

## USE OF ECONOMIC INCENTIVES IN DEVELOPMENT OF CIRCULAR ECONOMY IN MUNICIPAL WASTE MANAGEMENT

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**Abstract:** The circular economy model assumes active participation of producers and consumers in two big loops (cycles): biological and technical. Without involvement from both these groups of economic entities, it is not possible to close the circulation of materials for the purpose of their economic use for as long as possible. The paper discusses theoretical and practical aspects of the application of economic incentives, stimulating departure from the linear model of the economy for the circular one in municipal waste management. As a result, maximizing the efficiency of raw materials use and maintaining materials in the economic cycle should be simpler and cheaper than consumption of primary resources.

**Keywords:** circular economy, municipal waste, model of management.

### 1. Introduction

The growing demand for natural resources around the world is caused by an increasing human population and aspiration of billions of people, not only in less developed countries, to reach a higher level of consumption. The scale of production and consumption generates negative consequences, which are more and more recognized by science and by societies. It resulted in the development of the concept of circular economy as the best way to hamper demand for primary raw materials, and space for new landfills, to reduce emissions of greenhouse gases and to give new impetus for more sustainable economic growth. The article attempts to answer the research question on how to stimulate the departure from the currently dominant linear model of the economy towards a circular economy in municipal waste management. In particular, what economic instruments can be used to increase the households' interest in being inside the circular economy and not outside of it. In the article in accordance with EU regulations it was assumed that: *In a circular economy the value of products and materials is maintained for as long as possible; waste and resource use are minimized,*

*and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value* (European Commission, <https://ec.europa.eu/growth/...>).

## **2. Methods of research**

Circular economy as a new approach to economic development in accordance with social expectations and ecological limits is a political issue. It means that special regulations and instruments to realize such policy are required. In the research, based on studies of literature and European Union's regulations, economic incentives used in supporting the circular economy in municipal waste management were analyzed. The economic instruments were assessed to formulate some recommendations for the future. The final result is the model of the circular economy for households and enterprises cooperating together because of the profitability of the proposed solution.

## **3. Waste management as a key factor in circular economy**

### **3.1. Review of the literature**

The idea of circular material flows as a model for the economy was already presented in 1966 by Kenneth E. Boulding in his paper *Economics of the Coming Spaceship Earth* (Boulding, 1966). The practical applications of circular economy to modern economic systems and industrial processes have gained momentum since the late 1970s. It means, that the idea is not new, but nowadays an acceleration in its development is observed worldwide. It resulted from economic, environmental and social reasons. Walter Stahel and Geneviève Reday-Mulvey (1981) sketched the vision of a circular economy as an economy in loops in 1981 in a book *Jobs for Tomorrow: The Potential for Substituting Manpower for Energy*.

The circular economy model assumes active participation of producers and consumers in two big loops (cycles): biological and technical. Without involvement from both these groups of economic entities, it is not possible to close the circulation of materials for the purpose of their economic use as long as possible. In such type of economy the concept of 'waste' is to be replaced by the concept of 'nutrient'. In this case, a nutrient is a substance that provides nourishment essential for growth and the maintenance of the life of our economy. Products start their life cycle in a "cradle" and end in the same place as a nutrient for next product generations (Braungart, McDonough, 2009, p. 110; [www.ellenmacarthurfoundation.org](http://www.ellenmacarthurfoundation.org)). In other words, the concept of circular economy aims to overcome the linear economic concept of 'take, make,

dispose' by looping resources. By reducing the demand on primary resources and focusing on local economic activities, circular economy promises to decrease the impacts of the current economic structure on the environment, which should result in better living conditions and a delay in the risk of losing access to important natural resources. The International Resource Panel has estimated that resource efficiency developments would reduce natural resource use by 28% and GHG emissions by 72% and still improve economic growth (<http://www.materialflows.net/circular-economy/>).

It must be realized that the circular economy will become a real choice for economic entities (companies and households) only when it will be profitable *per se* or because it will be developed thanks to political decisions according to the command and control approach. Economic incentives can support and accelerate the transition to a circular economy. Such policy has been adopted in the European Union in 2015. The EU *Action Plan on Circular Economy: Closing the loop* includes greater recycling and re-use by creating a market for secondary raw materials. In accordance with the Final Circular Economy package (2019), a common EU target for recycling is 65% of municipal waste by 2035. A binding landfill target is to reduce landfill to maximum of 10% of municipal waste by 2035, hazardous household waste by 2023, bio-waste by end 2024, and textiles by end 2026 ([https://ec.europa.eu/environment/...](https://ec.europa.eu/environment/)).

The challenge is how to make it not only obligatory, but also profitable. Using economic incentives, particularly financial instruments, is widely discussed (Acceleration the transition..., 2019).

### **3.2. Municipal waste management as a challenge for circular economy in European Union**

Municipal waste is one of the most complex streams to manage due to its diverse composition, its large number of producers and fragmentation of responsibility. It consists of waste collected by or on behalf of municipal authorities and disposed of through waste management systems. Municipal waste consists mainly of waste generated by households. It also includes similar waste from sources such as shops, offices and public institutions. In 2017, residents of EU-28 generated on average 486 kg of municipal waste per person, 46,3% of which was recycled or composted, while a quarter was landfilled. For 2017, municipal waste generation totals vary considerably, ranging from 272 kg *per capita* in Romania to 781 kg *per capita* in Denmark (Table 1). The variations reflect differences in consumption patterns and economic wealth, but also depend on how municipal waste is collected and managed. There are also differences between countries regarding the degree to which waste from commerce, trade and administration is collected and managed together with waste from households. ([https://ec.europa.eu/eurostat/...](https://ec.europa.eu/eurostat/)).

**Table 1.***Municipal waste generated in selected years 1995 - 2017(kg per capita)*

| <b>Country</b> | <b>1995</b> | <b>2000</b> | <b>2017</b> | <b>2017/1995</b> |
|----------------|-------------|-------------|-------------|------------------|
| Austria        | 437         | 580         | 570         | 30.4             |
| Belgium        | 455         | 471         | 410         | -9.9             |
| Bulgaria       | 694         | 612         | 435         | -37.3            |
| Croatia        | -           | 262         | 416         | -                |
| Cyprus         | 595         | 628         | 637         | 7.1              |
| Czechia        | 302         | 335         | 344         | 13.9             |
| Denmark        | 521         | 664         | 781         | 49.9             |
| Estonia        | 371         | 453         | 390         | 5.1              |
| Finland        | 413         | 502         | 510         | 23.5             |
| France         | 475         | 514         | 514         | 8.2              |
| Germany        | 623         | 642         | 633         | 1.6              |
| Greece         | 303         | 412         | 504         | 66.3             |
| Hungary        | 460         | 445         | 385         | -16.3            |
| Italy          | 454         | 509         | 489         | 7.7              |
| Ireland        | 512         | 599         | -           | -                |
| Latvia         | 264         | 271         | 438         | 65.9             |
| Lithuania      | 426         | 365         | 455         | 6.8              |
| Luxemburg      | 587         | 654         | 607         | 3.4              |
| Malta          | 387         | 533         | 604         | 56.1             |
| Netherland     | 539         | 598         | 513         | -4.8             |
| Poland         | 285         | 320         | 315         | 10.5             |
| Portugal       | 352         | 457         | 487         | 38.4             |
| Romania        | 342         | 355         | 272         | -20.5            |
| Slovakia       | 295         | 254         | 378         | 28.1             |
| Slovenia       | 596         | 513         | 471         | -21.0            |
| Spain          | 505         | 653         | 462         | -8.5             |
| Sweden         | 386         | 428         | 452         | 17.1             |
| United Kingdom | 498         | 577         | 468         | -6.0             |
| <b>EU 28</b>   | <b>470</b>  | <b>521</b>  | <b>486</b>  | <b>3.4</b>       |

Source: based on: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Municipal\\_waste\\_generated,\\_in\\_selected\\_years,\\_1995-2017\\_\(kg\\_per\\_capita\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Municipal_waste_generated,_in_selected_years,_1995-2017_(kg_per_capita).png).

In the European Union, an average of 16 tonnes of material per person per year are consumed, of which 6 tonnes become waste. The municipal waste accounts for only about 10% of total waste generated. The EU economy currently still loses a significant amount of potential secondary raw materials' such as metals, wood, glass, paper, and plastics present in waste streams. The approach to waste management is based on the 'waste hierarchy' which sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, (preparing for) reuse, recycling, recovery, and disposal. Landfilling and incineration without energy recovery are the least preferable waste treatment options. In 2010, 36% of waste was recycled, with the rest landfilled or burned ([http://ec.europa.eu/environment/...](http://ec.europa.eu/environment/)).

Nowadays, for most EU countries an improvement in the national recycling rate is a political goal. The Directive 2008/98/EC on waste established the following target in Article 11(2): "for the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50%

by weight". Therefore, the intended trend in recycling rate is growing. For economic and technical reasons the long term goal can stay below 100%. Recycling includes material recycling (down- and upcycling), composting and anaerobic digestion. In 2017 10 Member States still landfilled over 50% of municipal waste, while five reported rates above 70%. Fourteen Member States have been identified as at risk of missing the 2020 target of 50%. These are: Bulgaria, Croatia, Cyprus, Estonia, Finland, Greece, Hungary, Latvia, Malta, Poland, Portugal, Romania, Slovakia and Spain (COM(2018) 656 final, p. 2). However, the amount of waste recycled (material recycling and composting) rose from 39 million tonnes (81 kg per capita) in 1995 to 116 million tonnes (215 kg per capita) in 2017 at an average annual rate of 5.0%. The share of municipal waste recycled overall rose from 17% to 46% ([https://ec.europa.eu/eurostat/...](https://ec.europa.eu/eurostat/)).

## **4. The model of municipal waste management in the circular economy**

### **4.1. Theoretical and practical remarks**

The development of circular economy needs new patterns of design, production, distribution, management and purchasing based on the approach, that each element used in production should be seen as a part of the matter-energy life cycle in the world. As was demonstrated by Material Flows.net, looping potentials are not only dependent on the product design or the business and purchasing models, but also on the type of processed materials. Biomass, for example, is used by more than 80% energetically in the form of food, feed, and fuel, and is therefore difficult to reuse. For the same reason also fossil fuels have a low circularity potential. In contrast, metals and minerals have almost infinite reuse and recycle potential (<http://www.materialflows.net/circular-economy/>).

The circular economy is much more comprehensive than the traditional focus on recycling. An increase in material productivity is achieved by elaborating various looping opportunities within the life-cycle of materials. However, it is not for free: creating and maintaining of the bigger loops cost more than smaller circles, where materials return faster to consumption and fewer resources are required. For example, sharing or reusing products among consumers requires less energy than recycling of these products. It is necessary to make the circular economy model a natural choice for each economic entity because of the cost-effectiveness.

The development of such model results from the interaction of two factors – knowledge and profitability.

Knowledge – in case of circular economy, the development of knowledge has a dual impact. Firstly, it is about better awareness of the threats to society and the environment related to the linear model of the economy. It is knowledge about the consequences of global warming,

the scarcity or limitations in access to water and mineral resources as well as losses in biodiversity. Secondly, the development of knowledge concerns new ways of design, production, satisfying needs and post-consumer waste management in households and by local communities. It includes the development of production, organization, communication and transport technologies that enable overcoming of the negative consequences of the current managing methods.

Profitability – in practice the best results are obtained if the behaviour of economic entities results from profitability. New business models arise spontaneously in response to the demand created by environmentally conscious consumers. For example, companies dealing in second-hand goods distribution, providing the function of goods instead of goods as such (rentals), operating in the sharing economy segment, mediating in return flows of used goods or parts thereof from the consumer to the producer. In the market economy price is a key factor affecting purchasing decisions, both in the value chain and for final consumers. In the European Union Member States are therefore encouraged to provide incentives and use economic instruments, such as taxation, to ensure that product prices better reflect environmental costs (COM(2015) 614 final, p. 5). The price should *inter alia* reflect the scarcity of resources used in production, costs of labour, transport, storage etc. It may also contain elements that result from the presence of policy instruments for the circular economy: relevant taxes, environmental deposits or product charges. Negative incentives also can be used to punish for staying out loop.

Unfortunately, linear model is deeply rooted in people's mentality. As it was stated in Stakeholder Views Report many factors contribute to the high cost of implementing circular models. These include the high costs of secondary products and raw materials, as opposed to the often lower cost of primary resources. Additionally, circular products tend to be more expensive than 'non-circular' goods because of existing taxation systems, which tend to reward linear model rather than circular one. Value-added tax on upcycled products, for example, requires paying twice (or more) for the same product. (Report..., r2pipproject.eu. p.14). Another economic barrier hindering the transition to circular economy is lack of understanding of the true costs of linear model – particularly costs of externalities including energy production and use, and declining of environmental quality and ecosystem services. The challenge is an accurate estimate of the cost in value chain and life-cycle assessment. Lack of economies of scale in the recycling markets in production of second and next 'generations' of goods is also a problem. The transition to circular economy is hindered by existing covert and overt subsidies that distort full cost-benefit analysis. Additionally, positive externalities linked to reusing, repairing and recycling are underestimated or omitted. Manufacturers often do not fully understand the value of keeping products in circulation for longer, or reusing materials (downcycling instead upcycling is a preferred option). All of mentioned factors reflect the absence of the right signals and values provided by the market.

#### 4.2. Economic incentives for circular economy in municipal waste management

Economic incentives can be recommended for development of circular economy. Fiscal instruments, such as subsidies (tax breaks, targeted subsidies, preferential loans for enterprises and local self-government units, tax differentiation), environmental fees, financial deposits and penalties may be complemented by actions supporting the development of relevant markets and infrastructure for secondary raw material markets. Expanding collection infrastructure, improving consumer awareness, and clarifying the transfer of ownership of waste equipment in the management chain should be used to strengthen the action. Still the problem is the widespread misconception that recycled products are of questionable quality, so there is currently little space for secondary raw material markets. For example, glass packaging can be infinitely recycled without compromising on quality. Each tonne of recycled glass means reducing CO<sub>2</sub> emissions to the atmosphere by 220 kg and saving about 1,200 kg of natural raw materials (glass sand). In economic terms, this means a cost reduction of about PLN 180 (in prices from 2016) (Muradin, 2018). Another interesting example of a new approach is recovery of precious metals from spent mobile phones in ‘urban mining’ (Szamałek, Galos, 2016).

To include households in the circular economy, it is necessary to conduct educational activities and to apply economic incentives simultaneously. Due to the complexity of the municipal waste stream, a different approach should be used for particular types of waste. The model proposed in Table 2. is based on the polluter pays principle and the assumption that post-consumer waste is a stream of nutrients (raw materials) for biological and technical cycles with a specific market value, suitable for further use. The value depends on the type of nutrient and homogeneity of the selected secondary raw material. Toxic and hazardous substances require special attention.

**Table 2.**

*The economic incentives for households in the model of municipal waste management for a circular economy*

| Type of municipal waste   | Recommendation   |
|---|--|
| Beverage packaging (bottles, cans)                                  | <p><b>Deposit system.</b></p> <p><u>Advantages:</u> high social acceptance; the possibility of using automatic thickening machines for plastic bottles and cans; obtaining raw material streams with high homogeneity and purity.</p> <p><u>Disadvantages:</u> relatively high costs of building appropriate infrastructure and providing access to packaging collection points; requirement of standardization and appropriate labelling of packaging by manufacturers.</p> |
| Paper;<br>Glass;<br>Metals;<br>Plastic and multi-material packaging | <p>In case of correct segregation, <b>picking up for free; a fee for incorrectly sorted waste as for mixed waste</b></p> <p><u>Advantages:</u> obtaining of quite homogeneous material streams for reuse (paper, glass, metals, plastics) or combustion with energy recovery.</p> <p><u>Disadvantages:</u> requirement of infrastructure for collection and recovery; requirement of constant monitoring of segregation diligence.</p>                                       |

Cont. table 2.

|  |   |
|--|---|
| Bio-waste  | <p><b>Picking up for free</b> at the place of origin</p> <p><u>Advantages:</u> compostable, suitable for the production of fertilizers for use in agriculture and greenery care, with beneficial effect on the biogen circulation.</p> <p><u>Disadvantages:</u> requirement of frequent picking up due to odors; not suitable for housing estates with multi-family blocks of flats; location difficulties for composting plants; high costs of infrastructure.</p>                       |
| E-waste (batteries, small electrical and electronic equipment) | <p><b>Picking up for free obligatory</b> in all shops trading such items</p> <p><u>Advantages:</u> creation of a stream of raw material with increasing market value (precious and rare earths metals, critical raw materials); minimization of risk to the environment due to elimination of contamination by hazardous components.</p> <p><u>Disadvantages:</u> requirement of infrastructure for collection and recovery; requirement of willingness to participate in the system.</p> |
| Expired drugs  | <p><b>Picking up for free obligatory</b> in all pharmacies</p> <p><u>Advantages:</u> avoiding of contamination of the environment by hazardous substances (hormones, antibiotics, and other biologically active substances).</p> <p><u>Disadvantages:</u> requirement of infrastructure for collection and recovery; requirement of willingness to participate in the system.</p>   |
| Mixed waste  | <p><b>Picking up with a fee per container / bag</b></p> <p><u>Advantages:</u> the fee covers only waste actually generated and unsuitable for segregation, encourages proper segregation.</p> <p><u>Disadvantages:</u> risk of throwing garbage in random places.</p>   |
| Bulky waste<br>Post-renovation waste                           | <p><b>Limited amount picking up for free</b></p> <p><u>Advantages:</u> environmental protection against waste abandonment in random places (forests, ditches etc.).</p> <p><u>Disadvantages:</u> requirement of infrastructure for collection and recovery</p>  |

In the initial phase, the system requires external support particularly for building infrastructure and market development. It may come from ecological funds, central budget, budgets of local authorities, financial resources of waste processing enterprises interested in obtaining streams of homogeneous secondary raw materials. Bank credits and EU funds can be an additional source of financing. The main goal is to obtain a stable stream of recyclable materials in the most homogeneous form for reuse. Especially in the early stages the system requires the involvement of educators, who will train the society how to properly integrate households and other municipal waste producers into the circular economy system. Social campaigns can be useful also. The benefits of participation should be made clear: lower costs of waste collection as well as ecological and social benefits, especially health. The system requires control at all times. The cost of control should be included in fees. Companies processing secondary raw materials should purchase them from cleaning plants at market price. The economic incentive for households is lower cost of waste picking up because they pay only for mixed waste fraction. It is a stimulus for segregation because the fee for picking up incorrectly sorted waste is like for mixed waste. The use of additional penalties for incorrect segregation should also be considered. Convincing people to participate in the system is the most important challenge. One should take into account the occurrence of opportunistic behaviour. The key to success is the involvement of a properly educated and disciplined society.

Changes in existing taxation patterns are also needed. The focus should be placed on lowering value-added tax on recycled products, increasing tax on primary raw materials in favour of secondary raw materials, increase in taxation of non-durable products, including one-



time use, and on externalities. It should be reflected in market price level, which stimulates the behaviour of economic entities.

## Summary

Although municipal waste accounts for only 10% of total waste, due to its complexity and its large number of producers and fragmentation of responsibility, to become a valuable element of a circular economy it requires a special approach. The proposed model of conduct takes into account the advantages of economic instruments that are revealed through economic calculation. Different fractions of municipal waste gain market prices as nutrients for next economic cycles. The propensity for opportunistic behavior of households is overcoming by financial incentives combined with appropriate education. By paying only for the collection of mixed waste, households are encouraged to do due diligence in terms of segregation. Received streams of secondary raw materials are valuable raw materials for enterprises.

## References

1. *A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy*. Brussels: European Commission. COM(2011) 21 final.
2. *Accelerating the transition to the circular economy: Improving access to finance for circular economy projects* (2019). Brussels: European Commission.
3. Boulding, K.E. (1966). The Economics of the Coming Spaceship Earth. In: H. Jarrett *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum* (pp. 3-14). Baltimore.
4. Braungart, M., McDonough, W. (2009). *Cradle to cradle. Re-making the way we make things*. London.
5. *Circular economy: a smart way of using materials*. Retrieved from <http://www.materialflows.net/circular-economy/>, 15.06.2019.
6. *Closing the loop – An EU action plan for the Circular Economy*. Brussels: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2015) 614 final.
7. Directive 2008/98/EC on waste.
8. European Commission. Retrieved from [https://ec.europa.eu/growth/industry/sustainability/circular-economy\\_en](https://ec.europa.eu/growth/industry/sustainability/circular-economy_en). 15.06.2019.
9. <http://www.materialflows.net/circular-economy/>.

10. [https://ec.europa.eu/environment/circular-economy/index\\_en.htm](https://ec.europa.eu/environment/circular-economy/index_en.htm).
11. [https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal\\_waste\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal_waste_statistics).
12. Muradin, M. (2018). Ekoprojektowanie opakowań wsparciem dla gospodarki odpadami. *Energia i Recykling*, listopad, 26.
13. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of EU waste legislation, including the early warning report for Member States at risk of missing the 2020 preparation for re-use/recycling target on municipal waste, COM(2018) 656 final. Brussels.
14. Stahel, W., Reday-Mulvey, G. (1981). *Jobs for Tomorrow, the Potential for Substituting Manpower for Energy*. New York: Vantage Press.
15. *Stakeholder Views Report. Enablers and Barriers to a Circular Economy*. Retrieved from <http://www.r2piproject.eu/667-2/>, 15.08.2019.
16. Szamałek, K., Galos, K. (2016). Metals in Spent Mobile Phones (SMP) – a new challenge for mineral resources management. *Gospodarka Surowcami Mineralnymi*, 32, 4, 45-58.
17. *Tackling the challenges in commodity markets and on raw materials*. Brussels: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM (2011) 25 final.
18. *The raw materials initiative — meeting our critical needs for growth and jobs in Europe*. Brussels: Communication from the Commission to the European Parliament, and the Council. COM(2008) 699.
19. *Towards a circular economy: business rationale for an accelerated transition*. Ellen MacArthur Foundation, [www.ellenmacarthurfoundation.org/assets/downloads/](http://www.ellenmacarthurfoundation.org/assets/downloads/), 15.06.2019.