the policy for spatial development. Regarding its territorial agenda, the objective of the European Union is to consider the different potential and variety of European cities and regions to achieve better realization of the Lisbon and Gothenburg strategy. Recently, a new territorial agenda for Europe 2020 has been agreed (Territorial Agenda of the European Union, 2011).

Germany took this concept on board and developed a new strategy of large-scale responsibility between metropolitan and rural regions. A program was therefore established with various focuses e.g., on infrastructure, supraregional cooperation and site management. Through cooperation and partnership, all regions should be able to improve economic growth and innovation (Bundesministerium des Inneren, 2018).

That means all regions should realize and connect their potential and abilities. Large-scale responsibility also means that strong regions help weaker ones. They should act as a kind of motor and create a climate of friendly responsibility, in which dialogue, learning from each other, and maintaining partnerships on equal terms will lead to large-scale cooperation. From the beginning of 2008 to the middle of 2010 the Federal Ministry of Transport, Building and Urban Development (BMVBS) and the Federal Office for Building and Regional Planning (BBR) supported seven regional pilot regions of supraregional partnership. All pilot regions should be innovative attempts at supraregional partnership.

Through their regionally adapted governance structures and through the involvement of business and science in their decision-making, they live a culture of cooperation that benefits

the entire region across administrative borders and administrative levels. The modern living environment does not always correspond to the historical administrative borders. Metropolitan regions strengthen the necessary cooperation here and promote territorial cohesion. In the update of the models and action strategies for spatial development in Germany, the MKRO confirmed these functions in 2016 and calls for the continuation and intensification of the work at the level of the metropolitan regions. Metropolitan regions initiate joint projects, for example in the areas of economic development, energy transition or transport, and have thus made an important contribution to securing Germany's international competitiveness for over 20 years.

One great example for such cooperation is the work between the city of Berlin and the Regional area of Brandenburg that is surrounding it (Berlin-Brandenburg Land).

The basis of the cooperation is an agreement between the governments of the states of Berlin and Brandenburg on their cooperation and the establishment of a joint coordination council from 1996. The number of joint authorities, courts, offices, institutions as well as international treaties has grown steadily since then. An example of a joint institution is the Joint State Planning Department Berlin-Brandenburg as part of the Berlin Senate Department for Urban Development and Housing and the Brandenburg Ministry for Infrastructure and State Planning.

The overall strategic framework formulates goals for the development of the capital region in this decade, creates a uniform framework for ongoing projects, initiates new projects and strengthens cross-departmental relationships between the projects. The strategic overall framework is intended to further intensify the close cooperation between Berlin and Brandenburg at the different levels of politics and administration as well as between business and associations. With these links, the challenges of digital transformation, the need for skilled workers, the shortage of space can be overcome, and the growth of the entire capital region can be promoted. The overall strategic framework is decided at the regular joint cabinet meetings and controlled by a steering committee at state secretary level – headed by the chancellery.

Czech Republic

In the Czech Republic, waste management is regulated by the Waste Act (Act No. 185/2001 Coll.). It defines the hierarchy of waste management methods, deals with the issue of waste classification according to the Waste Catalog, the obligations of waste generators, waste disposal, or economic instruments. Municipalities as waste generators must fulfil basic obligations in waste management (Tóthová , et al., 2020). They must have a waste sorting system in place at least in the scope of the paper, glass, plastics, biodegradable waste, metals, and hazardous waste. It is also advisable to have electrical equipment collection. Moreover, municipalities issue a generally binding decree, which addresses the system of accumulation, collection, transport, sorting, use, and disposal of municipal waste generated in its cadastral territory. This decree also includes a set amount, which citizens with permanent residence must pay (SMSČR, 2015).

Other objectives regarding waste prevention, landfill reduction, waste recycling, and packaging materials that are legally binding for Czech municipalities are issued by European Commission (EC). In 2018, the EC presented the second package for the circular economy while the first one was issued in 2015 (Soukopová, et al., 2020). The newest action plan of the EU for a circular economy was issued in March 2020. In this document, the European Commission specifically elaborates a relatively wide range of measures that should lead to a real transition to a circular economy throughout Europe. The measures do not focus only on the end of the product cycle, i.e., waste, but on the contrary, are systematically addressed and cover the entire life cycle. A large part of the measures therefore also concerns the sector of production of specific things, but also packaging, product life, materials used, etc. (ČAOH, 2020)

In 2020, new waste legislation was adopted in the Czech Republic. It considers waste separation as a key area and together with the targets for recycling and landfilling taken from EU legislation sets for the Czech municipalities binding targets for waste separation . The new legislation does not longer impose the obligation on municipalities to create Waste Management Plan (WMP). WMP is compiled for the entire Czech Republic and is also created on a regional level. The plan contains an evaluation of the state of waste management, as well as waste prevention measures, objectives, and indicators for evaluating their achievement and, finally, proposals for improving the system. The plan is prepared for at least 5 years. Apart from the WMP of the Czech Republic, other strategic documents focused on

circular, or waste management (elaborated by the Ministry of the Environment) includes the *State Environmental Policy of the Czech Republic 2030* or the *Czech Waste Prevention Program* (Tóthová , et al., 2020).

An important strategic document in this area is *Cirkulární Česko 2040* (Circular Czechia 2040), elaborated in 2021 by the Ministry of the Environment. Individual recommendations and measures aim to change the setting of production so that resources are returned and thus the impact on the environment is minimized. Circular Czechia 2040 should strengthen the competitiveness and technological maturity of the economy, increase the security of supply of raw materials and resistance to various external shocks, develop an overall sustainable social system, and create new jobs (Enviweb, 2021). The document covers ten priority areas, and it no longer focuses only on waste management (only one of the areas), but on the entire cycle of the circular economy. Circular cities and infrastructure are also priority areas.

The transition from waste to circulation strategies, therefore, means focusing on how to return the raw materials contained in waste back to the cycle, i.e., to reuse as much waste as possible. This will reduce the need for landfilling or disposal through landfilling or incineration and will also reduce the consumption of primary raw materials (Tóthová , et al., 2020).

4. International case study overview

Case studies from the Czech Republic

Jihlava

In 2018, the city of Jihlava received a symbolic award (the so-called Waste Oscar) from Arnika (a non-profit organization active in the field of environmental protection) as a city that is an example of good practice (Bednářová, 2019). *"Jihlava is a proof that in big cities, people can produce little waste and sort well. We especially appreciate the long-term effort to minimize waste production, which corresponds to the number and organization of collection points, providing citizens with purposeful information, and even the introduction of a program for self-employed people. As a result, Jihlava is the only city in the country with more than 50,000 inhabitants that throw away less than one hundred and fifty kilograms of waste a year on*

average. This makes it comparable to developed regions in Europe,” comments waste expert Milan Havel from Arnika (Arnika, 2018).

The citizens of Jihlava have three collection yards, a composting plant, where they can store their plant biowaste, and, in addition, a mobile collection of selected types of waste is organized. Citizens also have two opportunities to participate in the *Responsible Waste Management Program*. By participating in this program, they can save on the waste fee. One possibility is a reduction of the frequency of mixed municipal waste collection at the same time as the container for biowaste is allocated. The second option to engage is by use of a special card, which is issued in the name of the registered person and records the number of visits to the collection yard and composting plants. If a person meets the minimum number of visits, he is entitled to a discount on the fee. Moreover, Jihlava provides citizens with the opportunity to buy a composter for their household at a discounted price. Also, the houses in the city monument reservation that are located more than 110 meters from the nearest collection nest are provided with containers for plastic, paper, and biowaste. In Jihlava, we can also find the *Jihlava RE-USE center*, which allows the storage of preserved books, which are then used, for example, in homes for the elderly or in the city library (Bednářová, 2019). The city has been developing its waste management for a long time and conceptually. In 2017, 54 kg of paper, plastics, and glass were sorted per inhabitant in Jihlava, and only 140 kg per capita was exported (Table below). The production of municipal waste in Jihlava was reduced after the introduction of incentive discounts and by expanding the collection of biodegradable waste and reducing the frequency of garbage collection from family houses once every 14 days. The great results are also influenced by the support of small sole traders for sorting. The city informs residents about waste management very carefully on its website www.odpadyjihlavy.cz, where it not only advises what and how to sort, it also informs about the costs of the system and plans for further development (Arnika, 2018).

	2016	2017	2018	2019	2020
kg per person					
paper	28,9	27,3	27,5	28	27,7
plastic	11,6	13,3	14,5	16	17,7

glass	12	13,6	12,5	14,6	15,8
textile	0,2	2,4	2,4	2,2	2,1
metal	16,2	15,6	19,9	18,3	15,2
wood	6,1	7,1	6	5	6,9
biowaste	39,7	44,1	42,6	45,5	49,1
municipal waste	141,4	140,3	144,3	143	144,5
bulk waste	20,8	21,9	21,3	26,6	26,1
Sorted	41,40%	43,20%	43,10%	43,30%	44,10%

Table 1 Production of selected municipal waste in Jihlava. Source: <https://arnika.org/odpady/nase-temata/pro-obce/priklady-dobre-praxe/mesto-jihlava>

Mikulov

Mikulov has had an incentive system with similar PAYT principles since 2013. This ISNO system - intelligent waste management system (provided by company ISNO IT s.r.o.), which was transferred to MESOH (motivační a evidenční systémy pro odpadové hospodářství) in 2019 - incentive and registration systems for waste management.

Participation in the system is voluntary, in 2019, approximately 4,700 citizens (over 60% of the population) participated. The relief calculation is based on the so-called ECO points, which are divided into points for waste sorting, efficient use of containers and bags, and waste reduction points. The first type of ECO points is awarded for sorted waste (paper, plastic, and plastic with beverage cartons). The value of the ECO point is determined according to the total cost savings. The conditions for awarding points are as follows: the containers must have a bar code and cleanliness must be maintained. Furthermore, only half of the points are awarded if the boxes are not unstuck, the bag is not completely full, or the PET bottles are not trampled. The points are also multiplied by the fullness factor of the containers. Detailed conditions are specified in the general binding regulation of the city.

For the other two types of ECO points, it is essential to have a completed questionnaire, to have an account, confirmed site inventory, and have at least one waste container serviced per year. The award of these points depends mainly on the level of waste sorting and the total annual volume of serviced containers. To obtain ECO points for the efficient use of containers

and bags, compliance is assessed by a commitment to sorting biowaste from the kitchen, biowaste from the garden, glass, and textiles. ECO points for waste reduction are derived from the obligation to reduce waste production mentioned in the waste questionnaire (Tóthová , et al., 2020). It is important to mention that the economic impact on the municipalities in Mikulov region using the Incentive waste management system did not significantly differ from the variables calculated for the municipalities without any WM incentive system implemented. Although the income per citizen was slightly decreasing over time, the actual impact on the overall budget was not very different from the compared municipalities without IWMS (Wercholáková, 2022).

Moreover, the city informs citizens about waste sorting news in their city via the website or local newsletter. The city also runs tutorials about sorting and the use of sorted waste at STKO (waste management company) in Mikulov with a tour of the collection yard. The municipality has 72 collection nests and thanks to the use of an individual collection network it has many containers for sorted waste. It also supports using of home composters through information campaigns or MESOH (Tóthová , et al., 2020).

Dolní Poberouní

In a region of Czech Republic called Dolní Poberouní, 16 towns and municipalities joined together and formed an association named *Poberounské odpady*. From July 2022, they will collect waste using their own municipal company called POBERO s.r.o. The aim of this association is to gain more control over its waste management costs. One of the main actors of the union was jointly with other municipalities, also the town of **Černošice** near Prague. Petr Weber, Deputy Mayor of Karlštej and representative of the Poberounské odpady association stresses that payments for waste collection and disposal are constantly increasing, and unfortunately it will continue due to rising costs and fees. As responsible managers, they want to ensure that the impact of rising prices on our municipalities is as small as possible in the future.

Each municipality may continue to have its own frequency of collection system, type of containers and fee structure. The ownership of waste management processes allows municipalities and towns to quickly introduce changes and try out innovations that would be very difficult to enforce and deploy under regular waste management conditions. Similar to

other municipalities, waste represents a major topic for Černošice as well – from the city's point of view, the operational side and costs are demanding, and from the citizens' perspective, there is an intense demand for clean streets free of litter and container collection on-time. The coronavirus pandemic also had an impact on increasing waste production. As the cycle of filling the containers for separates like paper, glass, or plastic changes constantly, it became more difficult for the town to determine the correct collection frequency. These reasons motivated Černošice to install monitoring sensors by Sensoneo (global enterprise-grade smart waste management solution provider) in twenty semi-underground containers, so the small town can remotely verify the fill-level and free capacity in the containers in real-time. In mid-March, the town moved these 20 smart sensors with their own help into twenty 1,100 liter containers for waste monitoring purposes.

In addition to a mobile app, where up-to-date data about the fill level in bins is available to waste management staff straight away, the town also uses an online platform that provides more data, especially practical for the planning of the waste pick-ups. Thanks to POBERO, the town will carry out the waste collection independently, and by using the sensors, the town gains a simple tool for a dynamic waste collection – according to the actual need and through optimal waste collection routes. Semi-underground containers are one of the ways to collect waste within the town aesthetically and practically at the same time, as they are built into the ground, which reduces the smell and slows down the decomposition of waste. Another advantage of semi-underground bins is a large capacity – 5 cubic meters.

The town of Černošice uses various dimensions of semi-underground containers – 5, 3, and 1.5 cubic meters. Soon, the town with a smart city approach plans to further expand its network of semi-underground containers. Together with the replacement of the public collection company with their own municipal collection service organization, these are the two closest planned waste projects in the town (Sensoneo, 2022).



Figure 6 Sensors by Sensoneo Source: [Czech](#)



Figure 5 Source: [Czech municipalities joining forces to](#)

[municipalities joining forces to improve smart waste management \(sensoneo.com\)](#)



Case studies from Central Europe

Concerning the advancement of the application of circular economy activities in European Union countries, new studies were conducted. One research divides the countries of the European Union into two groups in terms of the rate of advancement towards circular economy (Mazur-Wierzbicka, 2021). Countries that promote environmentally friendly activity and apply the concept of the circular economy at the fastest rate include Germany, Belgium, Spain, France, Italy, the Netherlands, and the United Kingdom (Mazur-Wierzbicka, 2021). What's more, POLITICO research shows how EU countries are progressing toward the EU's goals of making economies reuse and recycle more while cutting down on waste, showing the same leading countries (Hervey, 2018). Above mentioned countries have robust recycling systems and high levels of innovation in circular economy sectors. On the other hand, the Czech Republic alongside with rest of the Central and Eastern Europe, as well as the South of

Europe have a slower rate of transition towards the circular economy. Unfortunately, the effectiveness of the countries' development strategies towards circular economy is low. What's more, only a few countries meet the EU standards.

As follows from the study, Slovakia belongs to the group of countries that transit at a lower rate to the circular economy. Furthermore, Slovakia produces more than 2 million tons of municipal waste every year, from which more than half end up in landfills. The goal is to transition away from a linear economy toward a more circular one. Successful initiatives can serve as a tool to bring behavior changes at an individual level as well as on the level of municipalities or local governments. Such initiatives are listed below.

European Union has undertaken a Circular economy action plan in 2020, that "aims to halve the quantity of municipal waste not recycled or prepared for reuse by 2030" (European Commission, 2020). What's more at least 60% of their municipal waste by 2030 must be recycled (European Commission, 2020). Most of the municipalities in central Europe try to convince inhabitants to separate waste with several informational campaigns or other methods of promoting environmentally friendly actions by emphasizing the impact that individual choices have on the environment, for example, recycling. Municipalities sometimes don't create enough incentives for people to change their behavior toward a more sustainable one. Not only that, most of the time residents aren't financially motivated to recycle. In the end, each person pays the same annual fee for waste collection and management whether they recycle or not. However, there is another way to increase the rate of separation considerably. One municipality in Slovakia has introduced a fundamental change which resulted in the growth of the separation rate by more than three times.

Trnava Hora - Slovakia

Trnava Hora is a village located in central Slovakia, in the north-eastern part of the district of Žiar nad Hronom, which is part of the Banská Bystrica Region. The village is quite small, with a population only of 1 216 inhabitants. In 2010 only 14.75 percent of total municipal solid waste was separated in Trnava Hora. Therefore, the percentage of waste separation in 2010 was below average. Trnava Hora has experienced great changes which resulted in the increase of the separation rate. Nowadays, the separation rate is almost 54% (Rojko, 2019).

One change contributed highly to this result. A change in the payment system provided a financial incentive for inhabitants to separate more. Instead of a flat-rate system, they switched to quantitative. Residents no longer pay for the number of household members, but for the amount of waste exported. So, the more they sort, the less money they pay. Separated waste is not charged, only municipal solid waste. How does this system work? Every household has a mandatory number of tokens to buy on a yearly basis. The price of one token is determined according to the volume of the waste container. The household then attaches the token to the trash bin before waste disposal takes place. If a person claims not to produce waste at all and rejects to buy tokens, the municipality then uses its measures to prevent the avoidance of payment. Eventually, the person will have to pay for waste collection and buy mandatory tokens either way. A 4-member household will save about 40 euros due to quantitative waste collection but only if they separate well (Hora, 2018). In 2020, they reduced the number of mandatory tokens purchased, so that even for lower-member households could the system create financial incentive in terms of reduced costs for waste collection. However, there is more to this success. Along with the change in the payment system for waste collection, the municipality also cancelled wild composting and started handing out home composters (Dallosová, 2020). Consequently, two years ago, they established the collection of kitchen waste as one of the leading municipalities in the Slovak Republic that have started it. The kitchen waste ends up in biogas station. Another key step that contributed to this achievement, was the building of a collection yard. In total, 27 types of waste are collected at the yard, which very few municipalities can do. After collection, the municipality tries to reuse what is possible. What is interesting, is that the village can even resell some of these materials, for example, wood is then sold to Zvolen company Kronospan. In the future, they do not expect the separation rate to grow only to maintain the current rate. The municipality now aims to help people with separation that needs it.

The municipality of Trnava Hora received the Golden Ant 2019 award for its complexity of the established waste management system, which was awarded at the DOH International Congress - Waste Management Day. The municipality also received an award in the municipal economy category for its long-term project efforts to intensify waste collection and sorting, thanks to which it increased from 14 to 54 percent from 2014 to 2019 (Dnes 24 Žiar, 2020). To sum up, in Trnava Hora, they built a collection yard, built new stands, abolished wild

composting, but above all, they began to educate the inhabitants and most importantly, reward them for their ecological behaviour. A graph below shows reduced costs because of

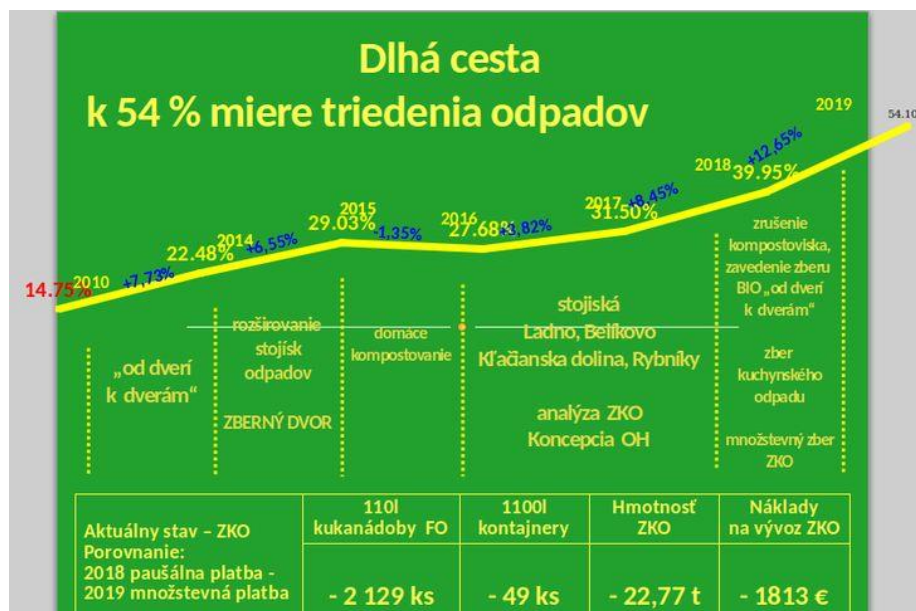


Figure 7 A graph below shows reduced costs because of the change in payment system of 1813 euros for the municipality. Source: urly.it/3p5kw

the change in payment system of 1813 euros for the municipality.

Košeca – Slovakia

The best European waste management project comes from Slovakia. Košeca, is a town in Slovakia, in the district of Ilava with 2606 inhabitants. In April 2019 the municipality introduced **an electronic waste registration and collection system** (Hudec, 2020). The ELWIS waste registration system was awarded as the most innovative project in Europe (Odpady Portal, 2020).

This municipality uses a different system to create financial incentives to motivate people to recycle. The electronic registration system allows a municipality to record the waste production of each household in detail. This applies to both mixed and sorted waste. Based on the volumetric system, they evaluate each household and provide discounts within the framework of a generally binding regulation approved by the municipal council (Hudec, 2020). All households received bags with unique QR codes to separate waste, which they take into

containers. For municipal solid waste, each collection container is marked with a chip. During the collection, the municipality's employees scan the chips and QR codes. According to the amount of sorted waste, the municipality then determines the height of the discount the household receives. In practice, the household is provided with a discount on the volume of the containers that are exported. Its inhabitants only pay for such waste that they cannot sort, and which ends up in a landfill (Odpady Portal, 2020). They use volume conversions. Afterwards, they use the coefficient to convert the volume to weight. At the end of the year, the rate of separation of individual households is evaluated and based on the rate, the fees for waste collection are then determined. The advantage of this system compared to the quantitative payment system is that the municipality determines the discount based on the volume of separated waste and not by the weight of the waste. Another advantage is, that the established ELWIS waste management system is fully automated. Additionally, after waste collection municipality immediately receives a data overview which then can be helpful in terms of administrative tasks that the municipality has in the field of waste management. On the other hand, the disadvantage is that it presents a more technologically demanding process than weighting the waste. As a result, household fees fell by 56 percent in the first year of operation (Odpady Portal, 2020). In 2005 the village achieved only the separation rate of only 2%. With the application of the system, municipality now separates at a rate around 40% In the coming years they will reach 50% and in 2035 the goal is to recycle up to 60% of municipal waste (Himič, 2021).



Figure 8 Source: urly.it/3p5fs

Several initiatives of Košeca preceded before the introduction of the new system. In 2009-2010, municipality created a financial relief for people involved in home composting. Unexpectedly, the results were very positive. Later, in 2008, they reduced the volume of funding for waste management by more than 25 000 euros. This has allowed Košeca not to increase waste charges for the inhabitants. The introduction of collection yard in 2013 brought great changes as well. Over the years, people have learned to use the collection yard and Košeca supported the use with financial concessions. The municipality motivated citizens and showed them that everyone can influence how much they pay for their behavior. All the above, created a way to avoid the automatic raising of fees for citizens. Otherwise, they would need to raise its fees due to increasing landfill fees for the municipality. The mayor of Košeca sees waste management as economically very important part of functioning in municipalities. Thanks to its innovative approach to waste management, Košeca has received several awards. Because of introducing an electronic waste registration and collection system, the municipality earned its the title of Official Act of 2019. (Hudec, 2020). As stated earlier, in 2020, the municipality of Košeca has won the European award *THE INNOVATION IN POLITICS*

AWARDS 2020 in the category *Digitization*, which is awarded by The Innovation in Politics Institute GmbH based in Vienna (Koseca.sk, 2022). The aim of the award is to draw attention to the innovative benefits and positive changes that are changing the lives of Europeans for the better (Koseca.sk, 2022).

Podkowa Leśna – Poland

According to recent studies, rainwater harvesting plays an important role in a circular economy because of its ability to serve as input in production or as a source of energy. Rainwater harvesting has many advantages and can mitigate the effects of environmental crises. With the use of rainwater catchment systems, the cost of damages from floods decreases. Another thing to consider is that water demand could be reduced. On top of that, there is the potential of reducing the cost of production (Espíndola, 2018). Podkowa Leśna is a town in Poland in the Masovian Voivodeship in the Powiat grodziski district in the commune of the same name with approximately 3 837 inhabitants. The town introduced a water management system that is not only complex but also comprehensive. Their program with the name *We Retain All Rainwater* was presented at the European awards *The Innovation in Politics Awards 2020* in the category of Ecology and got to the finalist's round (Innovation in Politics, 2020). The program 'consists of collecting and managing rainwater and snowmelt on-site, for example on the streets and the surrounding areas (Innovation in Politics, 2020). Rainwater goes to the underground tanks or infiltration boxes because of the absorption wells and drainage system. Under the gutters of public buildings are installed rain barrels where the rainwater is collected as well. In the town, different types of roadside retention technologies are used frequently on routes with no traditional rainwater drainage system, for instance, pedestrian routes or local roads.

This solution aims to replenish the groundwater and serve as an anti-flooding measure by restoring the drainage ditches and watercourses in the soil. Therefore, the purpose of this system is to supply groundwater with it. The solution has many advantages. After four years of implementation the results are the following. Firstly, the elimination of flooded areas along with standing water areas. This solution offers a cost-effective measure to reduce costs in the event of flood risk. Secondly, urban greenery thrives due to increased soil moisture and longer water retention in the environment. Thirdly, maintaining the desired level of soil moisture for as long as possible and irrigation of urban trees.



Figure 9: Retention technologies. Source: <https://innovationinpolitics.eu/showroom/project/we-retain-all-rainwater/>

Case studies from Hungary, Slovenia, Croatia, Bulgaria

Theory and practice have always been two different things. The aim in every scenery is that after gaining theoretical knowledge to be able to use it in practice, however it is not always this easy. Different factors affect the people, institutions, government, and countries daily that can make it hundred times more difficult to achieve the wanted goal.

Hungary is a good example for this. With its slowly growing statistics in environmental protection, it must be said that at some point the inhabitants of Hungary could experience some backwardness about the spreading of the correct information concerning the environment. That was not the fault of the people but the fact that the trends were different at times, and it was not that important for the government to care about the Earth that much. The acts about recycling came out more than 10 years ago, however it was not common to see people recycle regularly. The lack of information made it difficult to take care of the

environment for everyone. But even with the trends evolving there are a lot of cases where there is a lack of attention to the environment.

The country develops in small steps, and with time the country will reach the targets. But what do they do that are in favor of the environment now?

One famous and used method of getting the people to recycle is the annual paper collecting in Primary and High schools. But what is paper collection exactly? Every student of the class brings used papers to the class. Everyone collects it for their class, and the company that comes for the papers measures the amount by each class and the students with the biggest number wins.

But why would this be a good deal for the company and for the students? On the company side it is occurring quite clearly that they get a huge amount of paper just in one day. They do not have to go to different collecting sites to pick up the paper. Of course, the most important consequence is to share awareness with the residents, and this helps people to start not throwing out the paper. As a reward, the company pays for the schools depending on how much paper they collected.

There are two systems that are used in the prizing process of the classes. One would be that the class ranked top 3 receives prize money only. The other is when each class receives it, but the amount depends on the rate they collected. These companies figured out this really good way to motivate families. And not just the families are the ones that collect paper, but in a lot of cases, parents bring paper from their workplace, or they receive paper from the neighbors, grandparents also. There are not many better ways to reach this diverse target audience with just one event. They gain the knowledge through the kids, who also can achieve great information on the circular economy.

Next to the missing information about how someone should collect waste in an eco-friendly way, another problem occurred. There was not enough information about the sites where individuals could place their waste for recycling. In other cases, it was experienced that people were lazy or were not able to bring their sacks or waste to the collecting points.

Luckily, as the more important the protection of the Earth became new regulations came to life. In the county of Komárom-Esztergom since 2020 once in every month people living in detached houses could place their recyclable waste into trash bags on the street and the company working with this took them and brought them to recycle. This was a great method

however it still had some flaws. Not many people were informed about it, and it was rather difficult to store 5 or 6 trash bags in the gardens for a month.

In 2021 things changed and every family living in detached houses received a bin for the recyclable plastic and paper. The company now picks up this waste every 2 weeks.

Another way of doing some good for the environment is instead of recycling, you just do not use or buy a product. In Hungary plastic waste is getting minimized as in many other countries. The plastic gloves are removed from the fruit and vegetable isles and shops allow people to weigh fruits and vegetables without a plastic bag. Shops offer reusable bags and options to weigh the goods without any wrapping. This phenomenon is common in big supermarkets such as Interspar. Another example is Tesco at where they agreed to remove one billion pieces of plastic from products by the end of 2020 .

One person can make a bigger impact on the protection of the Earth than we think. In Hungary the density of population is 105 capita per square kilometers, there are a lot of chances where the individuals can make big efforts. For example, in villages and small towns, cities there are several examples where families start to compost biodegradable waste in their garden, or in some cases there are home breed chickens, pigs or even cows, with the help of this a lot of families reach closer to being self-sufficient.

Self-sufficiency not only helps the environment in a way that big companies can produce less food, but also this reduces the amount of plastic packaging as a consequence. In addition to all these factors people can lead a healthier diet. They can consume vegetables, fruits, egg and meat without any addition and people know where the food comes from.

This situation would not be possible in lands that do not have the opportunity to grow these types of plants, fruits or if the climate was not optimal for the animals to live in. Living in Hungary has its perks. Its climate and lands are optimal for agriculture.

Slovenia

‘Ljubljana is the leading European capital on the path to Zero Waste society’ reported the BBC at the end of 2019. Ljubljana was also named European Green Capital in 2016. What is more surprising about this, is that Ljubljana wasn’t developed enough 20 years ago. In pictures we could see piles of rubbish in the city. They made a change no one else was able during the

years. They reached as far as they can recycle 70% of the rubbish in the city. This percent is shockingly impressive, but this should be the followed norm (Republic of Slovenia, 2019).

How did they start this fast and enormous change?

It started when the city's waste management company's (Voka Snaga) lead said, "It takes up space and you're throwing away resources". Separate collection of paper, glass and packaging started in 2002. And just after 4 years they started to collect biodegradable waste door to door. For our information, bio waste separation is only mandatory from 2023 across Europe, but Slovenia was almost two decades ahead of its time. Every household received a bin for paper and packaging waste in 2013 and they cut in half the collecting of residual waste. This was a brave step which forced people to start recycling more efficiently.

They were able to achieve these amazing results because they contributed to the high-tech waste processing technologies used by the Ljubljana Regional Waste Management Centre or RCERO Ljubljana. In this center the organic waste is turned into compost and residual waste is converted into fuel. Addition to this information in Ljubljana only 5% of the waste goes to landfill which is not just a small number but also this 5% does not have any harmful effects on the environment. This number is as little as it leaves less than 60 kilograms of residual waste per inhabitant per year and will reach the number of one inhabitant being able to dispose of less than 30 kilograms of waste by 2025.

In the high technology center, they can generate around 60 thousand tonnes of solid fuel of different calorific values and 7 thousand tons of compost. It can also generate electricity and heat, in numbers specifically 17 thousand megawatt hours from the first and 36 thousand megawatt hours from the second.

The center not only services Ljubljana, but also a quarter of all Slovenia. It uses natural gas to produce its own heat and electricity. The RCERO Ljubljana is so popular, it gets 1000 visits a day, that is why the center is thinking about opening three more sites and 10 smaller sites in denser areas (The-Guardian, 2019).

Croatia

Croatia in 2018 was in the beginning of its transition towards a circular economy. Their planning of waste management was suboptimal, there were insufficient incentives to manage

waste according to the waste hierarchy and there was insufficient separate collection of waste. And in addition to that, the lack of clear allocation and tasks and coordination between the different administrative levels, things were really challenging for the country (Dinkelberg, 2018).

On 29 September 2020, an agreement was signed in Zagreb by the Minister of Economy and Sustainable Development, Tomislav Čorić and the World Bank Country Manager for Croatia, Elisabetta Capannelli. In which the World Bank states that it will provide technical assistance to support the Government of Croatia (The World Bank, 2020). The reason for this agreement was the lagging of Croatia in the case of meeting the EU targets in the circular economy plan. With the help of this assistance Croatia's National Waste Management Plan (NWMP) will be able to approach the European Union Directives and the Circular Economy Package. The program will be financed using the Bank's Reimbursable Advisory Services (RAS) instrument, which offers customized services to middle and high-income countries. The technological capacity was low in the country as well as the financial capacity of municipalities to be able to manage the waste separately. This plan is a 2-year program, and during the process the World Bank will help update the NWMP and provide diagnostic work and make recommendations based on the data they get (The World Bank, 2020).

Another project was also made in Zadar and Lika-Senj counties in 2020. This project covers 8 towns and 33 municipalities which is around 12% of Croatia's surface and the serving population is about 195000 people. They are building a waste management center in which they can produce solid residual fuel (SRF) from mixed municipal waste. This material will be used to make cement in Split, according to the agreement with the cement producer Cemex. Moreover 7500 tonnes of green waste will be composted in a year, and it will also be a site of demolition waste, with a capacity of 15000 tonnes per year (European Commission, 2020).

Bulgaria

To look a little bit further let us examine the situation in Bulgaria. The country joined the European Union in 2007 and it gave them a big turn concerning their waste management economy. The country faced a lot of negative headlines of how their situation was before and why it is not improving in the right amount. The problem why this all happened is far beyond

the waste and it is realized that it is due to the country's limited economic strength compared to other European countries and its lack of capacities in many areas. Bulgaria was not able to meet a lot of targets made by the EU by 2017. Considering 18 evaluation criteria, Bulgaria was placed almost in the last place, only Greece did worse meeting the targets. Even the cities in the country are individually placed in the lower part on the lists. However, they do try to change but the situation makes it difficult (Reichenbach, 2017)

In the early 2010s the country started to import waste from other countries' waste. The logic behind why this happened is easily explained. When someone lives in a developed country, they must correspond to their country's laws of waste management. However, in still developing countries where there are far bigger problems than the waste management, they tend to focus less on the waste. So, the idea that the bigger countries export some waste to smaller countries can be quite easy to occur. And, with this solution the people who are involved in the trade profit from this also than if they exported to some EU country.

They used this opportunity to make waste treatment sites. However not all rubbish can be accepted at each site and there are a lot of examples where they just burnt the already separated and bought waste. (Velina Gospodinova, Nikolay Stoyanov, 2019)

In contrast to all this information, there are several good examples in Bulgaria. Svilengrad is a city with 25000 residents in the southeast part of the country. The city was invited to be part of the Zero Waste City program. The locals had a Zero Waste Advisory Board and they set the aim of the city as zero waste. The city was the first in Bulgaria who started, with the cooperation of the Ecopack, the door to door collecting system. They made a test run that every block of flats has 3 green islands with keys for the residents. As well as installing the same sites in kindergartens so they can start educating children from a very young age. In the city a new compost machine was installed where they can compost 3000 tonnes per year (Evgenia Tasheva, 2019).

Case studies from Germany

Waste management has changed tremendously in comparison to the early days, from mere disposal management to full-blown waste management – a process that constitutes a veritable paradigm shift. In Germany, waste management now aims to conserve natural resources and manage waste in an environmentally sound manner, whereby sustainable

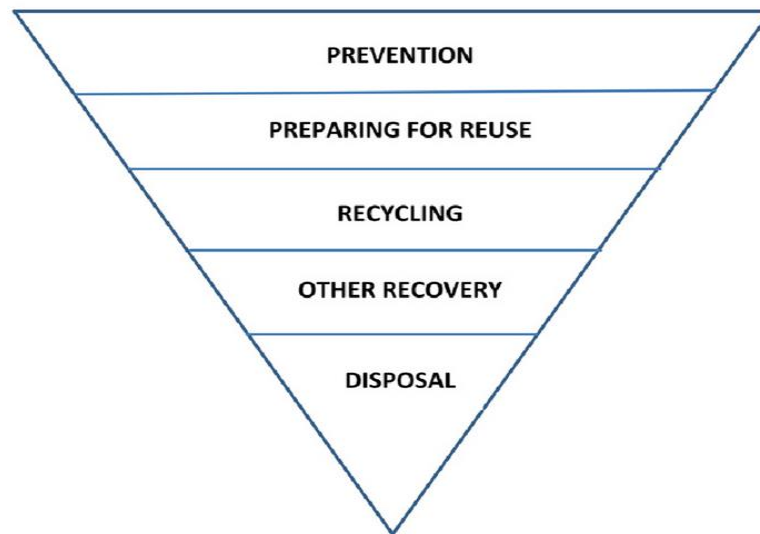


Figure 10 Waste Hierarchy according European and German Law.

(Nelles, 2015)

strengthening of environmental and climate protection measures, as well as resource efficiency, play a key role.

The centerpiece of Germany's Waste Management Act is a five-level waste hierarchy that lays down a fundamental series of steps comprising waste prevention, reduction, recycling, and other elements besides, including energy recovery, and finally waste disposal. In any given instance, the best option from an environmental protection standpoint always takes precedence, whereby ecological, technical, economic, and social effects are to be considered as well. Thus, waste management practices in Germany systematically aim to minimize waste generation and maximize recycling, while at the same time ensuring that the remaining waste is disposed of in a manner consistent with the common welfare.

The various types of waste must be collected separately at source (source separation at the collection point by depositing the various types of waste in separate containers designated for this purpose) to maximize the recycling potential of the various waste streams. Separate collection of the various types of waste is necessary in order to maintain waste-stream specific quality standards for recycling. Under the Waste Management Act, beginning in 2012 separate collection of all the various waste streams comprising paper, glass, plastic, and household organic waste was made mandatory (German-parliament, 2012).

The instrument of product responsibility promulgated by the Waste Management Act defines responsibilities along the product life cycle, as well as incentives for manufacturers to make durable products that generate a minimum amount of waste. The principle of product responsibility is also intended to ensure environmentally sound recovery and disposal of end-of-life goods.

Between 350 and 410 million tons (net) of waste are produced in Germany each year, with construction and demolition waste (including road construction) accounting for 60 percent of this waste, while municipal waste accounts for 14 percent, and hazardous waste for 5 percent (Bundesamt, 2020).

These various waste streams are managed in Germany via several sophisticated waste management methods, whose optimization is promoted and supported by the UBA (Umweltbundesamt/ Federal Environment Agency). These methods entail the use of various waste treatment techniques, depending on the type of waste involved. As much as waste management in Germany is highly advanced from a technological standpoint, the UBA strategically supports knowledge and technology transfer instruments.

In 1994, the Focal Point to the Basel Convention was established in the UBA Basel. The focal point's main task is to issue permits for trans-frontier shipment of waste through Germany, respond to queries, and advise businesses and government agencies (UNEP, 1994). It is also the point of contact for other focal points and correspondents, as well as for the UNEP secretariat and the European Commission.

The measures in Germany's Circular Economy Act focus above all on waste prevention, recycling, and disposal. Extension of the use phase and better resource exploitation within a Circular Economy are currently largely disregarded, however (Acatech, 2021). As a result of

this narrow understanding of a Circular Economy, the measures focus primarily on physically inadequately defined recycling rates and thus on end-of-life solutions. Although the amount of waste recycled or sent for energy recovery as a proven proportion of the waste generated in Germany has been increasing continuously since 2006 and currently amounts to approximately 81 per cent, the total volume of waste generated has also risen, growing in 2018 by the highest amount since the Federal Statistical Office started collecting data in 2006 (Destatis, 2021). The proportion of recycled waste in relation to the total amount of waste generated, however, remained roughly unchanged.

Berlin-Germany

Berlin has started using a concept that would help manage waste better. PAYT (Pay as You Throw) based waste collection system focused on the separate collection of PPW. The waste collection is organized and carried out by the Berliner Stadtreinigungsbetrieben (Berlin municipal cleaning company). This includes the waste materials considered for the so-called Dual Systems (German producer responsibility scheme for the packaging waste): paper, cartons, glass, and light packaging. Glass is collected separately (white, green, brown) and Berlin has 1,467 bring points for glass waste (Senatsverwaltung, 2019). Berlin also employs a PMD (plastic and metal packaging and beverage cartons) commingling method; PMD is collected in yellow shared containers and wheelie bins at 27,600 bring points throughout the city. Additionally, it is possible to get specific household waste bags (6€ per bag) at civic amenity sites, which can be ordered in case of an unusual high amount of waste. Berlin has 15 civic amenity sites. Co-mingled waste is collected using household waste bins ('Hausmülltonne'). There are five different sizes available, which can be ordered depending on the amount of household waste arising in a specific household (varying from 60 – 1100 liters). The frequency of collection is bi-weekly. Berlin also has a deposit scheme; whereby plastic bottles can be returned to machines in exchange for store credit. The first entry point for paper waste is the sorting facility WUB Wertstoff-Union Berlin GmbH, where the collected paper is sorted. Different material types are for example carton board, mixed paper, and de-inking capable paper. During this step, all non-paper material is removed. Plastic waste from the PMD entry point is sorted at the ALBA Recycling GmbH sorting facility, providing the

material to the market for subsequent recycling steps. Glass waste is handled fully by the dual systems (Alba-Group, 2022). The residual waste is sent to one of Berlins' waste incinerators.

In January 2013, Berlin was the first German federal state to introduce a model waste separation strategy, with a single recycling bin for light packaging together with similar materials. A new recycling bin for PMD was introduced in Berlin, uniting the previously separate systems ("Yellow bin", "Yellow bin plus" and "Orange Box") into the Wertstofftonne (recycling bin). In addition to light packaging, these bins are also used to collect equivalent non-packaging waste. Equivalent non- packaging recyclables include objects made of metal and/or plastics, e.g., watering cans, flowerpots, plastic bowls, toys, pots and pans, tools, cutlery, etc.

The municipality of Berlin reported to have generated 169,473 tonnes of paper, 45,000 tonnes of plastic, 14,400 tonnes of metal, 66,830 tonnes of glass and 9,000 tonnes of composite material. Berlin achieved a capture rate of 67%, 40%, 47%, 57% and 18% for these materials respectively (Destatis, 2021). 90% of the material that enters the residual waste is incinerated in Germany. Berlin is currently not meeting the 2025 recycling targets of the European Union for any PPW material. The organization of Berlin's waste collection is complicated due to historic reasons. Collection and sorting are not completely aligned. For instance, some areas collect brown and green glass together and for other areas, these are collected separately. Berlin employs a PET bottle deposit scheme, and it is likely that the collection of plastic is underestimated here.

Case studies from Austria and Switzerland

Austria-Vienna

In Austria, around 80,000 tonnes of WEEE (Waste Electrical and Electronic Equipment) are collected every year; the ARA service group (specifically, the ERA compliance service) accounts for 40% of this amount (ARA, 2021). Every Austrian resident collects around 9.5 kg of WEEE per year. Consumers and businesses can drop off WEEE and used batteries at around

2,100 collection points across the country. Vienna has 16 recycling-centers or “Mistplätze”, 93 mobile collection points and 4 stationary collection points on markets. In addition, people can also return WEEE to retailers/distributors when they purchase a new, equivalent device that fulfills the same functions as the old one, if the shop’s sales area is greater than or equal to 150 m². Batteries can always be returned to vendors free of charge without a need of purchase. Separate WEEE collection is divided among 4 PROs (extended producer responsibility organizations set by producers) operating in the entire country (ERA, UFH, ERP and ISA). The Austrian coordination body is called “Elektroaltgeräte- Koordinierungsstelle Austria GmbH (Austrian Coordination Body for Waste Electrical and Electronic Equipment)” (EAK). The EAK oversees the following tasks (EAK-Austria, 2020):

- Payment of the fixed infrastructure cost payback sum (Infrastrukturkostenpauschale)
- Pick-up coordination from public WEEE collection points (Collection points can indicate a need for a PRO to pick up equipment via the EAK website when they have accumulated a certain amount)
- Yearly planning of public awareness campaigns focused on WEEE
- Information gathering and writing of yearly report on current state of WEEE collection system
- Gathering of numbers and reporting to European central commission

A separate working group (Arbeitsgruppe Öffentlichkeitsarbeit) oversees providing a yearly plan on communication with end-users. They also provide education toolkits, posters, flyers and more. Recycling facilities in Vienna have “Tandler-Boxes” where equipment in functioning condition can be brought and offered for re-use. In addition, there are numerous repair-shops, -activities, - organizations and events all over the city of Vienna. Via an online tool offered by the “Reparatur Netzwerk”, pick-up and return or home repair-service can be requested. The “Reparatur- und Service-Zentrum” has offered its services since 1998. Currently it offers a repair-café, a repair service at home, rent service for equipment and more. It was able to re-use more than 98 tons of equipment and repaired more than 9.000 broken items last year. Collection in larger cities has proven especially difficult due to the anonymity they offer, but the “Demontage und Recycling Zentrum” (DRZ) deserves a special

mention. On top of offering pick-up, repair, and recycling of WEEE, the center has its own upcycling unit and can cover up to 25- 33% of its cost by selling used and redesigned appliances. On top of that, a great part of the dismantling and repair is done by people previously long-term unemployed and, most recently, gives work to refugees. As such, it is also a project with a big positive social impact.

Switzerland

Switzerland tops world rankings for having the highest recycling rates where every citizen is encouraged, through various campaigns, to recycle as much as possible. Switzerland no longer adopts the practice of burying the waste disposal in landfill sites—this means that waste is either recycled to convert them into usable energy or help conserve natural resources. In Switzerland, recycling can be done either through a door-to-door collection or via public facilities such as collection spots near you which can be checked using the Recycling-map. Either way, recycling is mandatory, and failure to do so can result in stiff fines (Swissrecycling, 2022).

Since 2000, the total volume of hazardous waste in Switzerland has been approximately 1.2 million tonnes per year. Hazardous waste thus accounts for about 6 % of all waste. In 2005, 43 % of the hazardous waste was incinerated, 22 % was landfilled after appropriate pretreatment, 23 % underwent chemical/physical treatment and 12 % was directly recycled. Chemical/physical treatment takes place mainly in Switzerland. This approach is applied to polluted wastewater, soil from contaminated site remediation and emulsions. The disposal of hazardous waste, which came into force in 2006, is regulated by the Ordinance on Movements of Waste (VeVA 1) (FOEN, 2019). The objectives concerning the disposal of hazardous waste are as follows: avoid their production, recycle them wherever possible, treat those that are not recyclable so that they can be deposited in landfills in an eco-compatible manner, and dispose of them mainly in Switzerland. The accomplishment of these objectives resulted in the creation of an efficient disposal infrastructure in Switzerland, and the establishment of an infallible legislation on hazardous waste flows. The industry has improved

its management of hazardous waste by taking measures to prevent it and to recycle unavoidable waste more efficiently.

Switzerland has a well-developed network of waste management facilities. Virtually every region possesses the infrastructure required to dispose of its own wastes. This helps to minimize transport costs and vehicle emissions. Since the introduction of the landfilling ban on 1 January 2000, all non-recycled combustible waste in Switzerland must be incinerated in appropriate plants and end up in one of the country's 28 municipal solid waste (MSW) incinerators. Since the plant "Thun MSWI" came on stream in 2004, a total incineration capacity of 3.29 million tonnes has been available in Switzerland. This is sufficient to allow the landfilling of combustible waste to be dispensed with altogether from now on.

Case studies from France

In essence, the circular economy is territorialized because it consists in optimizing and developing the local resources of the territories. The transition to this new economy requires the involvement of all stakeholders (elected officials, businesses, citizens, energy distributors, etc.) at all levels. This facilitates the transversal and systemic vision, a key success factor for circular economy projects. In Brittany, many territorial initiatives are already being implemented to facilitate synergies between companies and local authorities. The actors are asking for more link and decompartmentalization. The role of the Brittany Region with the support of its institutional partners is to structure animation at the territorial level and with companies in order to make connections between all stakeholders emerge. It is an indispensable lever for collaborative circular economy projects (public/private/associative). There is one example of this:

AutoRecyclLAB, From plastic waste to new objects!

AutoRecyclLAB is a mobile and practical workshop for recycling plastic by oneself, «Low tech» and with human energy. AutoRecyclLAB presents plastic recycling techniques (grinding,

injection, molding). Educational, it makes the participants (children, public) actors of the recycling process through manual machines that allow them to manufacture from A to Z a new useful object, playful or decorative, from their «waste» plastics such as plastic caps for containers. The aim is to promote waste reduction, sorting and recycling, while combating waste and promoting local recycling, repair and object creation but also to make it visible through this animation the values of exchange, “doing yourself” and sustainable development. (AutoRecycLab, 2017). France Active Bretagne It is the Breton branch of France Active, an initiative set up in France to finance the creation of social and/or ecological enterprises. The financial resources of France Active are provided by the State and local authorities, they are public funds.

Stations Services - raw material resources from enterprises

Stations services is a raw materials resource center located in the hinterland of Nantes, France since June 2015. It is the heart of a circular economy between the public, creative professionals, associations and businesses of the territory and promotes the «DO IT YOURSELF» in an eco-responsible perspective. The mission is to collect, sort, value materials and objects for: prolong their use, preserve resources, allow anyone to access it, changing practices and perspectives. The collection would happen every week. The recyclers collect the reusable waste from Enterprises and public institutions which is an on-demand service and from private individuals that wants to contribute voluntarily.

Why collect the second materials (remaining production materials which, thanks to upgrading, can be used a second time)?

- Put the second-hand objects at the service of individuals, local creation and the cultural environment while preserving the planet
- Giving access to raw materials to all
- Allowing the reuse of the production waste, industrial waste, etc.
- Build synergies between companies, individuals, creative and sustainable development
- Have an ecological impact, by extending the life cycle of your materials, while saving money.

The idea is to collect many materials and accessories in good condition: all types of wood, metals, plastic objects, textiles, stationery, hardware, tools, etc. All that is part of the fall in production for industrialists. To this end, the organization offers services for the collection of materials and upgrading through reuse (wood, metal, plastics, textiles, paper, furniture, structures, etc.). In line with the activity and it sets up a collection tour.

Part of the production falls is collected, sorted, and valued in the shop located in Rezé (the hinterland of Nantes), accessible to the handymen, creative and student.

Professional furniture can also be collected. These are all furniture used for a professional activity: office, bar, restaurant furniture, hotel furniture, school furniture, hospitals etc. Furniture in good condition is resold, otherwise they are dismantled to recover the parts, recycle them or upgrade them energetically.

Collecting them allows to:

- Give new life to furniture and preserving our planet's natural resources
- To ensure their recycling and to reduce the pollution associated with this waste
- To promote the repair and design of new furniture

The materials and objects collected are presented and sold in the associative shops, to individuals as well as professionals, each shop has its particularity and a different location.

The association supports members in their waste reduction and introduce students, employees, and cultural institutions to waste prevention. Also, the company share sustainable and responsible manufacturing techniques, and it's a support in the cultural entrepreneurship of re-employment.

Also, it offers company interventions to make the employees aware of waste reduction and artistic creation by:

- Team-building workshop on creative re-employment led by professional artists
- Creation of permanent or temporary works from productions

Conferences on ecological and environmental issues, on eco-design

Creation of compost based on school catering bio-waste - Collège of Fontenay

In 2014, Rennes Metropole offered the territory's colleges the opportunity to compost organic waste from half-board, on a voluntary basis. This project is part of the obligation to source sort for large bio-waste producers. The college of Fontenay, in Chartres de Bretagne, volunteered and set up a sorting of biowaste by the students and installed 1 large capacity composter to valorize 7 tons annually. The main environmental benefit lies in the reduction of residual waste. The college uses compost as an amendment for lawns because it does not have beds to use as fertilizer. The introduction of the system, and in particular the weighing of waste, has given rise to the motivation to reduce waste at the source. The capacity the composters had to be assessed by weighing the biowaste generated at the end of the meal. In order to do this and for the action in general, it was necessary to train the students in sorting, via a display and an ambassador of sorting, which was relatively easy. Finally, Stéphane Herlédan, from the technical team, had to acquire technical know-how related to compost maintenance. The town hall of Chartres de Bretagne regularly supplies crushes of branches to balance the compost with the carbon content. The main difficulty was to convince the reluctant people of the usefulness of the project and of the low importance of the nuisances associated with the treatment of bio waste. The project is easy to reproduce because any collective restoration generates a large amount of biodegradable waste that can easily be composted.

Swimming pool heated by datacenters in Paris.

The town of Paris has developed a project of what is a form of circular economy, industrial symbiosis. Industrial symbiosis happens when the outcomes (waste, consequences...) of an activity can be used for another one and vice versa. Like the symbiosis relationships that exist in nature both agents, in this case both companies, industries win by being near the other one.

This is exactly the case of the Butte aux Cailles swimming pool located in the XIII district of Paris. The pool is heated at 20% by a datacentre located right underneath it (Moniteur, 2017). Datacentres produce a lot of heat, and much energy is needed to cool them down. In fact, it is one of the most important costs that they have, the cooling and venting system. The heat produced by the datacentres is normally lost. That's why it is called "chaleur fatale" in French, meaning heat no recoverable. It will no longer be the case, now it will be used at 100% to warm the outdoor swimming pool of Buttes aux Cailles. This project estimated to save 45 tons of CO2 emissions a year. (PERRON, 2017)

The start-up company called Stimergy who is behind this, has developed digital boilers that

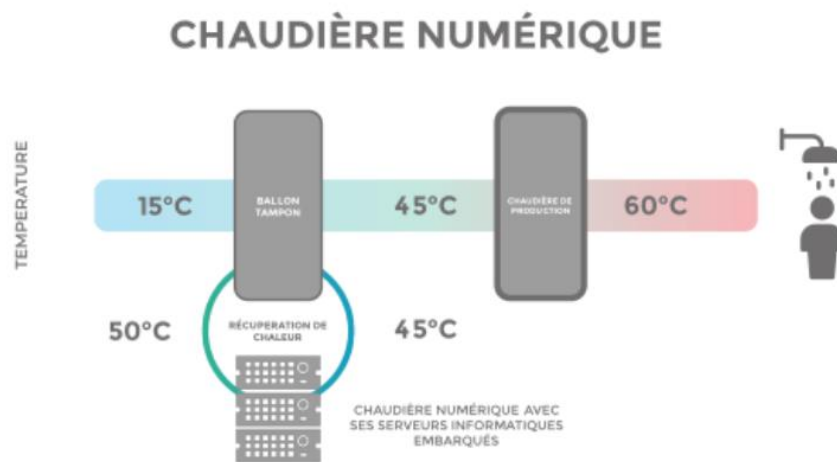


Figure 11 Heat cycle of the numeric heater

recover the “fatale” heat from the datacentres and is used then, for numerous goals. Their main action takes place in collective and service building such as hotels, students’ residencies, or third age houses, but also in pre-heating sanitation water. It covers between 30 and 60% of the needs in energy to heat water, lowering the amount of the energy bill as well as the carbon footprint. Since their creation in 2013, these have been used in other cities around France: Grenoble, Lyon, Lille, Nantes and of course Paris. It offers a greener and more affordable way to heat up water. Plus, they are responsible for the maintenance and exploitation costs during the contract duration of 15 years. A total of 12 installations have been done.

The energy generated from the heat is not only used to heat the water, but it is also used to make the servers run, which can save tremendous amounts of energy. In addition to this it avoids using cooling systems that consume more than 50% of the total energy used to run servers. As described by Neutral-it (Stimergy) their values are based on the synergies and how to better combine and interact for a better use of the resources and energy. It is also a great solution against the augmentation of energy prices. The proposition of Neutral it brings the price down to 50€/MWh. (Neutral-IT, 2022). They also develop other ways such as the heating of the swimming pool by the heat coming from the sewers.

Yoyo and the motivating recycling behavior in France.

Yoyo initiative to achieve 100% recycled plastic in France by 2025. Their functioning model consists of a collaborative model in where individuals and companies are rewarded for sorting and collecting plastic bottles. Their first objective is to double up the rate of plastic recycling in the French cities. Results have shown themselves promising.

It is a rewarding system where there are two types of actors, the so called “coach” and the “sorter”. The coach goal is to collect the bottles in bags, they are given orange yoyo bags in which they collect the bottles and are later rewarded with 25 points for each bag collected. The sorter then earns 125 points. These points can be exchanged for prizes offered by the city such as concert tickets, sport events tickets, museum, pool, public transport...

This small company puts emphasis on the sensibilization of citizens to the importance of recycling for the environment. Specially in the cities where the rate of recycling of plastic bottles is 10% less than the rest of the country, which is at 60%. The French government fixed a goal of 100% rate of recycling plastic bottles by 2025.

The system works like this. The sorters sign up in the application and chose a coach who is generally a neighbor. The coach is then responsible to contact them and set a meeting, he then provides the sorter with a bag (with a serial number on it) and when the bag is full the sorter brings it back to the coach who checks it and must take it to a sending point. The sorter is awarded 125 points and the coach 25 points for each bag. (Ville de Levallois, 2019) The company then ensures the traceability of the bag so that the individual who collected the bottles can see where his bottles are at. The bottles are recycled in the perspective of short circuit, which means that the bottles are recycled as close to the community as possible, keeping the economic flow local. (Veolia, 2018)

The Yoyo initiative searches to accelerate the changes in behavior by daring to compensate the people who don't sort their waste. They managed to increase by 50% the amount of PET plastic recycled during their tests in Bordeaux and Lyon. In addition to this, the sorting is of good quality.

This initiative not only contributes to the recycling of plastic bottles, but it has a double positive effect. They are a factor to social cohesion. The coaches and sorters pass eco-gestures that go far beyond just the recycling of the bottles. It creates a feeling of a community that is ecologically responsible and has an awareness-raising effect in the community. The individual can easily picture themselves in the process being active actors of it and understanding the direct and positive impact that the system has on the well-being of their community. (Barnosky, 2019) It has been shown that motivating a recycling behavior in a community has as consequences as more effective system. After their test in Lyon and Bordeaux, the project

expanded to many communities around France, in Marseille, but also in Levallois, Clichy and Asnières municipalities in the Paris region.

Case studies from Anglophone countries and Benelux GB, IE, US, CA, NL, BE, LU

Two case studies of organizations active in circular economy in Quebec:

Many Quebec businesses and organizations offer products and services that are linked to at least one circular economy strategy. Here are two presentations of these Quebec initiatives.

LA Remise

La Remise, a non-profit solidarity cooperative, was the first tool library to open its doors in Quebec. It took shape in June 2015 in the borough of Villeray, Montreal, which is mobilizing within the neighborhood on environmental issues. The cooperative is run by volunteers, who are members and who ensure the smooth running of operations and activities for the 2,000 members. (La-Remise, 2020)

1. Products, Services and Markets

The Discount offers three types of services. The first is access to a diverse library of tools that members can borrow for up to seven days. This includes tools for carpentry, construction, bike and car mechanics, cooking, gardening, and other uses. The loan is the most popular service and accounts for 50% of the business. The second service is access to workshops, which are available for personal projects (carpentry and cabinetry). Specialists are present on site to advise and accompany members in their projects and when using specialized tools. Finally, the third service is the provision of technical training by specialists who are members of the cooperative (bike mechanics, woodworking, sewing and electronic repair) for members.

To benefit from the services, citizens must become a member for a \$10 registration fee. Then, two types of subscriptions are offered, the first is the annual subscription, which gives unlimited access to the tool library with an annual borrowing limit. The second is the card

subscription, for occasional borrowers, which operates on a points system, where each tool is assigned a score value. Once the points on the card are spent, the co-op member buys a new one so they can continue to borrow. Finally, the cost of access to the workshops varies according to the time of use and the price of the training differs according to the subject, but some are offered free of charge.

La Remise has experienced rapid growth thanks to « word of mouth » within a community concerned with economic and environmental impacts, but also interested in access to creative spaces, thanks also to services that are part of the “DIY (Do It Yourself)” and in the waste reduction movement (zero waste). In addition, the limited space of the apartments makes it difficult to store tools that are rarely used (saws or drills). The clientele consists mainly of young adults living in neighboring.

The concept has created a buzz in other Quebec cities and even in Europe. The Discount provides advice to help others interested in developing a similar service offering. La Remise exchanges its tool lending services for various local projects and is invested in the exchange of expertise with other tool libraries. It may wish to develop partnerships with suppliers of local hardware stores and trade schools in Montreal.

2. Circular Economy Strategy

The services offered by La Remise are part of the circular economy mainly as part of the collaborative economy strategy. The library’s common assets and workshops are made available to members at low cost and the common know-how is valued among members. In this sharing approach, strategies for life extension, maintenance, repair, and replacement of obsolete components are used to preserve assets (tools and others) in functional condition for as long as possible. Most of the tools come from donations from individuals.

Thanks to La Remise, personal activities and projects undertaken by members can in turn be part of circular economy strategies. For example, the co-op found that about half of the wood used in the shop was recovered and reused. Also, some member projects sometimes include rework or reconditioning, for example when they use old furniture to repair or refurbish it.

3. Economic, environmental, and social benefits

The cooperative defines itself as a form of smart and responsible economy, where the borrowing approach takes the place of buying. Its business model has been designed to

operate on a financially self-sustaining basis, so that the cooperative is not dependent on subsidies or other forms of financial assistance. In addition, learning allows members to become self-sufficient and resilient, on a small scale, which can be an economic driver. This social aspect of sharing knowledge, in a meeting place, not only empowers the community, but its values self-fulfillment in manual activities, with a diverse clientele (women and low-income people).

Discount activities reduce the consumption of goods through shared use, optimizing resource efficiency and reducing the environmental footprint from a life-cycle perspective. In addition, the services offered limit planned obsolescence through product repair and access to sustainable products.

4. Stakes

Despite the benefits offered to volunteers, some administrative positions have a high turnover rate among members. These positions are dependent on the availability of volunteer labor. The organization has been working on this issue to find a long-term solution.

It would probably be more difficult to develop such a system outside the more densely populated environments, where the distance to obtain the tools could encourage people to buy their own materials and tools. This initiative thus benefits from the fact that the size of the dwellings limits the possibility of storing personal tools.

Bio-Bean

Since 20 November 2017, iconic buses in the city of London have been powered by 80% diesel fuel and 20% biofuels including oil extracted from the recycling of coffee grounds. The British start-up Bio-Bean collects coffee grounds from bars and restaurants in London and other cities in England and then turns them into oil at its manufacture located 20 km from Cambridge. This coffee oil is then mixed with other green fuels by Argent Energy, a company specializing in biofuel production, then this melting is added to diesel. 6,000 liters of coffee oil have already been extracted, enough to make a bus run for a whole year (if the oil is mixed alone with diesel).

This initiative was made possible by Bio-Bean, a start-up that has been developing for 4 years a process of recycling coffee waste into domestic fuel, in the form of briquettes, for stoves and fireplaces. It was supported by the Anglo-Dutch oil group Shell as part of this project and wishes to position itself as a full green fuel supplier. Coffee oil reduces bus carbon emissions by 10% to 15% without changing the engine or using more fuel.

Circular economy pillar: Reimagining waste as an untapped source

« It's a great example of what you can do when you start thinking of waste as an untapped resource: instead of sending the coffee grounds to the landfill where it releases methane and CO₂, we collect it, recycling and turning it into clean fuel » says Arthur Kay, founder of Bio-Bean.

Londoners consume about two to three cups of coffee per day, resulting in approximately 200,000 tonnes of used grounds. Wet heavy coffee grounds usually end up in general waste in landfills. To reimagine waste, bio-bean work with waste management companies to collect coffee waste process it into oil in its own factory. Coffee grounds are collected at various scales, be it at an independent cafe, a major coffee chain, universities, property groups or instant coffee factories. Bio-bean provides its waste management partners everything necessary to collect the waste such as caddies, refuse sacks, bins and even vehicles. The goal behind partnering with waste management companies was to minimize waste mileage and take advantage of the existing waste management infrastructure.

Recycling coffee equally proves to be beneficial to businesses. Indeed, a landfill tax is imposed on landfill site operators in the UK. Consequently, separating coffee waste from general waste and sending it for recycling can result in significant savings for businesses.

Coffee recycling has its load of environmental benefits. By recycling coffee grounds, bio-bean generates carbon-neutral, advanced biofuels that can replace harmful fossil fuels. Recycling coffee waste also dramatically reduces the quantity of organic material decomposing in landfill sites which represent 22% of methane emissions in the UK. Coffee recycling can thus dramatically reduce CO₂ emissions.

Expanding a network of partners for coffee recycling in the UK:

The initiative of bio-bean to recycle coffee waste to produce biofuel is appealing to various businesses and organizations that are eco-conscious. Costa Coffee, for instance, began its partnership with the company in 2016 and every year, about 3,000 tonnes of coffee grounds are collected from Costa sites across the UK. By doing that, Costa Coffee prevents about 360 tonnes of CO₂ emissions from entering the atmosphere annually. Kahaila Cafe is another small coffee shop in London that partners with bio-bean since 2016, mostly to promote an ethically minded approach to business. For the first year, the shop filled more than 400 bin bags equivalent to two tonnes of waste coffee grounds. The company has seen its costs on waste disposal as well as carbon footprint diminish.

One of the major partners of bio-bean is Network Rail. As thousands of passenger's transits through train stations daily, hundreds of tonnes of coffee waste is produced yearly. Network Rail was previously paying waste management companies to dispose of this waste in landfills. In 2015, it decided to partner with bio-bean to let the latter collect waste coffee in all coffee shops and retail sites in six of the busiest train stations in London. Over 10 millions of coffee cups with 868 tonnes of coffee waste have been collected and recycled. This resulted in £34,000 savings in waste disposal costs.

Catering companies like Vacherin also launched itself into this revolution by vowing to ensure to send zero waste to landfills. Its strategy is to see to it that every type of waste ends up in the most sustainable manner. For the year 2016-2017, approximately 250,000 cups of coffee were recycled, positioning the company as one of the most sustainable catering businesses in the UK. The teahouse and glasshouse restaurant Petersham Nurseries have equally joined the endeavor. Producing one and a half tonnes of coffee waste annually, they decided to opt for recycling them.

Bio-bean went a step further by recycling them into Coffee Logs, a high-performance winter fuel that burns longer and hotter than wood. Organizations such as Eversheds Sutherland also took the initiative to reduce its waste collection costs and help the environment by recycling its coffee waste. As a matter of fact, the large law firm in London creates approximately 500kg of waste coffee grounds as its 800 employees consume about 12,500 cups of coffee monthly. (Bio-Bean, 2022)

Origin of this idea:

Arthur Kay pitched the original idea back in 2012 and won the Mayor of London's Low Carbon Prize before going on to develop bio-bean further. Since then, the team has received extra financial support and office space in Tower Bridge through a scheme for entrepreneurs called the Sirius Program headed up by UK Trade and Investment.

Export the idea: The company is hoping to export the idea and are currently looking into franchising opportunities in Europe and the US, because the bio-bean start-up estimates that its product can reduce bus carbon emissions by 10 to 15% without changing the engine or using more fuel.

Case studies from Italy

Reuse centers

Reuse centers are facilities for the reuse of used goods. They bring back into circulation large volumes of reusable objects provided a certain level of integration with waste management (in terms of reuse and preparation for reuse). Although reuse centers are often the subject of specific policies in the Regional Waste Management Plans, there is still no real legal definition

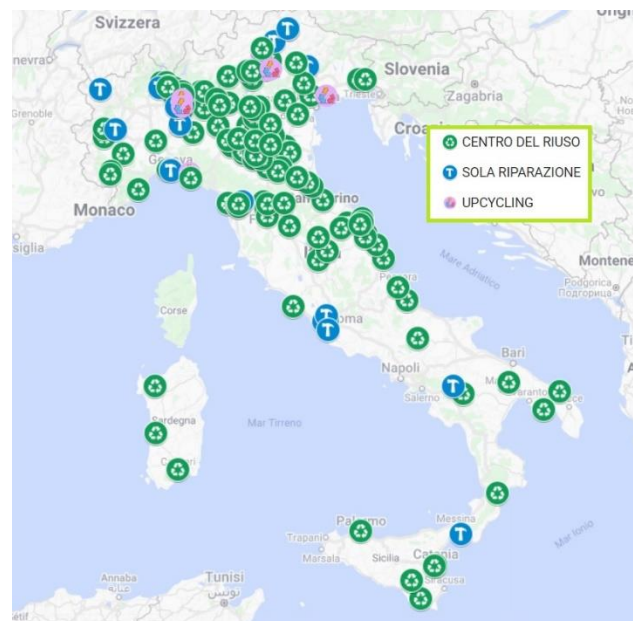


Figure 12 Map of Reuse and/or Repair and Upcycling

Centres in Italy. Source url.it/3nj06

for them, which makes it very difficult to distinguish them from other activities on the territory, such as a second-hand shop or a Charity center.

It is common to identify as a reuse center a place next to a municipal collection center where used goods are intercepted and distributed to prevent them from becoming waste earlier.

Danilo Boni and Maurizio Bertinelli, with the support of the Zero Waste Research Centre of Capannori in Tuscany and Zero Waste Italy, started a national census of reuse and/or repair centres. So far 95 centres have been surveyed, of which more than half (52.1%) are located in three regions (Lombardy, with 23.4% of centres, Emilia-Romagna with 18.1% and Tuscany 10.6%). Most of the centres were established after 2010.

The study also investigated the main motivation for setting up the centers. For about half of the centers (48.9%), the motivation is exclusively environmental: to reduce waste by promoting reuse. For 36.2%, the birth of the centers is related to both environmental and social motives (employment of disadvantaged people or giving goods to people in need). For 11.7% of the centers, the motivation is mainly social, and for a very small proportion the motivation is funding. The link between environmental and social aims is also confirmed by the nature of the center management, mainly social cooperatives (30.9%), local associations (29.8%) and volunteers (21.3%). As regards the structure, in 51.6% it is owned by the municipality, in the remaining cases by a private company. The main operations carried out in these centers are furniture restoration, household appliances repair, bike repair and tailoring. In 31% of cases no repair operations are carried out in the center.

The census also looked at the response of citizens, which was positive in more than 70% of cases.

Reuse centers remain one of the options in the hands of the municipal waste collection company and continue to be seen essentially as an alternative to disposal, almost always supported by social initiatives. These facilities are in no way comparable to those intended for repair and/or regeneration activities (with facilities equipped with equipment and machinery), as is the case especially in the automotive or household appliance sectors. Even ministerial decree no. 99 of 2008 (which tried to define the more operational aspects of the centers) states that 'no disassembly operations of bulky waste and electrical and electronic equipment may be carried out inside the collection center'. This limitation comes from an entirely internal circuit within the waste world, contrary to repair factories that operate

completely outside the Environmental Act. These regulatory loopholes leave too much space for uncertainty, mainly in the definition of the exact boundary between reuse and preparation for reuse. The distinction falls to the holder of the good, the true arbiter of the fate of the waste or non-waste status (under Art. 183 of Legislative Decree 152/2006). Therefore, reuse centers that reside in the same area as the classic collection center/ecological island, must provide different entrances and different procedures. According to Boni and Bertinelli's census, about 40% of re-use centers are next to the collection center.

The study also investigated the annual revenue, which for 65% of the centers turned out to be less than 10,000 euros and for 21.3% more than 20,000 euros, and the way in which the items are sold. In 34% of the centers a donation is requested, in 23.5% of the cases the goods are sold free of charge and in 20% there is both donation and free of charge. Thus, it turns out that more than 50% of the reuse centers do not give the goods for free but neither do they formally sell them. Goods are given in exchange for an economic consideration which, in practice, seems to be black trading. A phenomenon that the President of the Eco-mafia Commission Stefano Vignaroli has publicly denounced, remarking that, if its dimensions remain microscopic, it probably does not produce negative effects. But if the practice of disposing of goods does not change, the situation could become disastrous soon: the proliferation of reuse centers would in fact generate huge flows of submerged economy linked to goods taken away from waste disposal, and this would incentivize criminal organizations to create hoarding and illicit management mechanisms like those structured with second-hand clothes. Some centers, on the other hand, provide for the sale, evidenced by a tax receipt, of the goods (6% of centers) or for both free transfer and sale (3.5% of cases). On the political front, the situation in Emilia-Romagna is interesting. Regional law no. 16 of 5 October 2015 on the circular economy promotes the diffusion of reuse centers, also in synergy with waste collection centers, and the organization of a regional network of such centers to promote communication and the mutual exchange of experiences and skills. The promotion of reuse centers is also among the measures included in the Regional Waste Prevention Program, and the Guidelines for the operation of municipal reuse centers, issued in application of the regional law, delegate to the municipality the decision on possible tariff reductions based on the quantities of used goods delivered to the center. At the same time, they open a window for the exercise of purely economic activities: in fact, the Municipality

can provide for the management of the reuse center directly through its own facilities or by entrusting the service to an external subject, organizing the service according to criteria of efficiency and economy.

In Vicenza, in the Veneto region, on the other hand, there is the largest reuse center in Italy, which is also an important formation center on environmental issues and a social aggregation pole. One of the main merits of this experience is having initiated a dialogue with local institutions in order to arrive at a definition of 'preparation for reuse' activities, in a participatory and constructive logic. The cooperative that is managing it, which has been active in this sector since 1979, employs about 200 people, half of them assisted by the social services.

A first reuse center is active in Cagliari from 2021. It has been opened by the Municipality of Cagliari and the management has been entrusted to the company managing the integrated urban hygiene services. While in June 2022, a new waste disposal area will be inaugurated with a green space dedicated to the second life of abandoned but reusable goods that will be made available to citizens. This new reuse center is in an area, originally owned by the Region, which had been used as an illegal dump. The project was developed with the goal of increasing the population's consciousness of the concept of 'waste'. In fact, the facility will be linked to the city by means of a large green area with plants and street furniture, with the goal of making it a place that is more similar to a small neighborhood park, capable of bringing "ethical and environmental values through the use of materials deriving from recycling and/or processing waste, in any case from actions that are fundamental in the process of sustainability and attention to the concept of waste through care and attention to the philosophy of 'reuse'.

ZeroC

Separate collection has a primary role in circular waste management: on the one hand, it makes it possible to reduce pressure on landfills and the resulting gas emissions from them, and on the other hand, it enables all materials that can be given a second life to be efficiently processed and valorized.

In Italy, an overall improvement in separate waste collection can be observed: in 2020 it covered as much as 63% of the waste produced. In particular, OFMSW - made up of the wet fraction from kitchens and refectories (68.4%), biodegradable waste from garden and park maintenance (27.1%), waste sent for home composting (3.8%) and waste collected from markets (0.7%) - accounts for 39.3% of differentiated waste and is confirmed year after year not only as the most collected fraction in Italy (with an annual increase of 5.6% over the last 10 years), but also the largest portion of waste sent for recycling (43.2%). (ISPRA, 2022)

Proper separate collection of OFMSW is crucial to improve the transformation of organic waste into compost or products with high added value. This is also why new regulations, both on a European and national scale, aim to improve the collection processes for wet waste.

As of 1 January 2022, Legislative Decree 116/2020 stipulates the obligation of separate collection of the wet fraction in all Italian municipalities. This is a measure that transposes the European directive 2018/851 on waste into Italian law, anticipating by two years the entry into force of a similar commitment that will only be introduced in the rest of the European Union at the beginning of 2024.

The obligatory collection of OFMSW by appropriate methods will make it possible to reduce the frequency of collection of mixed waste while decreasing the fermentability of non-recyclable residual waste and will make it possible to solve the problem of the presence of plastic materials at organic waste treatment plants. In fact, certified compostable bags will fully enter the recycling processes of OFMSW as they suffer the same fate as organic waste and do not release plastic contaminants into the soil.

Today, the most common biological treatment methods of OFMSW are composting and anaerobic digestion, used to produce compost and biogas respectively. In Italy, the organic fraction collected through separate waste collection is transformed through composting (48.1%), integrated anaerobic treatment (46.8%), and anaerobic digestion (5.1%). Due to the low economic value of the product obtained and the limited reduction in waste volumes, anaerobic digestion is, however, often preferred to composting. Anaerobic digestion is a more cost-effective treatment method due to its high energy recovery potential and reduced environmental impact. Anaerobic digestion consists of a complex biological process by which organic matter is transformed into biological methane gas (commonly known as 'biogas') consisting of methane and carbon dioxide. The biogas produced represents a valuable source

of renewable energy and can be used for both heat and electricity production. Further, the liquid waste fraction can be subjected to appropriate aerobic treatment to produce compost, thus representing a valuable by-product. Besides the many benefits in terms of energy production, anaerobic digestion of organic waste is also advantageous with respect to the problem of odor and pollutant emissions. The odorous substances resulting from the process are, in fact, sent to combustion.

The production of energy and heat from recovered waste can be considered in the context of a circular ecological transition because it valorizes the so-called secondary raw materials, i.e., materials from recycling processes, to introduce them into the economic system as new raw materials.

In this context, the BioPlatform managed by ZeroC is a unique circular economy project on a national and European level: starting with the reconversion of two biodigesters in the existing waste-to-energy plant and the wastewater treatment plant, it will be possible to start up two production lines that will make it possible to valorize both the OFMSW collected in the project's member municipalities and the waste sludge produced by the CAP Group's water treatment plants.

ZeroC is a totally public company founded to support the transition to a circular economy in the metropolitan city of Milan.

ZeroC's partners are the CAP Group, manager of the water service for the Milan metropolitan city, and the municipalities of Cinisello Balsamo, Cologno Monzese, Cormano, Pioltello, Segrate and Sesto San Giovanni.

The fusion of the existing waste-to-energy plant and the water treatment plant, which is already equipped with two biodigesters, will make it possible to convert the area into a green and highly innovative site, unique in Italy.

The new facility will include two production lines: the first will be dedicated to the treatment of sludge from water depuration to produce thermal energy and fertilizers; the second will be anaerobic digestion for the treatment of wet waste (OFMSW) to produce biomethane. The work will have a minimal impact on the territory thanks to the reduction of odors and emissions, the reuse of materials, and the production of clean energy. In fact, an average reduction in emissions (NO_x , dust, TPC, CO, HCl, SO_2 , NH_3) and a decrease in flue gases of about 80% is expected.

While the carbon emitted in the sludge incineration will be equivalent to that 'sequestered' from the environment by the organic waste and treated sludge, thus allowing the platform to be carbon neutral (because it has 0 CO₂ emissions of fossil origin).

According to circular economy principles, the energy produced from waste treatment (sludge and OFMSW) will be totally green:

- Biomethane from anaerobic digestion.
- High-quality fertilizers from anaerobic digestion.
- Heat generated from the purification process and sludge incineration.

While the water purified will be recovered and reused for irrigation of parks as well as for industrial uses.

The start-up of the plant will not only allow organic matter (sludge and waste) to be recovered and transformed into energy but will also provide a strong boost to separate waste collection, bringing environmental and economic benefits to the area. The BioPlatform has been awarded a EUR 2.5 million grant thanks to the European Horizon 2020 Circular Biocarbon project, which will be implemented to obtain high value-added products, ready for marketing. A virtuous cycle capable of maximizing urban wet waste streams, taking a further step forward compared to classical anaerobic digestion and composting systems.

Next to the plant there are planned the construction of a reconstructed wetland area together with a nature trail; a cycle-pedestrian track that will connect the green areas and the new park to the north of the plant with the cycle-pedestrian track to the south along the Martesana Canal; the recovery of the external areas of the current municipal ecological island as green spaces; the reorganization of the green areas inside the Bio-Platform; and the strengthening of the flue gas filtration system to further reduce emissions.

The thermo-plant, the first production line, will valorize 65,000 tonnes/year of wet sludge equal to 14,100 tonnes/year of sludge produced by the CAP Group's sewage treatment plants, generating: 11,120 MWh/year of heat for district heating and phosphorous as fertilizer. The goal is to recover, in one year, material for: 75% energy and 25% fertilizer

The second production line, the sludge line, will treat 30,000 tonnes/year of wet waste (OFMSW) for the production of biomethane. This line will currently serve five municipalities

in the Milan hinterland: Sesto San Giovanni, Pioltello, Cormano, Segrate and Cologno Monzese.

The first line of the BioPlatform (the one dedicated to OFMSW) will go into operation in autumn 2022, the second (sludge) in spring 2023.

Furthermore, BioPlatform will not only reduce emissions by 80 per cent compared to the current levels but will also enable the activation of continuous monitoring plans for air, water and certain health aspects agreed with the citizens who participated in the participatory process.

It is also planned to reduce plant-related traffic related to waste or sludge transports, suppliers or third parties in general by 25% compared to the current plant. Not only that, but the vehicles that will carry out these transports will have the possibility of being fueled with zero fossil fuels such as biomethane.

The Circular Biocarbon project, mentioned earlier, is coordinated by the global environmental services company URBASER involving 11 partners from five European countries (Spain, Italy, Denmark, France, and Germany) and has received a contribution of more than 14 million of euros through the European Union's Horizon 2020 Program under the Call "BBI2020.SO1.F1 - Valorize the organic fraction of municipal solid waste through an integrated biorefinery at commercial level".

Zaragoza for Spain and Sesto San Giovanni for Italy will be the cities that will start innovative Circular Biocarbon plants as early as 2022.

The project will have a duration of 5 years during which the partners will have to:

- adapt existing waste treatment plants and support their transformation into integrated biorefineries.
- demonstrate on an industrial scale the feasibility of producing high added-value materials from solid fractions and make fertilizer formulations enriched with algae-derived bio stimulants.
- demonstrate on an industrial scale the production of high value-added materials from biogas (carbon-based products and diamond-like coatings).
- produce PHAs (Polyhydroxyalkanoates) from OFMSW and use them for the formulation of biodegradable and compostable bioplastics.
- demonstrate the feasibility of scaling up a microalgae production unit, capable of recovering CO₂ from biogas and nutrients from digestate.

- integrate technologies and processes into a functioning biorefinery to demonstrate the technical and economic feasibility of the concept and progress towards future replication.
- create awareness of the opportunities associated with the valorization of municipal waste to obtain market-ready products with high added value.

The 'La Filippa' landfill

La Filippa is a new generation, sustainable and certified landfill in Cairo Montenotte, a municipality in the Province of Savona. It is located on a site where a clay quarry was opened 50 years ago.

It is the result of the idea of two entrepreneurs, brothers Massimo and Carlo Vaccari, who thought of "a landfill that should neither pollute nor annoy, but should add environmental value to the area, guaranteeing its future usability".

The 4Rs (Reduce, Reuse, Recycle, Recover) at the basis of the circular economy still generate a fraction of waste that cannot be valorized, which must necessarily be disposed of this is the type of waste that is disposed of at La Filippa.

This is a new generation landfill for non-hazardous and non-putrescible waste, pursuant to Legislative Decree 36/2003. The main activity is the filling of the available space with waste assessed as suitable in accordance with regulations and the management model adopted. As the spaces are filled, the final landscaping of the area is carried out with topsoil, greening, planting and finally the creation of equipped green areas.

The waste allowed consists mainly of inert waste, excavated soil, water treatment sludge and waste from common non-recoverable materials such as rubber, plastic, paper, textiles, and glass.

All the waste disposed of is produced in Italy and more than 95% from Liguria.

La Filippa has an Environmental Management System (with which it has voluntarily equipped itself) that meets the strictest international standards, is certified, and constantly monitored by third parties. This system is divided into 3 phases:

1. The preliminary verification of the suitability of the client and the conformity of the waste with the company's management model.

2. The definition of the offer to the customer, articulated by contractual clauses that protect La Filippa and allow broad discretion on the acceptance of each individual load of waste.
3. The technical phase, i.e., the homologation of each specific waste, is activated after the customer's acceptance of the offer. The waste is characterized by the preparation of specific technical documentation that, in accordance with the law, constitutes the identity card of the waste itself, supported by the relevant certificates of analysis from specialized laboratories and from photographic representations.

In order to allow the public administration to guarantee citizens maximum transparency, La Filippa has voluntarily submitted, since the beginning of its activity, to a supervisory commission instituted by the municipality of Cairo Montenotte, which has free access to the plant and company archives. Observance of legal requirements and of obligations to safeguard health and the environment is also protected by economic guarantees that La Filippa has provided before the beginning of its activity.

As previously mentioned, only non-hazardous and non-putrescible waste is treated at La Filippa, so there are no environmentally significant biogas emissions, and leachate is reduced to rainwater running through the waste. This leachate is collected and sent with the municipal effluents to the wastewater treatment plant.

Some data:

- Start of disposal activities: 6 March 2008.
- Non-hazardous waste disposed of as of December 2021: 1,283,000 t. circa.
- Investments in information and communication and in initiatives and projects for the benefit of the local community as at 31/12/2021: €2,553,231.73
- Approximately sixty annual quality control monitoring of air, soil and water.
- These controls will continue after the plant's closure and are guaranteed by the allocation of an economic reserve of more than 9 million Euros.
- Closure is planned for 2030.

The plant's relationship with the community

Since the beginning of its activities, the company has paid almost 12 million of euros in service charges and special taxes to the public administration, while more than 2.5 million of euros have been spent on initiatives and projects for the local community.

Some of the projects are:

- Il Prato delle Ferrere (The Ferrere meadow)

It is a public equipped park, opened in 2010. It is located in an area a short distance from the company where there was previously an uncultivated and abandoned field. It receives constant maintenance from La Filippa, which, over the years, has renovated and extended it (2017) and replaced outdated children's games and added new ones (2019).

- Il Giardino di Casa (The Home Garden)

An old industrial site, previously used as a car park, has been requalified by La Filippa and transformed into an equipped green space according to the principles of reuse, redevelopment and enhancement of the area, inclusion, shared value, and social function.

Case studies from Portugal, Greece, Spain

Case study from Portugal: Pacto Português para os Plásticos (The Portuguese Plastics Pact)

Launched in February 2020, the Pacto Português para os Plásticos (Portuguese Covenant for Plastics) is led by Smart Waste Portugal, with the support of the Ministry of Environment and Climate Action, the Ministry of the Sea, the Ministry of Economy and Digital Transition, under the High Patronage of the President of the Republic and with the support of the Ellen MacArthur Foundation's Plastic Pact Network. The Portuguese Plastics Pact is a collaborative platform that aims to create a compromise between different actors in the national plastics value chain, including the government, universities, and NGOs, setting ambitious targets for 2025, including:

1. Defining, by the end of 2020, a list of single-use plastic items deemed problematic or unnecessary, and determining measures for their elimination, through redesign, innovation or alternative delivery models (re-use);
2. Ensuring that 100% of plastic packaging is reusable, recyclable, or compostable;
3. Effectively recycling 70% or higher of plastic packaging by increasing collection.
4. Incorporating on average 30% recycled plastic into new plastic packaging.
5. Promoting awareness and educational activities to consumers (current and future) for the circular use of plastics.

This is a more ambitious and broader initiative than many others because:

- It includes all stages of the plastics value chain, including design, production, retail, use, collection, sorting, recycling and recovery.
- Covers all plastic and single-use plastic packaging (all shapes, all polymers).
- It presents ambitious and timely targets reflecting all steps of circularity, including targets for the incorporation of recycled content.
- It involves representatives of the plastic packaging value chain, public and private bodies, associations and non-governmental organizations and representatives of the academic world.

Currently, the Portuguese Plastics Pact has 97 effective and institutional members from different steps of the plastics value chain, including companies such as Cerealis, Coca Cola, Lidl, and Nestlé Portugal.

The Smart Waste Portugal (SWP) Association was founded in 2015 by the main Portuguese entities related to waste, from industry and from the academic world, in order to coordinate and promote the national strategy for the sector, promoting cooperation, internationalization and business of its members. Since its foundation, the association has grown exponentially and is currently recognized nationally and internationally as the main representative entity of the Portuguese business strategy for the circular economy.

Case study from Greece: A2UFood

This project was developed in the city of Heraklion, which is the fourth largest city in Greece, the largest in Crete and its administrative capital. The city has 140730 inhabitants while the metropolitan area has 173993, according to the 2011 census. The average economic situation of the inhabitants is relatively good, being in the middle range of all regions of Greece in terms of poverty. With the economic crisis, the at-risk-of-poverty rate in Heraklion Prefecture increased reaching 25.5%-26.8 % in 2011. (Artelaris & Kandyliis, 2014). In the EU, an estimated 20 % of the total produced food is lost or wasted, while 55 million people cannot afford a quality meal every other day.

A2UFood is a project in which collaborate the City of Heraklion, United Association of Solid Waste Management in Crete, ENVIROPLAN S.A., University of Crete, Technological Educational Institute of Crete, Harokopio University and University of Stuttgart.

A holistic management scheme is proposed in which all aspects of food waste reduction, reuse and recycling are included. Specifically, a series of complementary project actions aims in the reduction of avoidable food waste, the use of unavoidable food waste as raw materials and the proper management of unavoidable food waste. In the core of A2UFood is the entire water and food production process (hotels, restaurants, and households). To realize the proposed solution, a series of innovative tools were designed and implemented:

- software to support families in reducing avoidable food waste.
- software and hardware for reducing avoidable food waste in the hospitality sector.
- a Second Opportunity food restaurant (i.e., a restaurant that redirects surplus food to meals for people in need);
- a bioplastic production system for the production of compostable bags.
- a range of state-of-the-art Autonomous Composting Units (ACUs) where treatment will take place on site.

A2Ufood aims to reduce food waste by 1% in households and 2%-3% in the hospitality sector. In addition, 1,000 tonnes or 2.5% of unavoidable food waste for the municipality of Heraklion will be diverted to composting each year.

The project started in March 2018. In September of the same year, information campaigns begin, the Second Opportunity Restaurant is authorized, and an analysis of the production and collection of food waste from accommodation units is completed. 100 households are selected to participate in home composting actions. In February 2019, ACU and home composting suppliers and contractors are selected. The Second Opportunity restaurant and bioplastic unit are built and equipped. In August 2020, A2UFood is in its operational phase and all infrastructure is operational. February 2021: at the end of the project, the information campaign has been completed and the final versions of the software and hardware developed as part of the project are available. The life cycle analysis and other cost-benefit assessments of A2UFood have been completed and the concept is ready to be expanded and adopted by other municipalities. The project was significantly impacted by the Covid-19 pandemic, increasing delays that justified an extension of its duration. The plans and tender documents for the Second Opportunity Restaurant were prepared, but had to be revised again, following requests from the Regional Decentralized Authority, before being approved. The revisions are

being finalized. Thus, the time schedule for its construction and operation (9 months planned in total) is extremely tight.

The goals:

- The Second Chance restaurant will serve over 10,000 portions of high-quality food to citizens in need.
- 50-70 bins were set up for food waste that is unavoidable in hospitality facilities.
- 100 home composting units have been set up.
- 250 tonnes of high-quality compost distributed annually to home and public gardens.
- 25,000 Heraklion citizens informed, trained and ready to adopt food waste reduction strategies in their daily routine.

Case study from Spain: TropaVerde and RECICLOS

TropaVerde and RECICLOS are two projects based on the same principle: to provide incentives for recycling. While RECICLOS is specific to cans and plastic bottles, TropaVerde covers all types of waste.

TropaVerde

TropaVerde was founded in Santiago de Compostela, Spain, in 2015 and seeks to encourage environmentally responsible behavior. It is a URBACT network covering at least six locations: Guimarães (PT), Zuglo (HU), Opole (PL), Nice (FR) and Pavlos Melas (EL). In Spain, it has spread beyond the city in which it began.

Its goal is to promote recycling by rewarding environmentally friendly practices. People earn 'recycling vouchers' by delivering recyclable waste to specific collection points in the city. The voucher is good for a certain number of 'points', which build up in each person's online account on a platform. They can then be exchanged for discounts and gifts on that platform. Local sponsors provide the rewards.

The initiative follows the logic of offering rewards in exchange for good behavior to encourage participation. Rewards include free hotel stays and beauty treatments. Above all, the initiative raises people's awareness of recycling and familiarizes them with the act of recycling itself.

On the tropaverde.org website, it is possible to find the places where citizens can deposit their waste and where they will be rewarded with vouchers by TropaVerde and the local sponsors offering rewards and/or discounts.

In the first two years of the initiative, more than 800 prizes were awarded with the help of more than 115 local sponsors.

TropaVerde also started to organize promotional activities such as workshops and street events. For example, its school campaigns collected used cooking oil for recycling.

RECICLOS

Blue Room Innovation co-created the RECICLOS project with Ecoembes, a non-profit association that manages the recycling of plastic containers, cans, tetrabriks, paper and cardboard in Spain.

RECICLOS provides incentives for recycling cans and plastic beverage bottles. Its main goal is to increase and improve the recycling of these items by introducing rewards that motivate people to do it. When people recycle using the RECICLOS app, they receive points that can be exchanged for sustainable rewards or used to support local projects.

The project started in 2019 with the first pilot scheme in the Pla de l'Estany region (Girona). The first prototype app and an incentive strategy were created, and a communication campaign developed. The project has now expanded to more than 60 municipalities. In 2021, Blue Room Innovation continued to develop RECICLOS and devised ways to improve the use of the app, including new reward dynamics and functional changes.

In 2022, the aim is to create a platform linking municipal actors and the plastic waste process to show what happens to packaging.

How does RECICLOS work? You download the app to your smartphone and create a profile. You scan the barcodes of the cans or plastic bottles you consume and deposit them in the yellow container or in the RECICLOS machines. For each item deposited in a container or machine, you will get 1 RECICLOS. RECICLOS can be exchanged to win prizes or can be donated to social and environmental projects. The system is basically based on a deposit return system. More than 3000 extractions have been made and prizes including electric scooters, tablets and bicycles have been won.

In the last four years, RECICLOS has expanded to cover more than 60 municipalities in Spain, reaching 3.5 million people. There are more than 130 RECICLOS machines installed in railway stations, shopping centers and markets.

In 2022, RECICLOS will start to be connected to smart containers and door-to-door systems. These applications represent a big step towards the deployment of RECICLOS in all regions and collection models.

Data show that the project increases the amount of plastic collected: in Sant Boi de Llobregat, a Catalan municipality of 82142 inhabitants, the project has increased the tonnes of packaging (cans and plastic bottles) selectively collected by 25%. 3,000 people are users of the mobile application Reciclos in Sant Boi (15% of households) and the 295 packaging containers in the town already use this technology.

Summary

It's clear for the reader that Europe is putting in a lot of work to shift from the era of Waste disposal and concentrate on Waste management instead. They integrated that topic in the European law. In that way, they organized the methods and the processes to deal with waste. The idea is to extract as much value as possible out of the waste before thinking about disposing it. One of the methods that helped maximize recycling behavior and minimized waste generation was creating the system of waste separation using separate containers for plastic, paper, organic waste, electronic waste and glass. Then comes private companies in place that collect, treat and recycle waste and then resell the refined or refurbished products to consumers. The last stage for the remains of waste that can't be used is incineration. Through incineration, energy can be eco-friendly produced, and this helps with the overall supply of energy in the country. It's also worth mentioning that the efficiency of incineration cites leads to a decrease in landfilling cites and not so eco-friendly methods.

Medium and smaller municipalities in the Czech Republic came up with some inspirational waste management systems. These mostly motivate the citizens to reduce the waste and sort it as much as possible in exchange for the fee reduction. The MESOH system which is used in several towns in the Mikulov region has proven to be very effective from an environmental

perspective. Regarding the economic impact, there were not observed significant differences when compared to the towns using non-incentive WMS. As a response to the continuous increase of WM costs and fees 16 towns and cities in Dolní Poberouní joined together and started to use their own municipal waste company. This inter-municipal cooperation enabled them to gain more control over their WM costs. Moreover, in one of these towns, they decided to install monitoring sensors in some of the semi-underground containers. These help to determine the correct collection frequency and, therefore, save the costs of waste transportation.

Even smaller self-governments can set a good example of legal actions towards a circular economy. What's more, the most innovative waste management project was created in Slovakia, in the village Košeca. Both mayors of Košeca and Trnava Hora realized the potential and environmental impact of financial incentives through reduced payments for waste collection. The electronic waste registration and collection system, created by Košeca, or the quantitative payment system for waste collection, provided by Trnava Hora, motivated inhabitants enough to gradually increase the level of separation. Altogether, the best practices in smaller towns or villages are following. Building a collection yard, building new stands, abolishing wild composting, and handing out home composters. However, most importantly educating citizens about more sustainable individual actions and rewarding inhabitants for their ecological behavior.

The countries above mostly come from a more difficult situation than countries from the west. In Hungary, Croatia and Bulgaria the lagging behind the bigger countries cannot be unseen. The biggest problem in these countries is the lack of information and the slightly more backwarded economic situation. With small steps and the help of the European Union they will be able to Meet the standards in waste management by 2025. In contrast to them the Slovenian government and especially the self-government of Ljubljana was able to achieve the title as the 'leading European capital on the path to Zero Waste society'. With the installation of the Waste Management Centre and the good spread of information they were able to reduce the amount of waste with a big amount leaving only 5% of waste going to the landfill every year.

5. Background

Czech Republic – national level

The system of state administration in the Czech Republic originates from a classical continental concept where the central state administration is based on ministries. Other central administrative authorities are targeted at certain specialized departments of state administration. In addition to the central administrative authorities, there are also administrative authorities of the state in the territory.

There is a two-tier system of territorial self-government in the Czech Republic, which consists of municipalities as basic territorial self-governing units and regions as higher territorial self-governing units (incl. the capital city of Prague). Independent competence means self-government within which municipalities or regions manage their affairs independently, being bound only by laws and other legal regulations. The principle of subordination does not apply here. Delegated competence concerns the performance of state administration, which the state does not implement directly, by its bodies, but indirectly, through local authorities. The principle of subordination applies here (Republic, 2018).

Region Southeast – NUTS2 cohesion region level

NUTS (Nomenclature of Territorial Units for Statistics) classification is a geographical classification subdividing the economic territory of the European Union into regions at three different levels. It serves as a reference for the collection of regional statistics, for the socio-economic analysis of the regions, and for the definition of the regional policies of the EU (INSEE, 2018). The NUTS is a five-level hierarchical classification (three regional levels and two local levels). Since this is a hierarchical classification, the NUTS sub divides each Member State into a whole number of NUTS 1 regions, each of which is in turn subdivided into a whole number of NUTS 2 regions and so on .

The average size of the regions (higher territorial self-governing units) in the Czech Republic is smaller compared to the 28 NUTS 2 average in the European Union by 2.5 times in terms of

the number of inhabitants and 4 times in terms of the area. Self-governing regions are therefore included in the NUTS 3 level. For the needs of the European Union, it was necessary to create so-called “associated regions” on the NUTS 2 level. The creation of this level in the conditions of the Czech Republic is currently purely statistical. The size, measured by the number of their inhabitants, to ensure the comparability of data in NUTS 2 areas in the Czech Republic with areas of the same NUTS level in the European Union, was decisive for the association of regions (NUTS 2). In the Czech Republic, it should be a territorial unit whose population is more than 1 million (Republic, 2018).

Region Southeast

The NUTS 2 Southeast Cohesion Region consists of two territorial units - the Jihomoravský Region and the Vysočina Region, with the regional cities Brno and Jihlava. It is the Czech Republic's second-largest cohesion region, after the Southwest Cohesion Region, with a total size of 13 991 km². With 1 641 125 residents (as of 1 January 2006), it is the Czech Republic's most populous area, accounting for 16 % of the country's total population. The Southeast region is second in terms of national GDP, accounting for about 15%. After Prague and the Central Bohemia Cohesion Region, its GDP per capita is 91.6 % of the Czech Republic's average (Jihovýchod, 2007).

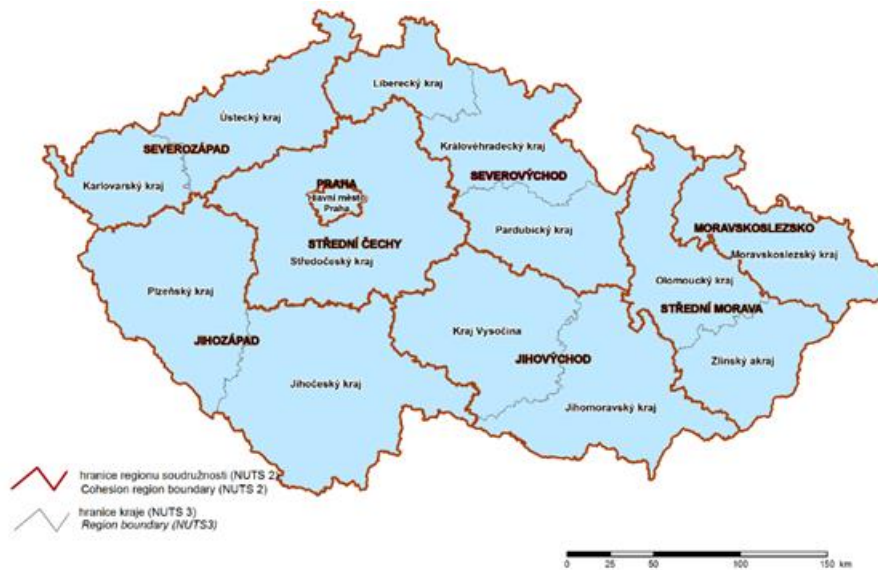


Figure 13 Cohesion Regions (NUTS 2) and Regions (NUTS 3) in the Czech Republic.

Source:: <https://www.arl-international.com/media/images/map-1-czech-republic-nuts-2-and-nuts-3>

South Moravian Region – NUTS3 regional level

Regions are higher territorial self-governing units. The Czech Republic consists of 13 regions and the capital city of Prague, which has a special position. The seat of the region is the regional city, which is usually the economic, cultural, and largest center of the region. The region manages its property and its own revenues as defined by law. In legal relationships, it acts in its own name and bears responsibility for the resulting relationships. The region cares for the all-around development of its territory and the needs of its citizens (Republic, 2018). For municipalities and globally for the higher territorial unit (Incl. South Moravian Region), it is essential to create a comprehensive vision of the system regarding a setting of the circulation-oriented waste management system, one that exceeds the level of the municipality or collection area. Without some "roofing", the system would be functional and effective only at the local level and especially smaller collection companies would not have a chance to implement all the waste management methods that are preferred within the

circular economy. The role of individual regions is irreplaceable in the methodological and in the smaller scope in financial assistance. However, the most important is their role of a regional guarantor who will guarantee and support the creation of an effective system of waste management (it should have more delegated powers in this regard).

The regional level is the one that, with its sufficiently large catchment area (and thus the waste production), is suitable for efficient implementation of larger and more costly projects which are essential for the further direction of waste and most importantly circular economy (e.g., waste-to-energy plants, automatic sorting machines, efficient logistics network, etc.). The region enforces its circulatory objectives through the municipalities and authorized entities (on which the region operates either directly or indirectly). The role of the Ministry of the Environment then is to determine the framework of goals to be achieved in the region. However, these (goals) should also reflect the requirements of the regions, which include both financial support and a stable legislative environment .

South Moravian Region

With an area of 7,195 km², the South Moravian Region is the fourth largest region in the Czech Republic and in terms of population (1,191,989 inhabitants as of 31 December 2019) is the third largest. The region shares borders with Slovakia and Austria. Within the Czech Republic, it borders the following regions: Jihočeský, Vysočina, Olomoucký, Pardubický and Zlínský. Together with the Vysočina region, it forms a unit NUTS 2 Southeast. The center of the region is the second largest city in the Czech Republic and the regional city of Brno.

The South Moravian Region has significant economic potential. Especially in recent years, the number of business entities has been growing in the field of IT, telecommunications, software development, and other "hi-tech" fields. The above-average level of education in the region is partly due to the high quality of the higher education system. Due to the industrial tradition of Brno and its surroundings, the manufacturing industry still has a dominant position in the region's economy. Trade, consumer goods repairs, and so-called commercial services also have a significant place. A traditional sector (especially in the southern regions) is agriculture which accounts for almost 60% of the region's total land area.

The current goals of the South Moravian Region in the circular economy are defined in the *Waste management plan of the South Moravian Region 2016–2025*. For South Moravian

Region so as for the municipal level, several topics need to be addressed where the role of the region is most pronounced. These are:

1. Increasing the rate of circular waste management
2. Promoting waste reuse and prevention
3. Intensification of sorting, including a suitable connection to the use of non - recyclable waste components
4. Ensuring a smooth transition to a higher share (at least concerning legislative requirements) of energy recovery from waste

The region should also reflect these key issues when designing measures that lead to reducing municipal waste and waste prevention with a focus on municipalities and their citizens as well in its circular economy plan .

District level - LAU1

In 1960, the new administrative division of the Czechoslovak State was introduced which set newly conceived regions and districts as the basic administrative and economic units for the performance of state administration of the socialist state with a centrally controlled economy. The post-revolutionary reform of territorial public administration consisted in the termination of the activities of the district offices and the transfer of their powers to other public administration bodies, especially into the new category of municipalities - municipalities with extended powers. The execution of many state administration agendas so far carried out by district offices was transferred to these municipalities. This, together with the new definition of administrative districts of municipalities with extended powers, defines the territorial jurisdiction of the administrative offices of this municipality. The new concept understands the territory of a district (LAU 1) as only an accounting statistical unit in the structure of a state with a gradually decreasing administrative function (Republic, 2018).

Microregions

Microregions and local action groups (LAG) are created on the basis of voluntary cooperation of municipalities in order to promote the interests and intentions common to associated municipalities. They are most often created as groupings of municipalities around the natural

center and their size is diverse. LAGs and microregions are entities that often operate in the same territory and are even linked by a common organizational and functional structure of development management.

Municipalities are connected to microregions or LAGs mainly by the common interest of general development of the territory or on the contrary, are established for a monothematic reason, for example, to build sewerage systems or gas installation supply (MVCR, 2008).

Municipal level – LAU2

The municipality is the basis of territorial self-government. It has its own assets, manages its affairs independently, performs legal relations on its own behalf, and bears responsibility for these relationships. A municipality may also carry the designation of a city and a township if it meets the specified criteria. The Municipalities Act regulates a special category of cities designated as statutory cities, which have the right to further break down internally into city districts or boroughs. They are particularly important cities. There are 26 of them in total, and all cities have more than 40,000 inhabitants.

A municipality is a basic self-governing entity. If it reaches the threshold of at least 3,000 inhabitants, it can apply for the status of a city, which is approved and determined by the chairman of the Chamber of Deputies of the Parliament of the Czech Republic following the government's statement. In order to unify the procedure for deciding on granting city status to municipalities, the government issued a resolution in 2001 setting out the criteria for assessing municipal applications for the city status (Republic, 2018).

The Municipal and Region acts, both amended in 2002, make a distinction between autonomous and delegated responsibilities, i.e., exercised on behalf of the central government. While municipalities have equal status, they are divided into three categories according to the scope of their delegated responsibilities:

- category 3 – municipalities with “extended powers” (ORP),
- category 2 – municipalities with some delegated powers (e.g., registry office, building authority) including municipalities with an authorized municipal authority,
- category 1 – “basic” municipalities.

Municipal competencies include education (pre-elementary, primary, and lower secondary education), agriculture, housing, primary health care, social care services, local roads and public transport, and water and waste management (OECD, 2016).

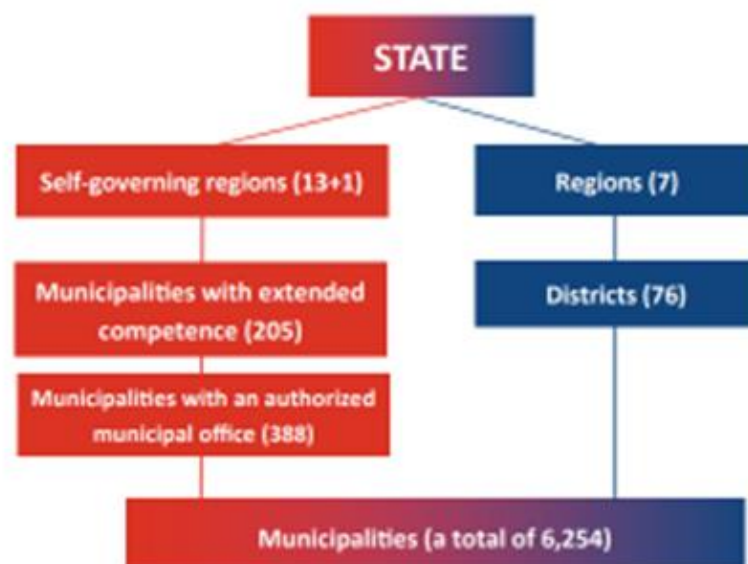


Figure 14 Structure of the territorial division of the Czech Republic. Source: urly.it/3p5kx

Competencies of Czech municipalities in the circular economy

Municipalities and cities play a crucial role in the application of principles of the circular economy. Given the ambitious goals set by the European Union, the current practices in waste and circular management are very limited, both in terms of volume and waste management structures. For this reason, the transition to a circular economy will be very challenging for Czech municipalities, although it also offers attractive economic, social, and environmental opportunities (Soukopová, et al., 2020).

Methodology of circular economy of cities and municipalities, the document published in 2020 as a part of the project “Municipalities in the circle of circular economy”, contains a detailed description of the individual topics and procedures regarding cities and municipalities' transition to the principles of the circular economy. The document mentions the following sections of municipal transition to the circular economy: waste, biodegradable waste, reuse, water, transportation, business, shopping, and innovation (TAČR, 2020). In the following

paragraphs, we are going to further examine the municipal competencies in some of these areas.

Wastewater

Wastewater management is an important component of environmental protection in the municipality's environment. Municipalities manage their wastewater according to Act No. 274/2001 Coll., On water supply and sewerage. Wastewater means rainwater (rain) and wastewater (water produced by households and other entities from their activities). Another important regulation is Decree No. 416/2010 Coll., On indicators and values of permissible wastewater pollution. The municipality may operate the waterworks (rainwater or sewage constructions) only with a permit to operate this type of construction issued by the region (Section 6 of the Water Supply and Sewerage Act).

In the practice of category 1 municipalities, this means that it may have a sewerage system located in the municipality common for the drainage of waste (sewage) and rainwater (rainwater) at the same time or it may have two sewers built. One for wastewater disposal and the other for rainwater drainage. If a sewerage system is located in the municipality, the municipal council issues sewerage regulations. If there is no sewerage system in the municipality, each property must manage the disposal of sewage in the form of a sump, which is impermeable and has no overflow. At the request of the environmental protection authority, it is obliged to submit a document on the disposal of sewage (SMSČR, 2015).

Municipal waste management

This part was discussed in the Institutional and self-government review of the Czech Republic.

Potential problems in recycling

Recycling can seem quite easy, but in real life companies face a lot of difficulties during the procedure. In Brno it is also relevant to mention the most important problems when it comes to recycling.

The first and foremost difficulty is the law itself. There are specific rules in recycling and waste management. As in different countries also the waste management must correspond to the law of the country. It is a crucial point what kind of materials can be recycled, and how. Another aspect of the law is when the recycling process finishes. How can the new product start a new life as a new thing?

In addition to the point before, the quality of the recycled goods can be poor in some cases because of the lack of education. This stays really close to the mentioned law before because in some cases the recycling cannot be carried out because the material was contaminated, or the material people put into the stream is non-recyclable.

Another big problem can be the training of the employees. There are a lot of cases when we hear about poorly trained or in some cases even poorly managed employees. The lack of information and training to their job. Without having told them the basic operations they will not be able to understand the expectations that they would need to suit. With the right managers and leaders, they can be trained to a way, they can hold on in the most difficult situations too. With the help of this the motivation of the employees can be sold at the same time and it will result in a better quality.

However, to be able to seize the maximum of the potential, the safety of the workers should be really important for the company. In recycling processes there are several ways to meet with chemical exposure, powerful equipment with moving parts and machine guarding hazards. These are some risks that must be taken care of by the leaders for the workers to feel safe.

The price that the city will have to pay for the bins and new factories is going to be high. Of course, it is going to be worth it in the end, but Brno must think about how it will be able to finance all the new installations. Luckily, today the most relevant issue is global warming, so the state and the EU often help cities in order to be able to function zero waste but when it comes to the potential problems of Brno, everything has to be taken into consideration.

In today's world we live in a multicultural world. There are a lot of different cultures but most importantly different languages. In some cases, the company hires workforce which are not from the country's residents. In those cases, a language barrier can cause some problems. Miscommunication can be a crucial problem when it comes to delivering important tasks. Being able to hire managers and employees who share the same language is a key factor. (Leadpoint, 2020)

"It seems to us, that there is a risk of the term smart being profaned soon, similarly as the terms sustainability or the previously popular Agenda 21. Today, once again everything is concealed under smart while it sometimes seems that it is only a marketing strategy of modern technologies' suppliers. We want the human, as the ultimate user of these measures and

solutions, to not be left out (Drápalová, 2017),” says Jana Drápalová, Mayor of the district of Nový Lískovec, municipality of Brno.

Local roads

The importance of the public transport has always been great. Public transport is a more efficient way of transport than when one person goes to work by car. In the South Moravian Region and in Brno the public transport is provided by Integrovaný dopravní systém Jihomoravského kraje IDS – JMK (the South Moravian Integrated Public Transport System). The ticket system is time based and zone based not length based so when using this public service, the only thing you have to be aware of is the time and which zone you are in. In Brno the zones are 100 and 101. Purchasing a ticket, there are many options, such as using the yellow vending machines, buy them at information centers, stations or newsagents. And if one has a Czech phone number, they can buy tickets via SMS or mobile app (Wolters Kluwer Hungary Kft., 2022).

In this way it is no surprise why the public transport system works so well in Brno. The city's smart city aim can be only reached if the residents take this aspect to consideration as well.

A new project is in process currently in the country, and this project is the C-roads. The main goal of this with the cooperation of other European countries is to harmonize the providing services for data communication between vehicles and intelligent roadside infrastructure. This project emphasizes the impact on traffic and transport safety. This project is achievable with the implementation of cooperative intelligent transport systems or in short, the C-ITS, which are going to create an environment for the arrival cooperative and when automated vehicles will be more popular and easily achievable for the average residents, they will also benefit from this. The safe transportation is a change that everybody need is their lives. And in addition, better working traffic favors for the European economy too.

In the project is it also stated that the public transport is prioritized. This means that signals that are given by the automobiles, public transport vehicles and which the traffic lamps are connected, will give the green light to the public transport first and not the automobiles.

The city of Brno plays a big role in the C-Road project. The stage concerning Brno is DT2. The city benefits from this project as the city will get a better summary and understanding of the traffic situations of every day throughout the whole city. And what is more fascinating to this is that the drivers will be warned when for example they will approach an emergency vehicle

or when a vehicle passing through an intersection on a red light. Brno is the pilot location of the project. One of the project partners that participated from 2016-2018 was the company y Brněnské komunikace a.s. And in 2018 the public contract "Implementation of C-ITS systems in the City of Brno " was announced and chosen, so as the contractor. In 2019 for Czech and cross-border testing the system was delivered. And further implementations and documentation started from 2020.

They installed C-ITS systems to 31 locations in the city of Brno mainly to large city ring, radial roads and those which connect it with the D1 highway. After the testing stage the aim is to make it a long-term operation system with highly efficient results, safer, smarter, and better transport system (C-Roads, 2021).

Greenery

For a city that places the environment in the first place it is not a big surprise that Brno has a big variety of green territory. The number of parks that invite people to spend some time in a green area are almost uncountable. Some famous parks and gardens are Denis gardens, Spilberk Park, Luzánky park and Tyrs park (TIC BRNO, 2022).

The city offers the option of "Tree adoption" which means you can be the adoptive parent of a selected young tree or trees for a year and the chosen name can be entered for that tree on the map managed by the city of Brno. This process is a donation in which you can adopt a tree from CZK 500, but from an amount of CZK 100 people can become a "contributor" to the care of a tree. These funds support the care of trees in Brno. The organization contributes to this case, the Public Greenery of the City Brno. In this way not only, the organization can do something for the green spaces but also the individuals can make a big effort in keeping the environment safe.

In Brno the quantity of the green roofs increased during the years. From 2003 to 2017 the quantity grew from 45 to 233. The installation of a green roof not only looks aesthetic but the impact it has on the environment is impressive. It helps the managing of rainwater, and it reduces airborne dust. Also, it is a great help for the regulation of the temperature it is installed on because it regulates the surface temperature of the building, reducing the greenhouse effect.

The New Green Savings program support the green infrastructure with a benefit of 18,5 EUR per 1 square meters. They monitored the already existing green roofs and created a database.

The results they found is that 77% of the roofs are extensive green roofs and 23% are intensive green roofs. One roof contained both type of green roofs. The areas vary between 9 square meters which is a private house in Brno-Jundrov to 18000 square meters which is the University campus of Brno-Bohunice. Large roofs occupy 9% while medium and small are 42% and 49% of the total. The most significant jump of the quantity was from 2006 to 2012 where it increased from 68 to 173. With the help of the green roofs, they could determine the annual rainwater detention. The highest score was 60000 m³ per roof surface. (Rebrova, 2017)

Metropolitan Area of Brno - Core vs Hinterland

Definition of the Brno metropolitan area

The metropolitan area of Brno represents the dominant urbanized area of South Moravia, and the fourth largest urban area in terms of surface area and the third most populous urbanized area in the Czech Republic (Ouředníček, 2020). The metropolitan area of Brno is a typical example of a monocentric metropolitan area - this area has a single core, which is the city of Brno - which represents the most important center of services, employment opportunities, education, etc.

In order to define the territory of the Brno Metropolitan Area, a study was conducted in 2013 by Mulíček et al. This study identified the area as consisting of 167 municipalities, with a population of 609,114 inhabitants, of which 384,277 residents in Brno and 224,837 residents in the neighboring municipalities.

Other studies from the same years have obtained different results, for example Dvořák identified 305 municipalities and a population of 719,271 inhabitants, while for Tonev et al. the Brno Metropolitan Area consists of 290 municipalities and 711,091 inhabitants.

According to a 2020 study by Ouředníček et al., the BMO includes a total of 184 municipalities from 673 municipalities in the South Moravian Region (27% of municipalities). The territory of the metropolitan area covers an area of 1 978 km² and had 696000 inhabitants on 1 January 2019 (58% of the region's population). Almost 381 thousand inhabitants, that is 56% of the population of the metropolitan area, live in Brno.

Taking into account data from the Czech Statistical Office, which considers the Brno Metropolitan Area consisting of 188 municipalities, the population residing in the city as of 2020 was 382,405, while the rest of the Metropolitan Area had 226,442 inhabitants.

These differences show that there is no established and unified method to define metropolitan areas, it must also be considered that their authors have often adapted to the requests of the institutions promoting the study. (Tonev, et al., 2017)

Author of the study	Year	Number of municipalities	BMA population
Mulíček	2013	167	609.114
Dvořák	2015	305	719.271
Tonev	2017	290	711.091
Ouředníček	2020	184	696.000
Czech Statistical Office	2021	188	608.847

Table 2 Results of studies of various authors

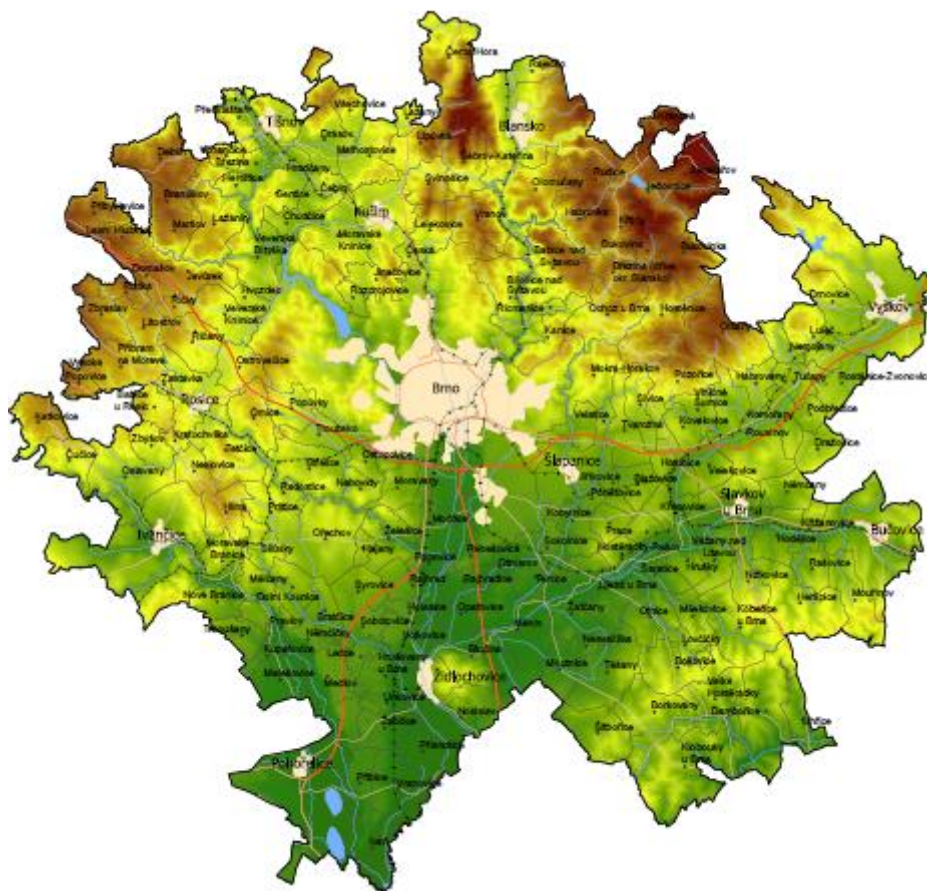


Figure15 Brno metropolitan area (2021). Source: <https://metropolitni.brno.cz/>

Currently, there is no legislative framework for the administration of metropolitan areas, so the coordination of activities in the area takes place on a principle of cooperation and through communication of the city of Brno with neighboring municipalities.

Water, Wastewater, Gas

In the city of Brno, practically all dwellings were connected to the water supply system in 2016 (when the latest CZSO data are available, which is the only one that tracks the connection of houses and flats to individual utility networks). A lower share (93.6%) in the Brno metropolitan area, which is, however, similar to the data for the South Moravian region. However, both the city of Brno and the metropolitan area are above the average for the Czech Republic (88.3%). Public water supply is available in almost all BMO settlements, including most of the smaller settlements. A higher number of dwellings than the national average of 63.6% and slightly lower than the average in the South Moravia region (91.2%) has a gas

connection in their house; according to CZSO data, 86.6% of the dwellings have one. Therefore, the gas supply in BMO can be described as sufficient or adequate, but it is still the lowest data for the entire region.

The number of municipalities with a sewerage system is 86.6% in BMO, in line with the regional average (87.9%) and above the national average (77.6%).

Looking at individual dwellings, however, the data gets worse:

in Brno 91.50% of the houses are connected to the public sewerage system, the figure drops dramatically when considering the metropolitan area, only 67.58% are connected. However, this figure is in line with the regional average of 68% and higher than the national average of 56.28%. 24.68% of house in BMO have a septic tank or cesspool, only 5.23% in Brno. The following graphs summarize the various types of house wastewater disposal for the city of Brno and BMO.

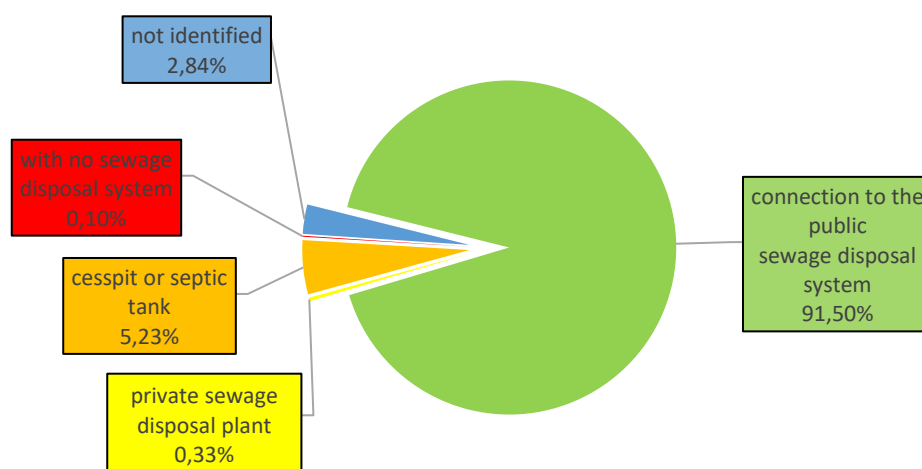


Figure 16 Type of sewage disposal system in Brno

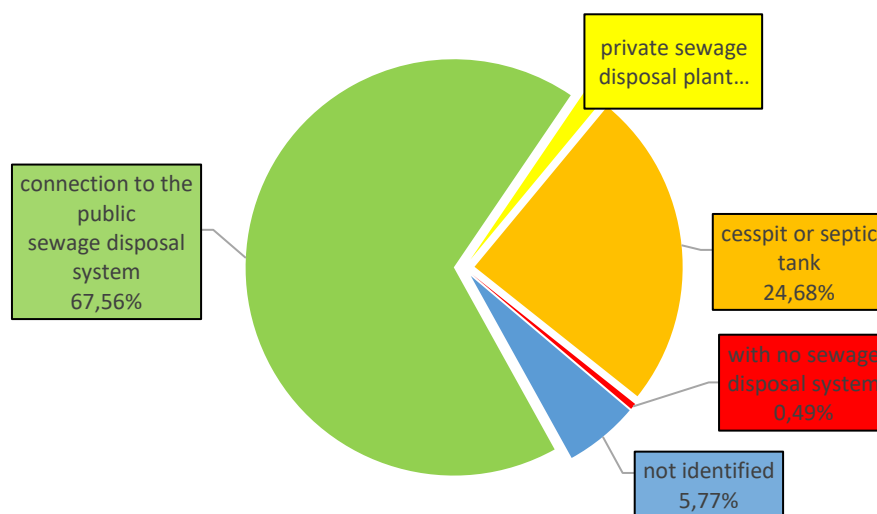


Figure 17 Type of sewage disposal system in BMO

Houses in smaller settlements in the suburban parts of the South Moravian Region are more often connected to the sewerage network than in BMO itself. However, there are also a large number of settlements in the region with a low share of these facilities (up to 20%), some settlements are even completely without gas and sewage (SPF Group s.r.o.; HOPE GROUP s.r.o., 2015). Thus, this problem can be described as one of the most important ones in the field of technical infrastructure and the environment.

Finally, the percentage of municipalities served by a WWTP is 73.3% in BMO, which is much higher than the national (54.1%) and regional (66.4%) averages.

According to information based on statistics from the Czech Statistical Office, in 2018 the South Moravian region produced the second highest amount of all waste compared to other regions in the Czech Republic. The same is observed for the production of municipal waste.

The following information is taken from the two Assessment Reports of the South Moravia Region Waste Management Plan 2016-2025. These two reports refer to the two-year periods 2016/2017 and 2018/2019. Unfortunately, no specific data about the Brno Metropolitan Area

were found, but it can be assumed that they do not differ too much from the regional ones. (SPF Group s.r.o.; HOPE GROUP s.r.o., 2015)

According to the Second Assessment Report of the Waste Management Plan of the South Moravian Region 2016-2025, in 2016, the total waste production of the region was 3617380 tonnes, in the following two years an increase can be observed, it is 4230300 tonnes in 2017 and an impressive 5270290 tonnes in 2018, more than 1000000 tonnes more waste than the previous year. The largest contribution to the total waste, and thus to the annual increases, is made by the category "others".

Waste in the 'hazardous' and 'municipal' categories varied, but slightly, and did not follow the trend of the total waste generated (e.g., in 2017, slightly less hazardous waste was generated than in the previous year, while total waste increased to more than 4000000 tonnes).

Adding all the three categories (hazardous, others and municipal waste) does not give the total because municipal waste is a subset of hazardous and others waste.

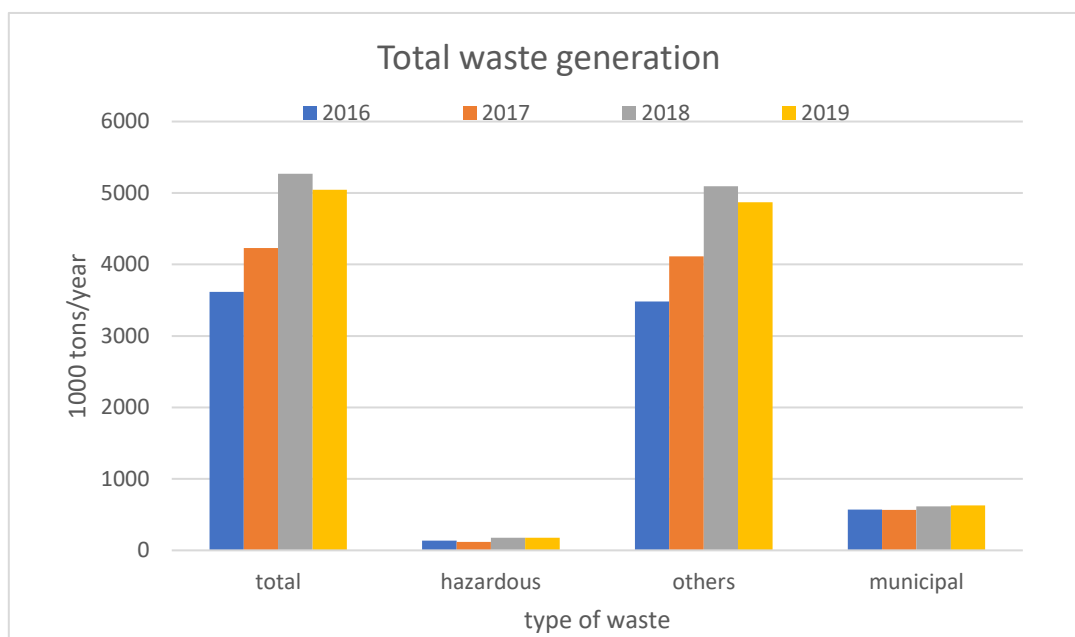


Figure 18 Total waste production in the South Moravia region

The graph below shows the per capita generation of waste, considering total waste and only municipal waste. Regarding the second ones, a slow but gradual increase can be observed,

from 484.02 kg/capita/year in 2016 to 527.19 kg/capita/year in 2019. Considering the per capita generation of total waste, the values are even higher because the waste category

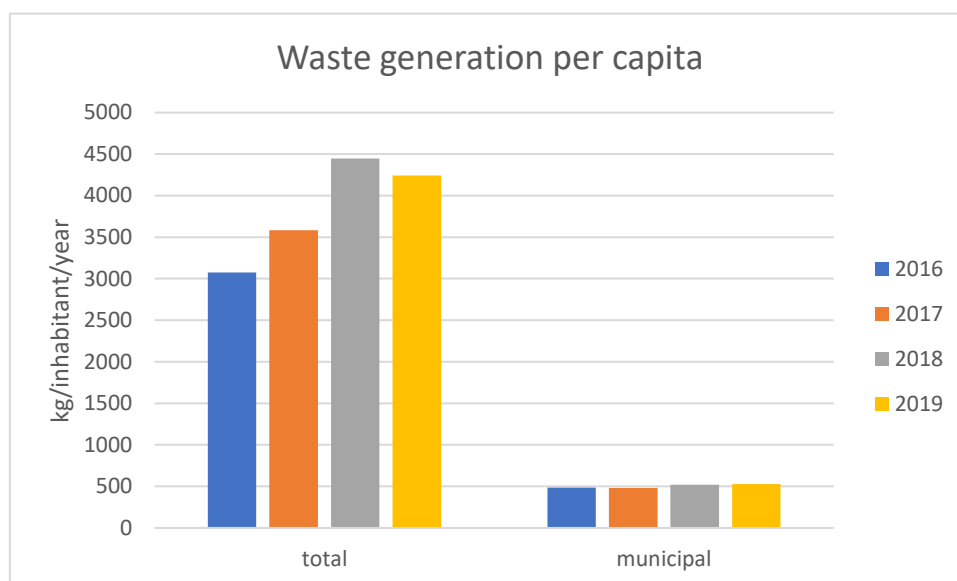


Figure 19 Waste generation per capita in the South Moravian region

'others' contributes significantly.

Construction and demolition waste represent the largest share of total waste generation: in 2016 it was 61.96% of total waste generated, while in 2017 it was 66.76%. In 2018 it was 71.08% and in 2019 70.58%. It can therefore be seen that these shares are increasing over the total.

Hazardous waste represents only a relatively small part of total waste generation. In 2016, 136.43 thousand tonnes of hazardous waste were generated, in 2017 116.83 thousand tonnes and in 2018 and 2019 177 thousand tonnes. These values still represent less than 4% of the total waste generated in these years.

Municipal waste is a subset of others waste and a subset of hazardous waste. In 2016, 569.67 thousand tonnes of municipal waste were generated (15.75% of the total waste generated by the region), a very similar quantity in the following year (568.1 thousand tonnes, 13.43% of the total waste generated). While in 2018, 615.29 thousand tonnes were generated (11.67% of total waste generation) and in 2019 627.11 thousand tonnes (12.43% of total waste

generation). These four years considered show a generally balanced amount of municipal waste generated.

The recovery rate for 2016 was 93.56%, 102.33% for the following year, while for 2018 it was 88.60% and for 2019 89.41%. Regarding the value reported above 100 per cent, in the first report of the Waste Management Plan it is explained by the fact that in that particular year the waste for processing was taken from the previous year's stockpiles and to this was added the waste received for processing in that year, including the import of waste to the South Moravian region from another region.

In 2016, the material recovery rate from waste was 84.67%, in 2017 it was 94.92% and for both 2018 and 2019 it was 82.64%. A constant trend can be seen, the 2017 value is influenced by the increase in construction activity and thus more waste produced in that field.

Regarding energy recovery from waste, in 2016 the recovery rate was 8.88%, in 2017 7.42%, in 2018 5.97%, and in 2019 6.77%. However, values below 10% in the four years analyzed.

Landfilling: the share of waste disposed in landfills was 6.89% in 2016, 6.36% in 2017, 4.95% in 2018 and 5.24% in 2019. The share of hazardous waste disposed in landfills was 1.61% in 2016, 1.25% in 2017, 0.97% for 2018 and 0.87% for 2019. The use of landfill for these types of waste is slowly being reduced. The share of municipal organic waste landfilled was 40% in 2016, rising to 43% in the following year. In 2018 and 2019, a positive trend of decrease seems to have been undertaken; in fact, one of the objectives of the Waste Management Plan of the South Moravian Region 2016-2025 was to reduce the maximum amount of biodegradable municipal waste to be landfilled so that the share of this component would not exceed, in 2020, 35% by weight of the total amount of biodegradable municipal waste produced in 1995. It is necessary to move in this direction to eliminate the landfill option for biodegradable waste.

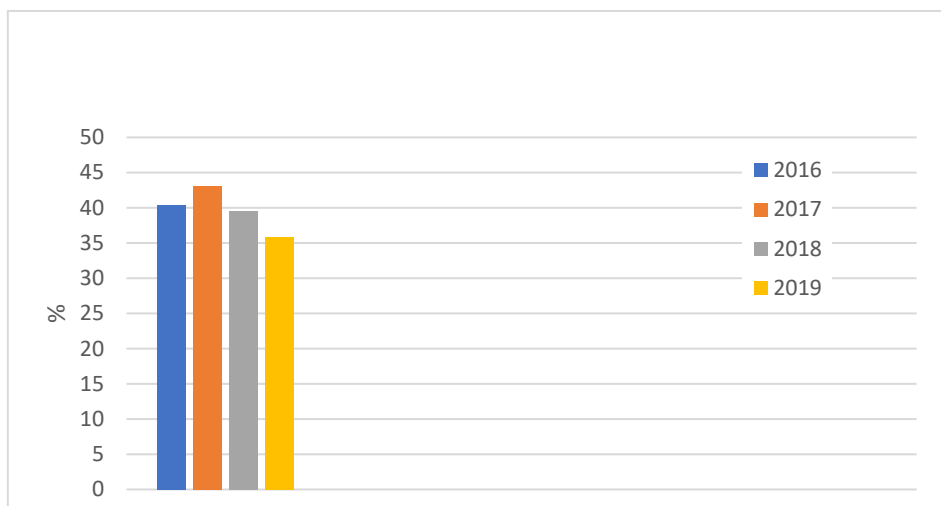


Figure 20 Percentage of municipal organic waste landfilled compared to the baseline (1995)

The grants of the Environment Operational Program 2014-2020 have contributed to increasing the use of biodegradable waste, in particular, by financing household composters, composting plants, and biogas plants. Unfortunately, in the last calls (as of 2019), the support for composting plants has been stopped, thus partially compromising the goal of reducing the disposal of biodegradable waste in landfills.

The percentage of waste incinerated was 0.08% in 2016, 0.07% in 2018, 0.05% in 2018 and 0.06% in 2019. The percentage of hazardous waste incinerated was 1.97% in 2016, 2.3% in 2017, 1.30% for 2018 and 1.61% for 2019.

The share of used construction and demolition waste was 108.16% in 2016 and 115.96% in 2017. The excess of values above 100% is related to the processing of waste that had been in storage since the previous year, as well as the import of waste to the South Moravian Region from another region. In the following two years, the percentage of construction and demolition waste used was 94.58% in 2018 and 95.43% in 2019. The utilization of construction and demolition waste is also largely due to its use in landscaping and remediation of mining sites in accordance with current mining and quarrying legislation. The share of construction

and demolition waste landfilled is very low: it was 1.01% in 2016, 0.91% in 2017, 0.77% in 2018 and 0.83% in 2019.

Although positive results have been reported for construction and demolition waste management, in practice the situation is very difficult and often unclear. The amount of illegally managed waste has increased in recent years. These include the construction of illegal storages; unauthorized landscape works and the illegal dumping of unsuitable waste. (all data are from the Second Assessment Report of the Waste Management Plan of the South Moravian Region 2016-2025).

Waste management in Brno

Regarding waste management in the municipality of Brno: in 2021, 2,510 tons of waste were produced more than the previous year. A total of 110942 tonnes was produced, of which approximately 20% was recycled. 87170 tonnes came from inhabitants and 22948 tonnes from waste collection centers. (data are from data.Brno)

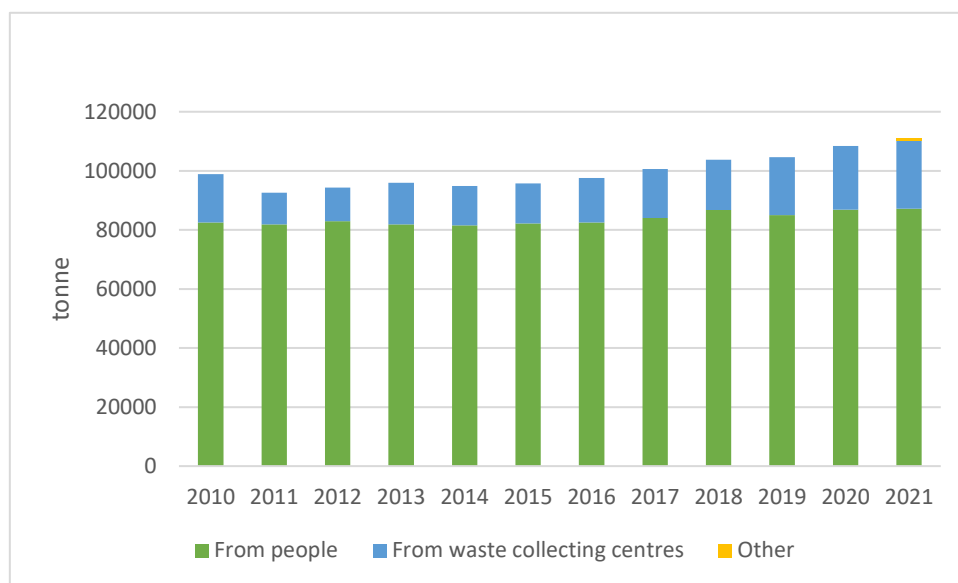


Figure 21 Communal waste production Brno

The following two graphs indicate that the landfilling for waste disposal has drastically reduced since 2011. Whereas in 2010 almost 30% of waste was landfilled, in the following years it went down to 4%, then 3% to even below 2% as of 2018 (1.8%), with almost all waste going to incineration. (data are from data.Brno)

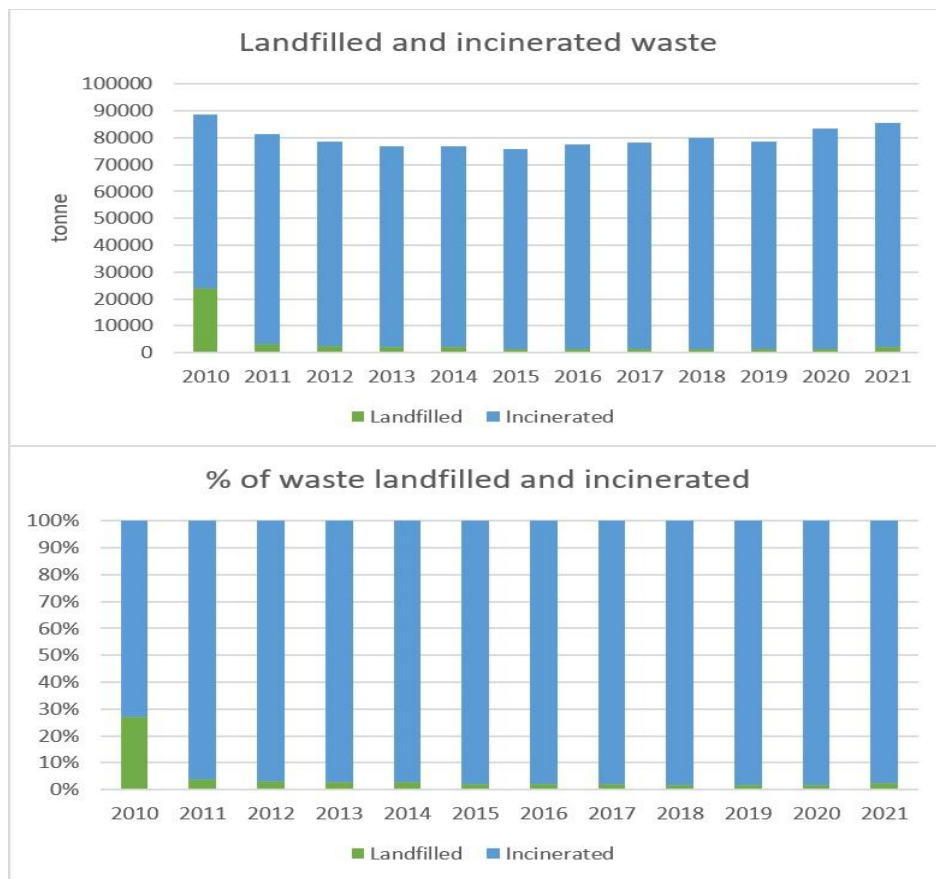


Figure 22 Above: landfilled and incenerated waste. Down: percentage of waste landfilled

Regarding energy from waste, electricity production is down for the second year in a row. In 2019 69436 MWh of electricity were produced, in 2020 64690 MWh while in 2021 60657 MWh. Since 2019, the amount of recycled waste has increased. From 2018 to 2019, approximately 7,000 tonnes more waste was recycled, exceeding the total of 23,000 tonnes of recycled waste. However, the percentage of recycled waste in relation to the total did not increase too much: it went from 19.5% in 2018 to about 22% in the following years. (data are from data.Brno)

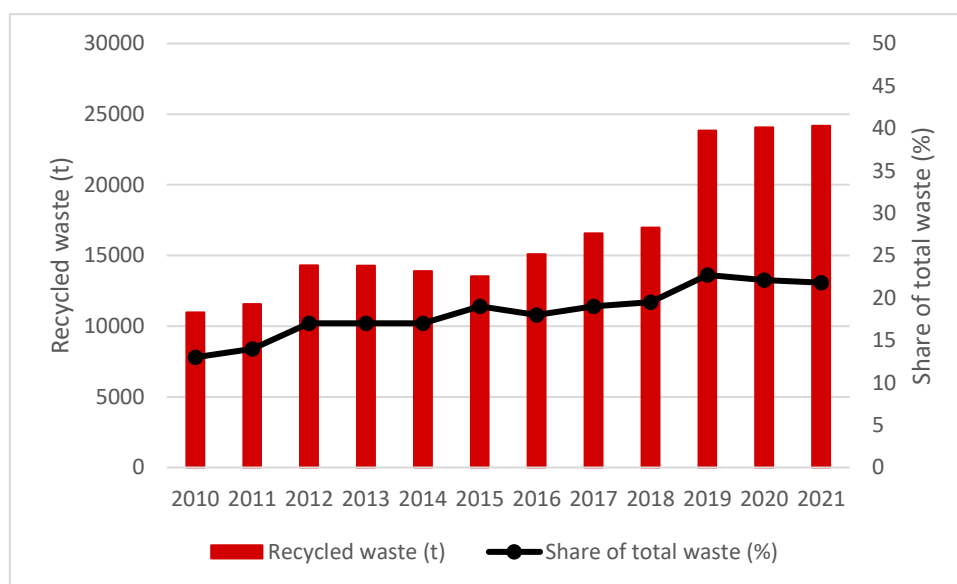


Figure 23 Recycled waste in Brno

The number of containers for the collection of the various waste fractions continues to increase: they were 7088 in 2019, 7349 in 2020 and 8926 in 2021. In addition, more than 1000 containers for the collection of organic waste have been distributed since 2021. (data are from data.Brno)

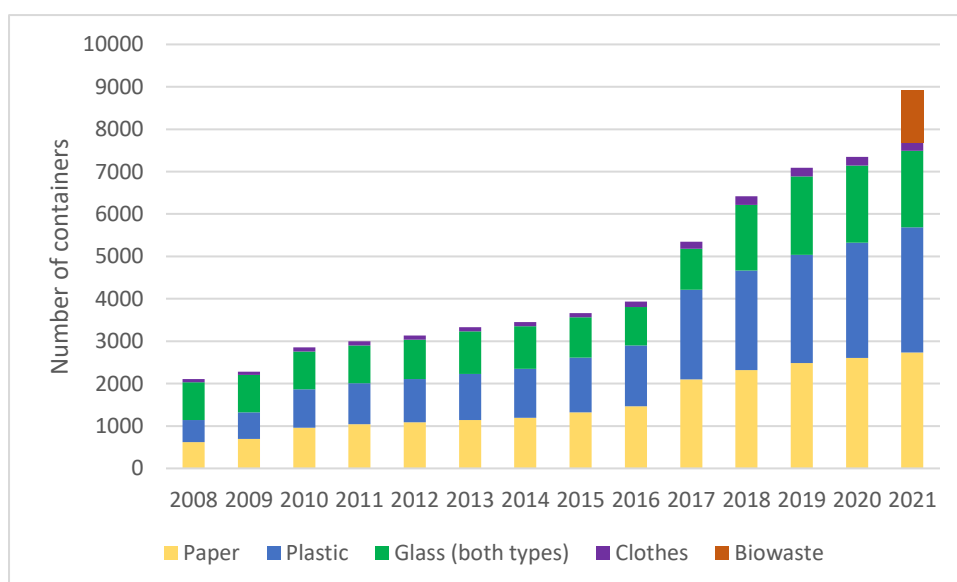


Figure 24 Number of recycling containers

Land uses

The city of Brno has an area of 23018 ha, the metropolitan area of almost 150 thousand ha. The CZSO periodically collects data on land use; it makes an initial distinction between agricultural land and non-agricultural land. The former includes arable land, hop-gardens, vineyards, gardens, orchards, and permanent grassland. Non-agricultural land, on the other hand, includes forests, water areas, built-up areas and yards and other areas.

55.9% of the BMO area is agricultural land, of which 84.6% is arable land. The share of agricultural land for the city of Brno drops to 32.9%, of which 64.5% is arable land and 27.5% gardens. Compared to 2011, there has been a very small reduction in the size of agricultural land for both BMO and the city of Brno, by approximately 900 hectares and 300 hectares respectively.

Non-agricultural land represents 44.1% of the area of the Brno Metropolitan Area and 67.1% of the area of the city. The largest part, 71.8% and 41.4% respectively, are forest areas, while only 4.6% for BMO and 13.7% for Brno are built-up areas. Compared to 2011, the data for agricultural land are also practically unchanged.

From this very general overview, it can be concluded that land use has not changed much over the past ten years, that most of the BMO's area is occupied by land in agricultural use as opposed to non-agricultural land use, and that these ratios are reversed for the city of Brno, with almost seventy per cent of the area in non-agricultural use.

The following graphs show the data, in hectares, of land uses for the Brno Metropolitan Area and the city, for the years 2011 and 2021.

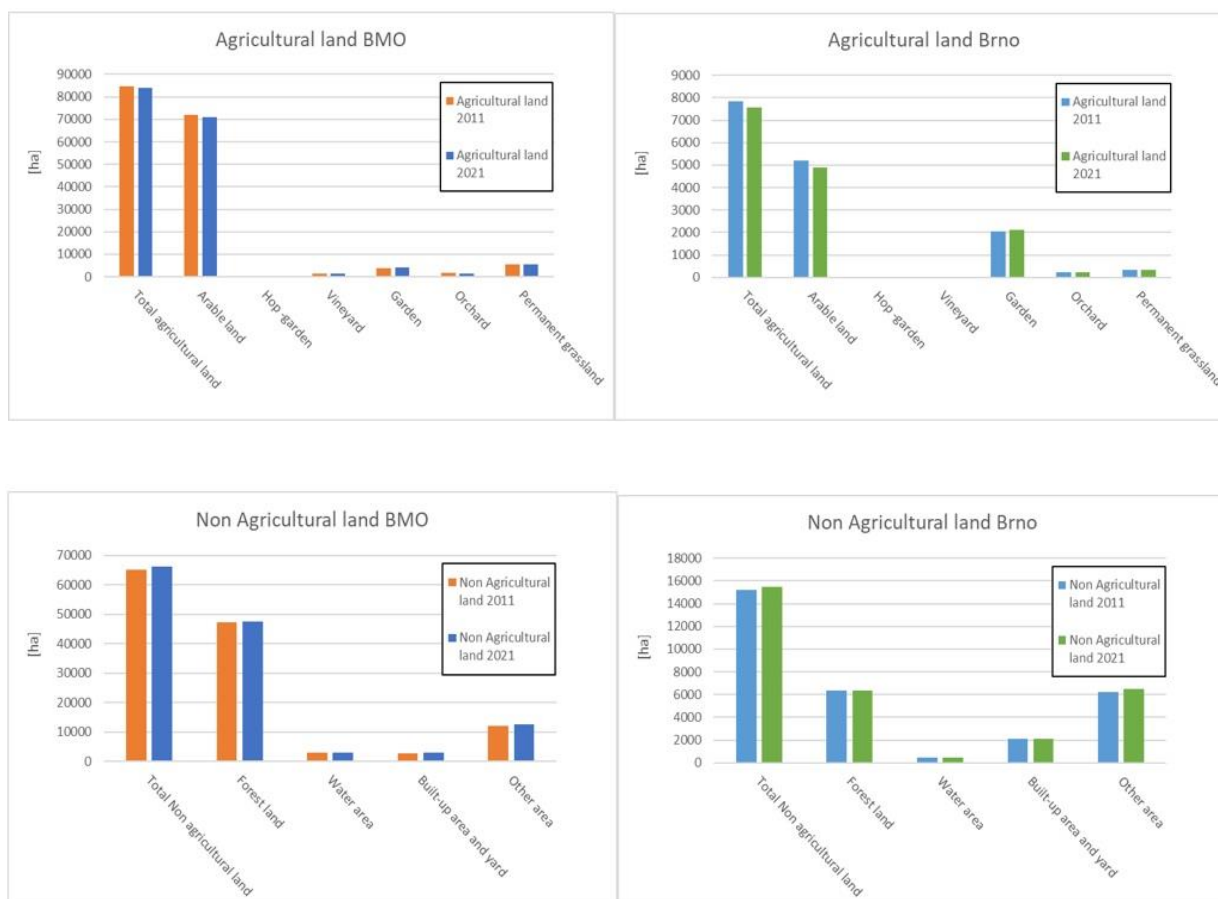


Figure 25 Comparison of agricultural and non-agricultural land use in Brno and BMO

6. Proposal

Vision of Brno

The future of the city's waste management is strongly interconnected with new waste legislation which came into force on 1 January 2021. This law was adopted in response to the European Union legislation from the so-called circular economy package. Compared to the previous legislation, the new Waste Act contains several significant changes that will affect not only ordinary citizens but especially entrepreneurs and municipalities.

The new Waste Act introduces a different amount of the fee for all 5 categories of waste (usable, residual, hazardous, selected technological and remediation waste). Starting in 2021, the landfill fee rate for selected types of waste is regularly increased until 2030. The annual rate increase concerns usable and residual waste (e.g., usable waste until the end of 2020 was

charged at CZK 500)., in 2021 it was charged at CZK 800, and in 2029 it will be charged at CZK 1,850 per ton of such waste deposited in a landfill. In contrast to the current legislation, the fee for landfilling hazardous waste was reduced (abolition of the so-called risk component of the fee). Also, from 2030, the landfill of usable waste will be banned. This prohibition will apply to waste with a specified calorific value, waste exceeding the biological stability parameter and recyclable waste. In other words, waste that can be used for energy, biodegraded, and recycled. This procedure reflects the so-called waste management hierarchy, in which landfilling is the last possible way of waste management. Municipalities are now obliged to designate places for separate collection of recyclable components of municipal waste (i.e., hazardous waste, paper, plastics, glass, metal, biological waste, edible oils, and fats, and from 1 January 2025 also textiles). Municipalities are obliged to ensure that separately concentrated components of municipal waste make up at least 60% in 2025-2029, at least 65% in 2030-2034 and at least 70% from 2035 of the total amount of municipal waste generated by the municipality in a given year. To meet these objectives, municipalities will have to ensure the sorting of significantly more individual components of municipal waste than before. Municipalities will have to focus mainly on a thorough sorting of bio-waste. According to the legislator, without a thorough sorting in this area, it will not be possible to achieve the objectives (epravo.cz, 2021).

In addition, in January of 2017 Brno representatives approved "The Strategy of Brno 2050". The plan is to reduce waste production by 80% as well as reach 60-80% recycling rate or to achieve 100% utilization of bio-waste in the city. Other goals examples of goals are to achieve 90% recycling of nutrients from wastewater, or 80% recycling and reuse of wastewater (Študent, 2018).

This all means that Brno municipality will have to find new ways to either minimize the residual waste generation or maximize waste separation. As the prevention of waste generation is placed in the first place (therefore it is the best option) in the waste hierarchy, it would be ideal to educate and incentivize the citizens and enterprises to generate less waste. However, with today's setting of the enterprises' production and the consumption habits of the society, this option would represent a huge challenge with a less likely chance to succeed. Prevention of waste is surely the goal of waste management which cannot be achieved in the short term. It will need complex and innovative approaches that will gradually

change the embedded habits. Although waste prevention cannot be neglected, the second option - maximization of the waste separation- now represents the more realistic approach. To increase the separation of individual waste components, Brno and surrounding municipalities will not only need to motivate people to separate more, but also adjust the current waste management system. As for now, the local incinerator does not have the capacity to process all the waste from the surrounding municipalities, therefore it ends up in landfills. Given the new legislation, it will be necessary to move towards other waste processing techniques.

Critical goals regarding phenomenon

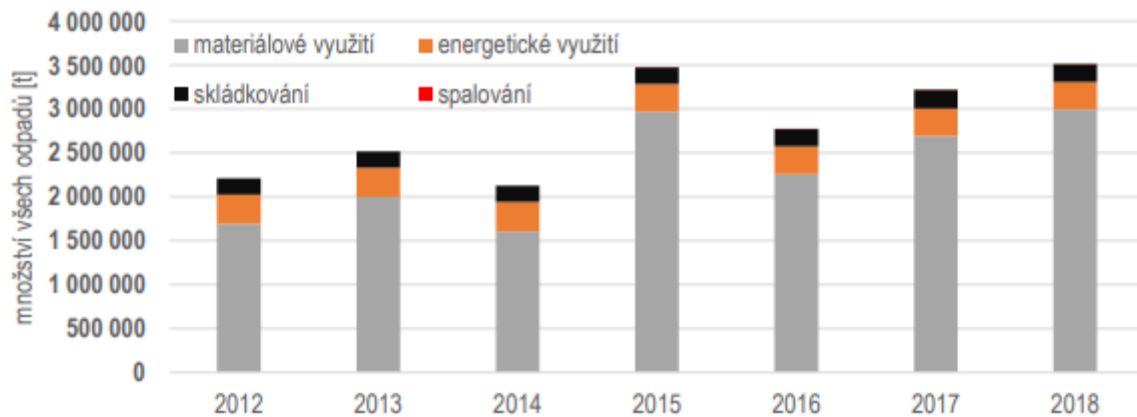
The current situation in the field of municipal waste management in the Czech Republic is not up to the mark. When compared to the rest of the countries of the European Union, the percentage of municipal waste that ends up in landfills is above average, while at the same time recycling is below the average. The aim is to drastically reduce the share of landfilling while improving material and energy recovery. All changes need to be in line with the principles of the circular economy and the need to meet the objectives of the European Circular economy. The Circular economy action plan, from 2020, sets an aim that at least 60% of municipal waste by 2030 must be recycled.

As mentioned in the previous section of the proposal, the landfill fee will be regularly increased until 2030, which subsequently increases the costs of waste management for the municipalities. Therefore, municipalities face two decisions, that is to either considerably increase waste management fees or to increase the rate of separation of residual waste which will minimize the amount of waste that needs to be landfilled. Another option is to minimize the waste that is being produced. Unfortunately, it can be assumed from the statistical data available that the production of waste will increase throughout the years. In 2020 Brno produced more than 2,000 tons of waste than in 2019 (Ekodotace Brno, 2021) What's more the recycling rate in Brno, which is around 20%, did not increase compared to 2019 (Ekodotace Brno, 2021). On the other hand, the amount of material that can be used grows

every year. Within the operation of the Brno incinerator, ferrous and non-ferrous metals are also sorted from slag even though these materials were not collected in a separate collection. A recent World Bank publication suggests that waste generation in Europe will continue to grow (EURAKTIV, 2019). One of the main challenges that result from the statistical data available, is the low capacity of plastic recycling facilities. Every material that the sorting lines cannot sell due to lower demand of the specific type of material goes to a landfill or incinerators. This residue is called discard and its share is surprisingly high. It can be up to half of the waste that people have sorted into colored bins. Considering this issue, the state plans to invest 3.5 billion crowns in recycling infrastructure within two years from the National Recovery Plan (Česká Televize, 2021). Another thing to consider is, that according to the amendment to the Waste Act, unused plastic residues from sorting lines cannot be disposed of in landfills from the beginning of January 2022. In addition, EKO-KOM, the authorized packaging company, has been publishing misleading data about the level of recycling for years. In annual reports, it stated that the recycling rate of plastic packaging in the country rose to 69%. The calculation wasn't correct because it included all the plastics that came from the yellow bins to the sorting lines, while not reflecting that not all plastic that was separated was in the end recycled. Only a small part of these plastics was recycled, part was burned as an alternative fuel, or in incinerators, and some went back to landfills (Česká Televize, 2021). The graph listed below shows the total use and disposal of all waste in the Brno Metropolitan area. Approximately, 3 million tons of separated waste in 2018 were sent to sorting lines for

material utilization. However, it cannot be stated that all of the waste was in the end recycled, due to the misleading calculation issues that EKO-KOM used for its statistics.

o5-1 CELKOVÉ VYUŽÍVÁNÍ A ODSTRAŇOVÁNÍ VŠECH ODPADŮ V BMO (AGREGACE ZA SO ORP DOTČENÉ BMO)



zdroj dat | ISOH 2020

Figure 26 Source: url.it/3p5k2

Even though ecodesign measures are expected to help reduce waste production in the future, due to demographic and economic changes it is unclear to what extent the reduction in waste production is realistic. On the other hand, statistical data predicts that the amount of waste produced will globally increase (Euractiv, 2019). The graph presented above supports this premise as well due to the increased amount of waste produced by 1.75 times from 2012 to 2018 (Altimapo, 2020). To sum up, we identify two trends occurring in the following years. Firstly, the production of waste will increase, therefore the municipalities cannot rely on reduced costs due to lower production of waste from households. Hence, we advise that the goal of each municipality should be to motivate citizens to separate the waste more either through financial incentives or by educating its citizens. Secondly, several investments in recycling infrastructure need to take place to fulfil the goals of the European Union in terms of recycling. On top of that, the Czech Republic needs to support and further develop a market for recycling products through investments, legislation or offering incentives.

Currently, more than 80% of separated plastic material is transported to other countries that have a market sector in recycling more developed in terms of promoting the sales of recycled materials (Česká Televize, 2021). Only two-fifths of plastic packaging is recycled and reused, while the situation is much worse for aluminum, only one-third is recycled (České Noviny, 2022).

Application objectives

As discussed in previous sections, regarding the goals set by the EU, we consider the maximization of the waste separation and recycling as the crucial steps in the following years. While the waste separation rate in the Czech Republic tends to increase, there exist great discrepancies between the set goals and actual capacities for recycling. This creates a complex problem to resolve. Recycling will have to increase, but at the same time, it is the most demanding and expensive way of processing secondary raw materials.

Firstly, **we suggest using higher quality plastic and materials to produce plastic packages, Bottles, and Containers.** The poor quality of some plastic materials makes it impossible to recycle them and, in some cases, to incinerate them. The role of the Municipality here would be essential as it would influence the SMEs to be more environmentally responsible and to use higher-quality materials and plastic. Although this solution would initially represent costs for the municipality, eventually the positive impacts could be multiple. Our **second suggestion concerns raising awareness through marketing campaigns.** It is proven that advertising influences our behavior subconsciously. Therefore, we would use this technique to stimulate people and to make them more aware of their bad environmental habits. This solution is less costly but can make a significant difference when it comes to e.g., waste separation. Thirdly, we think that the **implementation of the PAYT system in the hinterland** could bring many positive changes in waste separation and reduction. Based on the previous case studies concerning incentive waste management systems in the Czech and Slovak Republic, there is a good chance that these systems could work successfully in the smaller municipalities.

Therefore, one option to improve recycling and reuse is to build facilities dedicated to do-it-yourself repairs and the exchange of objects and tools. Something similar to a reuse centre exists in Brno and it is the FabLab, but it is a paid service. We believe that the development

of centres more similar to the Spanish and Italian examples could encourage the population to use them. The construction of these facilities should take place close to the collection centres, so that the user wishing to get rid of one of his goods has the choice between considering the good as waste or giving another person the opportunity to use that good. The creation of an online catalogue can also be considered, so that it can be easily consulted by users.

Activities

Suggestion 1

Promoting the use of higher quality plastic or other materials as wrapping packaging

We can start with the definition and a brief history of plastic. A plastic is a type of synthetic or man-made polymer; similar in many ways to natural resins found in trees and other plants. Webster's Dictionary defines polymers as: any of various complex organic compounds produced by polymerization, capable of being molded, extruded, cast into various shapes and films, or drawn into filaments and then used as textile fibers. The world's first fully synthetic plastic was Bakelite, invented in New York in 1907, by Leo Baekeland, who coined the term "plastics". Dozens of different types of plastics are produced today, such as polyethylene, which is widely used in product packaging, and polyvinyl chloride (PVC), used in construction and pipes because of its strength and durability. Many chemists have contributed to the materials science of plastics, including Nobel laureate Hermann Staudinger, who has been called "the father of polymer chemistry" and Herman Mark, known as "the father of polymer physics" (Americanchemistry.com, 2011).

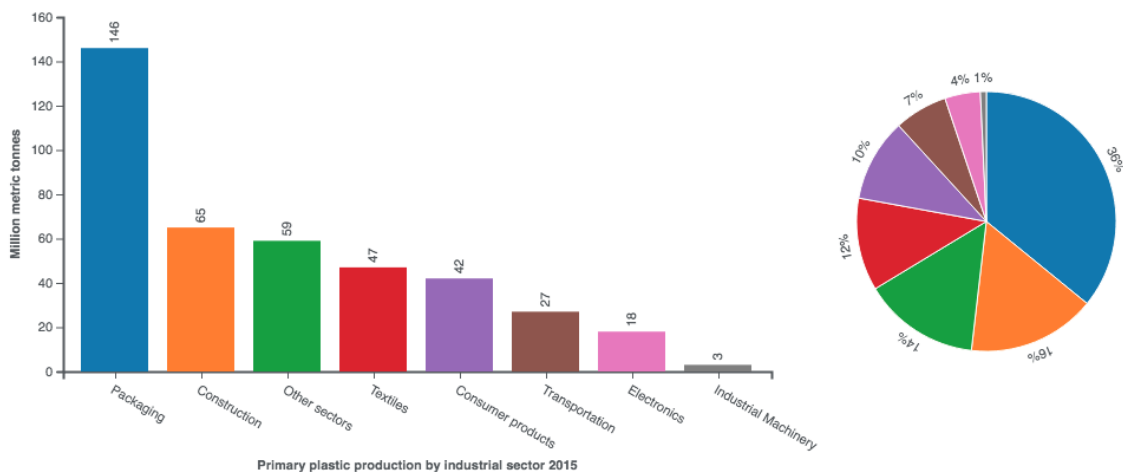


Figure 27

The largest application for plastics is as packaging materials, but they are used in a wide range of other sectors, including construction (pipes, gutters, door, and windows), textiles (stretchable fabrics, fleece), consumer goods (toys, tableware, toothbrushes), transportation (headlights, bumpers, body panels, wing mirrors), electronics (phones, computers, televisions) and as machine parts.

The Czech Republic has already acted against single-use plastic products such as straws and single-use plastic bags (Stark , 2021). That was a very helpful step towards reducing the amount of low-quality plastic in the plastic waste container. The types of plastic that are commonly used are:



Figure 28

Polyethylene Terephthalate (PET) & typically included in drink bottles, medicine jars, carpet, combs, and rope.

High Density Polyethylene (HDPE) & found in milk cartons, shampoo bottles, children's toys, and motor oil.

Polyvinyl Chloride (PVC) & found in clingfilm, plumbing pipes, carrier bags, shoes, gutters, and window frames.

Low Density Polyethylene (LDPE) & The type of resin used to make plastic bags, frozen food bags, sandwich bags, bottles for condiments, and material to hold multi-packs of cans.

Polypropylene (PP) & can be found in certain car parts, Tupperware containers, bottle caps, disposable cups and plates, and kitchen utensils.

Polystyrene (PS) & commonly used in delivery packaging, packing foam, disposable coffee cups, disposable cutlery, and food containers.

Other such as polycarbonate, acrylic, and nylon & commonly included in CD's and DVD's, medical storage containers, lighting fixtures, and glasses.

We aim with this suggestion to maximize the amount of plastic that can be recycled or incinerated (PRC level 1-4). Since each type is made up of various types of resin that all melt at different temperatures, recycling factories are often only set up to process specific types of resin. That's why we should try to minimize the usage of PRC level 5-7 plastic (inciner8.com, 2021).

In this situation, there are 3 parties that we must keep in mind and make sure that we don't affect their level of satisfaction. Those are: The Municipality, Small sized local enterprises, and the end-consumers.



Figure 29

The Municipality

The municipality is the main character in this main idea. The suggestion is applicable if it was ready to act as a safety net for the local enterprises. The main goal is getting a higher ratio of recyclable and good-to-incinerate plastic, which the municipality use to generate energy, which helps cutting the costs of energy and regain the investments made. Another way to benefit from this idea is through the revenue made by selling highly recyclable plastic to recycling facilities. There are other factors that are going to help reduce the costs even more, but we'll discuss them in the coming suggestions. The project could be started through reducing the fees that farmers and other local enterprises have to pay for the license to sell their products on the market in their municipality or other areas.

The use of better materials would cause for the price of the products to rise. So, there's a risk for the companies to lose customers because of that. There are two ways for the Municipality to help and it depends on the cost factor.

But of course, There's always the possibility of experimenting and sensing the reaction of the market on the price raise, if the municipality is willing to back the businesses in case the plan goes wrong.

The first option would be to cover the difference (**X**), between the costs of low-quality plastic that is being used by the enterprises, and the costs of high-quality plastic that would be used. In this way, the enterprises won't have to face higher production costs and at the same time, they won't need to raise the price of the products.

The second option would be to cover the loss of revenue that would take place (**Y**) if the companies raised the prices of their products and caused a hit on the customer basis of the companies.

So, in order to find out which option is more economically reasonable for the municipality, we would have to compare **X** with **Y** and figure out which option would be more economically reasonable for the municipality.

Higher-quality types of plastic materials could result in reduced costs for the recycling facilities due to the higher recycling potential of separated plastic materials. The amount of non-recyclable plastic waste will be reduced. Therefore, transportation costs for these materials from the recycling facility to the incineration plant or the landfill will be lowered. Another benefit is that it would increase the efficiency of the whole recycling process. However, a cost-benefit analysis would specify the benefits even more.

Small local businesses

The enterprises that we have in mind are the ones that are under the jurisdiction of each municipality in the regional area of Brno. We're talking about land farmers, beekeepers, local cattle raisers and dairy farmers, retail sellers, restaurants and accommodations and other local enterprises. The enterprises that would be willing to participate on such a program are aiming to be environmental-friendly and of course, they also want to benefit from a tax cut. They also seek the same goals other enterprises seek, maximize revenues, and increase Market capitalization. But with this project, it is also possible that the process gets slowed down in the short term. We must keep in mind that the companies are carrying the risk if the whole project backfired, and they started losing customers. That would lower down the

revenue of the enterprises and their advantage over other competitors. But It's also worth mentioning that in the long term, the ROI (return on investment) for the enterprises would be economically and environmentally positive.

The process would start by contacting the packaging provider of the business and agree on the type of materials used for the products and negotiate the price. The businesses would calculate the new price of the products and release it to the market.

The End-consumers

The end customers are the most complicated variable in this equation. Yet, they have the ultimate power to support this project and the enterprises or destroy them. The consumer's job is not easy. The process of choosing a specific product from many others is a relatively long and the calculations that happen in the consumer's head are complex.

There are two types of consumers in this situation. The first type of consumers would react negatively due to the rising prices and stop buying those products or will search for cheaper alternatives to satisfy their needs. At the end, the consumers have limited resources every month. The other type of consumer would be willing to pay for the enhanced product and would think of the price difference as a small contribution to the environment. In addition to that, the consumers would be proud of themselves for buying that product and not the one with the low-quality packaging.

Suggestion 2

Awareness Campaigns (the Art of Marketing)

A product or an idea can be good but if it is not showed to the public in the right way, it loses from its value. Marketing plays a crucial role in distinguishing one product from another. Today, the main aim for everyone is to raise awareness through campaigns.

When we think about marketing and advertising, we think of manipulation, deceit, consumerism and influencing behavior. What if we used that technique for a good thing?

What if we used those same instruments to promote for a better behavior when it comes to waste and separation? We want the people to feel good about themselves when they put the plastic bottle in the plastic waste container or the potato peels in the Bio waste container. The people should reach a point where they literally feel proud of themselves and would pat themselves on the shoulders.

But in able for that to happen, we need a deep understanding for marketing and behavioral psychology.

Marketing both as a practice and a discipline grew enormously in the fifties and sixties. This was partly due to the post-war boom in demand for branded packaged goods and the emergence of large regional and national supermarkets such as A&P and Kroger. Interdependence between marketing and society is the heart of research in macro marketing including the impact of public policy on consumption (demand) and on production (supply). Examples include demarketing of harmful products such as cigarette smoking and alcohol consumption by public policy and regulations. Indeed, most industries are regulated with respect to product safety, product disclosure, product labeling, and truth in advertising and lending laws. Marketing, also on the other side, has an enormous impact on society through social and celebrity-led aspirations as well as peer group influences. Marketing can and does enhance consumers' willingness to pay even in segments of the society where there is no ability to pay (Sheth, 2021).

The biggest debate that we want to solve is: what kind of advertisement and marketing strategies would have a bigger impact especially on the people living in the hinterland? Content that would leave them happy and smiling? Or Content that would disturb or irritate them?

Negative marketing is a tactic that traditionally taps into negative emotions such as fear, irritation, anger, or sadness in order to elicit a response from the consumer, often in favor of what a brand offers or against what a brand opposes or competes with. Studies have shown that Negative (adverse or threatening) events evoke strong and rapid physiological, cognitive,

emotional, and social responses. This mobilization of the organism is followed by physiological, cognitive, and behavioral responses that damp down, minimize, and even erase the impact of that event. This pattern of mobilization–minimization appears to be greater for negative events than for neutral or positive events (Taylor, 1991).



Our idea is to present for the public an environmental villain, a sacrificial Lamb. The idea is to create content 1-offline (Posts in public transportation, newspapers, catalogues) that would target the older generations that still use the traditional media, and 2-online (social media, internet ads, targeted content) for the younger generation that are frequent users of internet, social networks, and smartphones, of people doing things that are unacceptable when it comes to waste disposal. Imagine the next scenario: a video of a person putting the Bio waste in the plastic container, although the bio waste container is exactly next to it. What's your initial reaction? Irritation and anger. It just feels wrong to see such things happen in front of us. Now here's the catch. We want to engrave that picture with that emotion in the heads of people so that when they reach the above-mentioned situation, they would do the right thing. And even if they did throw the bio waste in the plastic container, their conscience will not be easy on them.

With such methods we would be able to influence people to behave better subconsciously. And that's the most effective type of influence. On the other hand, it's very important to mention that such a plan would save a lot of money for the municipality and the taxpayers. All what is needed to get this plan going is a team of brilliant young people that are aware of how social media and marketing works and get creative with designing pictures, ads and directing short videos or sketches.

What is the role of the municipality in marketing? They are the one that have the power to be able to influence and make a change. The municipality can finance the campaigns for a greener city.

The negative marketing has been on the market for a long time. The most well-known negative ads are probably the anti-smoking ads. Companies print the most disturbing pictures with the texts that make people more aware of the risk. The companies publish what can happen in the worst scenery. The videos on the internet with real life events make it even more scary for the people, and with these campaigns a lot of people got off from the cigarette or never starts it.

Suggestion 3

Introducing PAYT system to the hinterland and promoting cooperation between municipalities. Currently, in Brno metropolitan hinterland area, each resident pays the same fee for the operation of the system of collection, transport, sorting, and use of municipal waste. No matter how well a citizen recycles, the fee stays the same. The introduction of incentive discounts or the abolition of the fee is not yet being considered, as Brno officials stated in 2018 (Študent, 2018). However, the municipality of Brno prepares a system of non-financial bonuses as an expression of gratitude to those who sort and participate in waste prevention projects. PAYT system is one of the recommended measures from the European Commission from the Roadmap for the Czech Republic . However, this system also has its disadvantages. There is a risk that citizens will start to behave irresponsibly, for instance depositing waste in

foreign containers or illegal dumping. That's why some municipalities are not planning to apply the system.

The general definition of Pay as you throw (PAYT) system is "a usage-pricing model for disposing of municipal solid waste" (Wikipedia, 2022). The system is very popular many European countries as well, for instance in Denmark, Spain, and Germany. The implementation of the system minimizes the residual municipal mixed waste and at the same time maximize number of sorted components . Several options on how to apply the system are possible. In this section, we'll explain the use of different systems based on the principle *pay as you throw*. Later, we'll discuss the best option that could be applied by the municipality of Brno for the hinterland area. The first option presents the quantitative payment system, applied by the municipality of Trnava Hora in Slovakia. The system was thoroughly described in previous part of this document – case studies from Central Europe. Thanks to the application of the quantitative payment and digital evidence of waste creation, citizens in 2019 produced less residual mixed waste than in 2018 by 23 tons (Enviroportal). Therefore, the municipality faced lower costs for waste management by almost 8%. At the same, Trnava Hora experienced no rise in illegal dumping. On the other hand, neighbors began to motivate each other in separation. Secondly, an electronic waste registration and collection system, short for ELWIS (Slovak abbreviation), was applied in another municipality in Slovakia, in the village of Košeca. The municipality partnered with a solution supplier company, that is an expert in waste management. The company provided the municipality with a comprehensive system that contained collected data from waste management in the village with other solutions that the municipality wanted to use (Noviny, 2019). The benefit of the partnership between the municipality and solution supplier is also the possibility of consulting the development and strategy of self-government in waste management (Noviny, 2019).

Thirdly, the basic explanation of another type of incentive waste management system – MESOH (Czech abbreviation) implemented in the Mikulov region was already discussed as a part of the case studies from the Czech Republic. Now we are going to ground our suggestion based on findings contained in the thesis of Wercholakova which analyses the effects on the municipalities of the incentive system in a 10-year-long period. In her work, she examines the

economic and environmental impacts of this system during years: *“Even though some of the municipal representatives claimed that they perceive the economic impact of the system as slightly negative in the most recent years, the financial data of the municipalities showed that the economic impact is marginal compared to the municipalities without such incentive waste management system. However, all the interviewed representatives considered the environmental impact of IWMS as significantly positive.”* The environmental effects included more households sorting recyclable waste, producing less residual municipal solid waste, and raising people's awareness of environmental issues. All interviewed representatives confirmed that there was no rise in illegal waste dumping (Wercholáková, 2022).

The considerable negative impact, as several representatives disclosed in the interviews, was the economic impact of the system which became a burden for the small municipalities. The author, however, also suggests a possible solution which might be lowering the maximum discount from 70% to a lower percentage (Wercholáková, 2022).

With all that said, we consider the MESOH system, which is already proven to work in Czech conditions as the most suitable version of the PAYT system for the hinterland. However, we are aware that it would be very difficult to implement PAYT in each small municipality. The mayors usually do not have the time and resources to search for the information and they do not know how the system works or what are the costs and benefits. Here would come the role of the Brno municipality which could act as a middleman. The main idea is that Brno municipality would provide a guide and support for other municipalities or to their mayors. This would serve as a promotion of the PAYT system and could convince the municipalities in the hinterland to put an effort into its implementation. Also, the increased awareness of the mayors could further motivate them to cooperate and to benefit from reduced costs of the joint waste management system.

We see as the most preferable solution the intermunicipal cooperation with joint PAYT system. The joint PAYT system means that each municipality that wants to participate in the cooperation would have the same waste management fees. Without the implemented PAYT system, the municipalities, and towns in Dolní Poberouní region managed to lower their waste management costs by creating association Poberounský odpady. Therefore, the

solution comes with several economic benefits. Firstly, the lowered costs due to the intermunicipal cooperation. Secondly, decreased administrative costs of the electronic waste registration and collection system thanks to the introduction of the joint PAYT system. Another advantage is the enhanced environmental impact. This solution could be implemented in several smaller bordering municipalities in the Brno hinterland.

Suggestion 4

The setting of a space dedicated to the DIY reparation and exchange of objects and utensils.

The Spanish Example

Outeiro de Rei is a small municipality of 5000 inhabitants situated 17 km north of Lugo city in Galicia, Spain. Along the lines of recycling and circular economy, they put in place a new municipal space for auto reparation and exchange of different objects.

This helps having a better and wider waste management. Something that is waste for someone can be a treasure for someone else. And therefore, the municipality, along with green company e-Sostenible worked together setting up this initiative that will also be taking place in other towns and villages of the entire Galician Region.

The total cost of it was of 37,500 euros and it will be a one flatted surface of around 60 square meters located right next to the household waste recycling center (punto limpio). This facility will have direct access to the recycling center, it as well as a high ceiling and access for cars.

This will allow to recover used utensils that were deposited in the household waste recycling center of the municipality so that other people that come can exchange them for some others of their interest. This can be a very wide variety of objects going from furniture to toys, clothing, or even small electrical appliances. This industrial will also have a place with basic tools that allow to make small repairs and the auto reparation tasks in the same building (Carrera, 2022).

This public repair shop will open every Friday from 9-13 and 16-19h30, and not only for the citizens of Outeiro de Rei but to anyone who wants to.

How does it work in practice?

The space that has been built will have one storage part and another dedicated to the repairing. The main idea is that the neighbors who want to get rid of an object (clothing,

furniture, electrical appliances...) can give it a second life before throwing it to the punto limpio, this exploits the synergies. That is why they can store it where themselves or another neighbor can repair it with specialize tools. The aim is to provide a working place for people that don't have space at home.

It is likely to work on the hinterland more than in the center since the demand in the center can be to high and get quickly saturated.

This center will mainly offer three different activities:

- Repairing: (reusing, reconditioning, upcycling) As said they will be bringing the broken objects and benefit from the place and the tools, but also from pieces of other goods from the recycling center such as a chair or a table who's lacking one leg or broken electrical appliances because of a cable or a piece.
- Exchange: The users can leave freely objects so that another person can reuse or recover. Before throwing it to the punto limpio you have the option to leave it for someone to repair it especially if you don't have the necessary knowledge for that. On example of this is a neighbor that left a microwave that was broken and another one made a bird's house out of it.
- Training and workshops such as courses on repairing toys or recycling furniture...

Circular economy and savings

Initiatives like this offer a chance to reduce waste but also represent savings for the neighbors. Since the objects are not deposited in the recycling center yet they can be reused before becoming waste, at the essence of circular economy. On top of that collecting less waste implies less expenses for the town that is already paying 100 euros for each ton of waste collected.



Italian Example

In Italy these centers are common they are known as reuse centers, and they are very similar to the one in Outeiro de Rei. There is a large variety in these centers, some are closer to secondhand stores others closer to charity. The motivation also differs apart from the environmental motivation some have more a funding motivation and others more of a social one. Studies made on the population show that these centers have an approval rate of 70%. The initiative is working from an environmental point of view, but it is starting to be used by mafias for money laundering, which can be a real problem. To avoid this the centers need to be legally defined with clear limits and control.

Canadian Example

An initiative on the same line is La Remise in Montreal which is a tool library, it means people can go and work there but also have the possibility to take these tools on a loan. Projects like this promote DIY practices as well as reconditioning, better use of resources and the sharing of knowledge, combining both environmental goals with social goals.

What is there in Brno?

In our search we found that the closest thing to this concept that exists in Brno is FabLab. Like La Remise, FabLab provides tools and organizes workshops. Many high-performance machines are available for the users to do their projects. It is a great initiative since these machines are not generally at the reach for people. It is also a part of circular economy and sharing economy, the machines are used by many more users and not just by one, there is an optimization in the resources, but also, they are many times used for repairing objects extending their lifetime.

FabLab is open for all types of public entrepreneurs, designers, artistes, students, and DIY, but it is a paying space. It is the only place in Brno of these characteristics and the only one in the entire country (FabLab, 2022).



Our suggestion

We suggest building these by the municipal disposal centers. This is very useful because it reduces the needs for publicity, since it is already by the disposal center the users will automatically see it and can leave their object there or even better, learn about the possibility to repair it. The repair shop part of the center could have the tools from donations of companies from the construction or repairing sector, of whom many are legally forced to change after a certain number of years, but that still can do the work. These tools can also come from donations of the neighbors.

These centers can have the same function as the one described: repairing, storing, exchanging and providing formation. This can also be an opportunity for people with repairing knowledge to work there helping the users, creating a greater sense of community.

This for starters but these centers can be improved. It is true that these facilities being right next to the disposal center almost eliminates the needs of publicity campaigns. But since there won't be a reuse center in every municipality (at least not for now) campaigns can be done to encourage people from neighboring cities and municipalities to come and enjoy, but also contribute to the life of these facilities.

Creating a sort of online catalog could be useful in this information campaign, users looking for a table for example, could look on the internet what tables are at the reuse center. And if there are more than one reuse center in a certain area, it can show a common and wider catalog with the products from all centers nearby. It is important to notice that publicity campaigns should always include people from the municipality since they know their town

better than anyone, and their opinion can be decisive in whether a publicity campaign will work or not.

We could take it a step further and imitate the way automobile scrapyards work. In many countries, such as Spain, when your car has a problem that can be repaired with a new piece many people resort to scrapyards. These places transform cars into scrap, but they disassemble them before and collect the pieces that can still be of use. These pieces are later to be sold at a more reasonable price to the consumer. We could have something like that. As an example, selling like wood boards for people to build their own tables at a lower price that IKEA does. This could create jobs, recycle the materials, avoid creating waste and offer goods at affordable prices.

Suggestion 5

Supporting local production of food by providing communal space for gardening

For this suggestion, we start with the assumption in mind that a certain municipality has a piece of land that falls under its jurisdiction that is not being used for any agricultural activities. We see the opportunity in creating a communal space for gardening to support the local production of food. The concept of *Schräbergärten* or allotments (Senat, 2022) is being used all over Germany on a big scale and especially in Berlin. But if we deconstructed the idea, we notice that the idea can also be implemented on a lower complexity level in the hinterland. At first, the municipality would need to prepare the land in a way that can be immediately planted and used. It would be important to make sure that the quality of soil is good enough and that the land has access to fresh water. Installing natural fences or using trees to separate the gardens would also give the tenants a sense of ownership. Afterwards, the municipality can rent the gardening space to the inhabitants at a price just as high to cover its initial investment cost. The idea isn't to profit from this activity but rather to promote eco-friendly behaviour by harvesting and planting one's own crops. It's also important to mention that an individual that is interested in renting the garden must be aware of the standards that are pre-set and comply to the general house rules (e.g., no poisonous plants, specific number of plants per square meter).

The second option would be to approach the owners of unused properties and discuss the possibility of renting the land to the municipality. In this situation, the municipality would act as a middleman. On one hand, the municipality provides an opportunity for the landowner to profit from their unused property. On the other hand, it allows residents of the municipality and other interested individuals to practice their agricultural habits and hobbies in case they don't have access to a garden. Not only the inhabitants of the municipality but also the citizens of Brno would have the opportunity to rent a piece of the allotment gardens. It's important to have the municipality as an intermediary between the landowners and interested parties to negotiate a price that is reasonable and would attract the attention of interested people. We can claim that the landowners don't need the middleman, but the problem would be that the price they are going to offer for their property is going to be high. The money would flow from the tenants to the municipality and then to the landowners. With that, we reach a win-win-win situation between all three parties.

It would also be a good idea to build a collecting point for the surplus of the crops that the tenants can't consume. In that way, the number of unused crops that rot and go to waste is reduced.

7. Conclusion

This paper gave us the possibility to go through all sorts of information regarding waste and waste management, statistics, urban, and environmental sciences. We got to realize how developed are the methods and systems that are being used in Europe to process waste and dispose of it. It's also noteworthy that the European countries have taken legislative action in order to protect the environment even further. Some of them have been highlighted in this document. And it is working. If we compare the numbers before 20 years with the numbers today, we will notice a great difference in the amounts of waste that is being produced, recycled, reused, landfilled, incinerated, and separated. Brno is one of the places that is doing a great job at that. And the fact that the municipality is supporting the Green city project proves that it's trying to improve it even more.

The literature has also shown that there are a very big number of ideas, suggestions, and alternatives out there that try to get people to behave more environmental-friendly and try to make them act in a way that would contribute to solving the problem of waste in the world. The issue with most of the ideas is that they try to fix the human element. The fact that there are so many ideas suggests that it's not really working, and the reaction of people differs and is not consensus. For example, the idea of having to pay for plastic bags at the grocery stores. For some nations, it works, and the behavior of the people changes. For other nations, people would literally rebel.

That brings us to the fact that the Human element is the most complex factor in the equation of making the world a better place. The technologies are there, the funding is there. The discipline isn't. That's why municipalities and governments tend to use the system of incentives, hoping to enhance the behavior of people. With incentives, municipalities didn't only increase the amount of separated waste but most importantly avoided the rising problem of illegal dumping. Illegal dumping would have been the first solution the people would go to if the government used force and a hard fining system to enforce eco-friendly behavior.

With our suggestions, we try to address different aspects other than the human element. Elements that can be regulated or improved in case the government intervened as a partner, not as an authority. We aim to reduce the residual mixed waste in Brno and increase the rate of waste separation in households, especially in the hinterland of Brno. At the same time, we try not to cross the level of tolerance of all 3 parties (Municipality, Enterprises, End-consumers). And each party has a different tolerance level. That's what makes the issue more complicated.

The transition to the circular economy is not synonymous with a decline in economic activity. On the contrary, the case studies identified show that, in addition to reducing the environmental impact, the circular economy has the potential to increase the number of jobs and foster the development of new markets. However, companies are called upon to rethink their business model and production methods. That's what a lot of the maintainers we've

presented have done, changing the way they design, produce, and sell their products. In fact, as part of this transformation, there are many opportunities for businesses to do business.

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