

The waste management sector of Hungary

ÁGNES HORVÁTH

Associate professor

UNIVERSITY OF MISKOLC

e-mail: vgthagi@uni-miskolc.hu

ANDREA S. GUBIK

assistant professor

UNIVERSITY OF MISKOLC

email: getgubik@uni-miskolc.hu

MÓNKA KIS-ORLOCZKI

associate lecturer

UNIVERSITY OF MISKOLC

email: orloczki.monika@uni-miskolc.hu

KATALIN LIPTÁK

associate professor

UNIVERSITY OF MISKOLC

email: liptak.katalin@uni-miskolc.hu

SUMMARY

Nowadays, the waste management sector faces a number of challenges. Changes in consumer habits generate huge amounts of industrial and household waste. Today's trends, which involve a higher use of critical raw materials, such as in the manufacture of batteries and solar cells, make it urgent to extract valuable raw materials from waste. The waste sector as a whole, taking into consideration all levels of the waste hierarchy (prevention, reuse, recycling, energy recovery, landfilling), is a significant branch of the national economy, both in terms of employment and income-generating capacity. In addition, the sector can be considered a major intermediary in industrial value chains as it contributes to the generation of secondary raw materials that can be sold to industries and thus help to achieve a circular economy through the collection, treatment and processing of waste.

Keywords: waste management sector, circular economy

Journal of Economic Literature (JEL) codes: L26, Q53

DOI: <http://doi.org/10.18096/TMP.2021.02.04>

INTRODUCTION

Today companies have to face two challenges in enterprise resource management.

On the input side of the value chain, the scarcity of resources and therefore the provision of a sustainable resource supply is an increasing problem. Due to its significant dependence on raw materials, the EU emphasizes the classification of raw materials according to their criticality. The evaluation methodology of 2017 classified raw materials according to their criticality based on two factors, economic significance and supply risk. The EU examined 78 raw materials for criticality in its 2017 study, of which 27 were rated as critical. Based on European Commission 2017a,b,c we compiled a list of raw materials used in the five top value-added manufacturing sectors. According to this, it can be stated that in all sectors the proportion of raw materials considered critical according to the 2017 EU classification is significant. In each of the highest

value-added manufacturing sectors the share of critical raw materials in the total variety of raw materials used by the sectors exceeds 50 percent. (The figures for each area of manufacturing are: chemicals and chemical products: 57.%; fabricated metal products: 55.6%; computer, electronic and optical products: 80.0; electrical equipment: 75.0%; machinery and equipment n.e.c.: 46.7%; motor vehicles, trailers and semi-trailers: 55.6%) (based on European Commission 2017a,b,c).

In September 2020, an additional five materials were included in the tested materials, so 30 of the 83 items tested were classified as critical raw materials. The rating of some materials has changed compared to the 2017 rating, and there have been both positive and negative changes (European Commission 2020). Based on the new classification, it is likely that a sectoral analysis today would show similar results to the 2017 data.

Today's development trends, such as the spread of electric cars and the increasingly ambitious shift

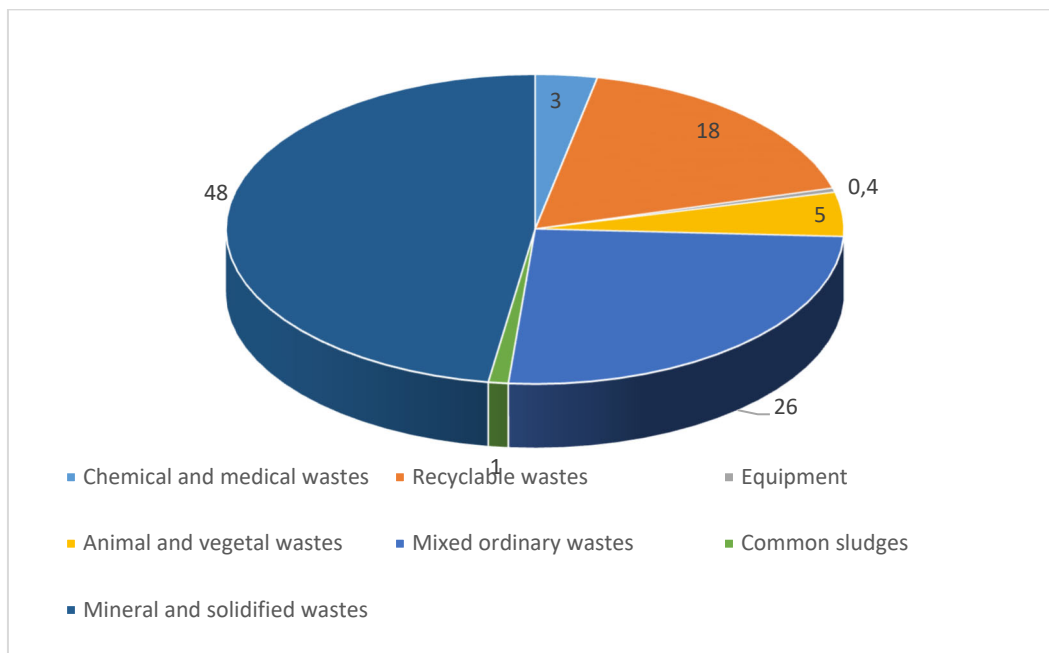
towards renewable energy sources (including solar energy), further enhance this problem while creating other problems due to the waste generated. Batteries and solar cells are increasingly used in the production of high-value, critical raw materials, and their treatment as waste at the end of their life is also a source of significant problems. The construction of appropriate end-of-life management methods and infrastructures can play a key role in reducing this risk, during which valuable raw materials can be recovered from waste (Mathur et al. 2019, 2020). This highlights the key role of the waste sector, which is already facing serious challenges as a result of current production and consumption patterns. The proper management of significant amounts of industrial and household waste and the reduction and avoidance of environmental damage is a serious problem for national economies.

The aim of this article is to describe the current situation of the Hungarian waste management sector

with the help of statistical data, analyse the macroeconomic environment of the sector, and draw conclusions about the future of the sector.

THE ROLE OF THE WASTE MANAGEMENT DIVISION IN THE CIRCULAR ECONOMY

According to Eurostat data, 15,938,077 tonnes of waste were generated in Hungary in 2016 in households and in economic sectors (NACE Rev. 2) together. The distribution of this is shown in Figure 1. It is important to highlight that according to the data, only 18 percent of the generated waste was classified as recyclable waste.

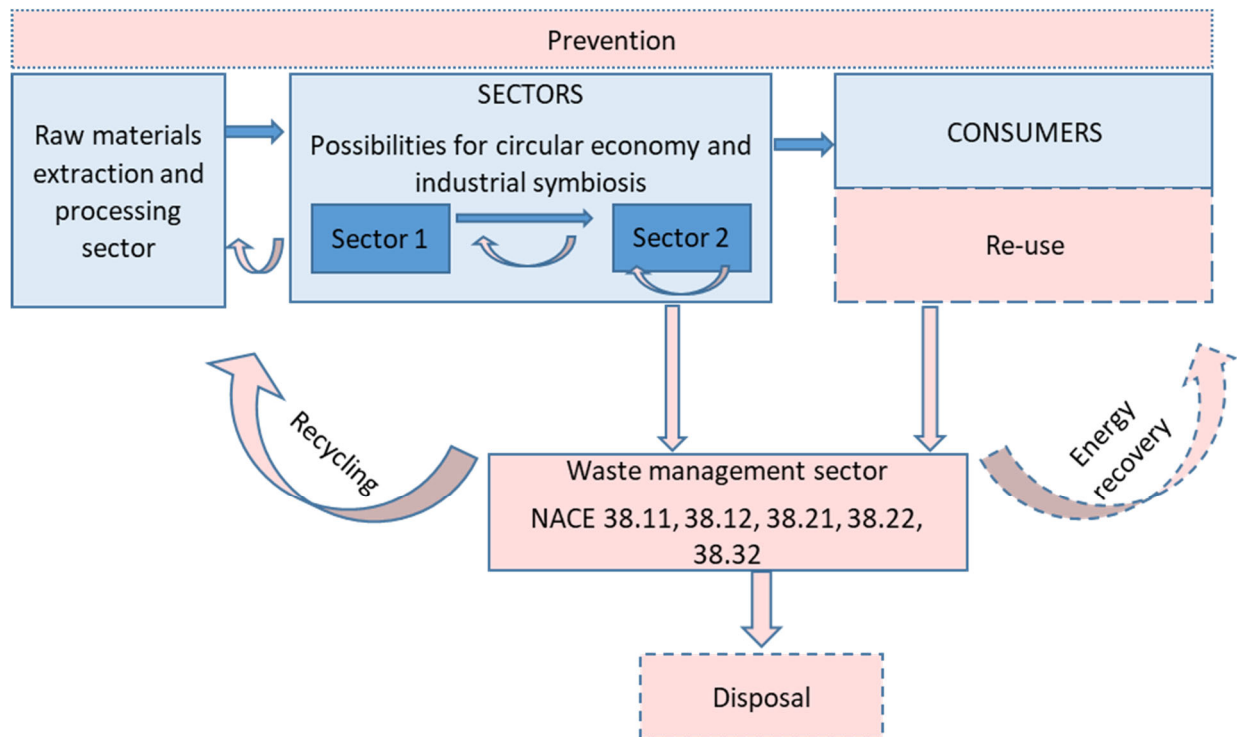


Source: own construction based on Eurostat

Figure 1. Generation of waste by waste category, Hungary, 2016

Figure 2 illustrates the role of the waste management sector, which we consider to be very important for tackling the problems of scarcity of resources and waste management. Our approach is based on the general approach of the industry value chain, where after the raw materials production and raw materials processing sectors, different sectors produce a product for final consumption for final consumers. Some products find a new owner in the form of re-use and eventually end up in the waste

sector in the form of waste. The waste management sector is seen as an intermediary that connects waste donors and recipients. It contributes to the production of valuable secondary raw materials through the collection, treatment, disposal, and possible processing of waste. Ultimately, the energy recovery of waste also reduces the amount of materials transported to landfills (Aid et al. 2017; Horváth & Bereczk 2019).



Source: own elaboration

Figure 2: Role of the waste management sector in solutions for sustainable resource management.

The problem of waste management is a burning issue nowadays, and tightening environmental regulations lead to predictions for the growth of the sector while all segments of the waste pyramid offer many opportunities to implement innovative ideas. Based on all of these factors, we consider the waste management division to be a priority area of a solution to the parallel problems of scarcity of raw materials and the high amount of waste generation.

METHODOLOGY OF THE RESEARCH

Information on the waste management sector was compiled based on the data available from the OPTEN database of Hungarian companies. The database contains data on enterprises operating in the sector in December 2019, partly for the closed year 2018 and partly for the period of the last five years (2014–2018). The limitation of the database is that the data for five years are compiled from the data of currently operating enterprises, so they do not include the performance of companies that have been closed down in the meantime. Thus, we draw conclusions for the sector based on the data of companies with five closed years.

The most important characteristics of the domestic waste management sector for Hungary are summarised primarily on the basis of the aggregated data of companies. We examined the business

demography characteristics, net sales revenues, employment data, and profitability indicators of the currently operating enterprise in the period 2014–2018.

Beyond the classification according to the main activity, there are typically several areas in the activity of the companies; thus, we examine the five classes of the waste management division together. Division 38: Waste collection, treatment and disposal activities; materials recovery consists of five classes: 38.11 Collection of non-hazardous waste, 38.12 Collection of hazardous waste, 38.21 Treatment and disposal of non-hazardous waste, 38.22 Treatment and disposal of hazardous waste and 38.32 Recovery of sorted materials.

THE IMPORTANCE OF THE WASTE MANAGEMENT DIVISION IN THE NATIONAL ECONOMY OF HUNGARY

The waste management division (NACE rev. 2 division 38) belongs to NACE rev. 2 Section E - Water supply; sewerage; waste management and remediation activities. In the publicly available KSH (Central Statistical Office of Hungary) databases we find data only at the level of sections. The most important macroeconomic data on Water supply; sewerage; waste management and remediation

activities in Hungary (2014-2018) is summarised in Table 1.

Table 1
Data on NACE rev. 2 Section E - Water supply; sewerage; waste management and remediation activities in Hungary (2014-2018)

	2014	2015	2016	2017	2018
Gross domestic product (at current price, million HUF)	259 424	277 104	302 060	315 395	312 379
Number of full-time employees (thousand people)	38.7	38.4	41.0	39.9	40.5
Average gross monthly income of full-time employees (HUF)	224 447	230 574	234 037	269 090	300 387
Average net monthly income of full-time employees (HUF)	151 959	154 583	161 091	184 663	204 083
Number of enterprises	1 734	1 689	1 877	1 812	1 717

Source: KSH (Central Statistical Office of Hungary)

Section E accounts for about 0.8% of the total gross value added of the national economy and about 1.5% of the number of employees. The average gross and net monthly incomes of full-time employees are lower than the average monthly earnings in Hungary (by about 8–10%). Of all enterprises, 0.24% operate in this section. The value of gross fixed assets at current prices was HUF 4,795 billion and the value of net fixed assets was HUF 2,886 billion in 2016, which corresponded to about 2% of the total assets of the national economy. However, these data also include data on water supply and wastewater collection and treatment.

In general, the performance and importance of the waste management sector cannot be judged

solely on the performance of companies with a given NACE rev 2 code. The performance of the sector is underestimated in official statistics; its real performance can be interpreted along the industry value chain, as many innovations and achievements related to waste management/recycling are reported in the user sectors under other NACE rev. 2 codes.

COMPANIES IN THE INDUSTRY

The companies of the waste management sector and their characteristics were examined on the basis of the OPTEN database.

Table 2
Business demography of Hungarian enterprises operating in the waste management sector

NA CE Class	Activity	Number of enterprises 2019	Data availabl e for 2018	Number of companies surviving 5 years	Numb er of new companie s 2014- 2019	Closed without a legal successor 2014-2018
38.11	Collection of non-hazardous waste	433	409	356	76	200
38.12	Collection of hazardous waste	43	43	38	4	16
38.21	Treatment and disposal of non-hazardous waste	212	190	138	71	90
38.22	Treatment and disposal of hazardous waste	57	54	46	10	23
38.32	Recovery of sorted materials	311	277	221	95	196
Div. 38	Waste management total	1056	973	799	256	525

Source: own elaboration based on OPTEN database

Table 3
Distribution of companies by size (based on the number of employees) (2018)

NACE class	Enterprises with 0 employees	Share of microenterprises %	Share of small enterprises %	Share of medium-sized enterprises %	Share of large enterprises %
38.11	71	66.3	20.0	12.2	1.5
38.12	8	79.1	18.6	2.3	0.0
38.21	53	76.3	15.3	6.8	1.6
38.22	16	55.6	31.5	13.0	0.0
38.32	82	78.7	16.2	5.1	0.0
Div. 38 total	230	71.7	18.6	8.7	0.9

Source: own elaboration based on OPTEN database

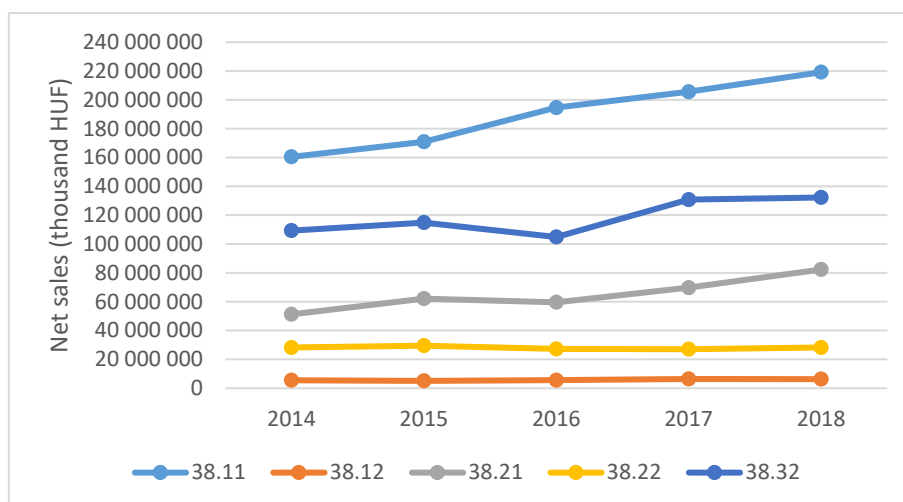
In 2019, there were 1,056 companies operating in the examined sector. The dominance of micro-enterprises is typical (72%). The medium company size is mainly found in the field of waste collection and in the treatment and disposal of hazardous waste, which is usually the province of public utility companies and with higher technological demands. There are a total of nine large companies operating in the sector, providing activities related to non-hazardous waste.

In terms of their legal form, out of 973 companies (2018), 855 companies operate as limited liability companies, 61 as limited partnerships, 41 as limited companies, 15 as co-operatives, and 1 company as a general partnership.

The waste management sector employed 20,367 people in 2018, of which the SME sector accounts for 71%. The rate of employees engaged in the

collection of non-hazardous waste was 61.5%, 18% were employed in the treatment and disposal of non-hazardous waste and 13.1% in recovery of sorted materials. The collection, treatment and disposal of hazardous waste accounts for 7.4% of employment.

We drew conclusions about the development of the net sales revenue of the sector on the basis of the data of 799 companies with 5 closed business years. The combined net sales revenue of these companies increased by 32% from 2014 to 2018. The largest increases were in the collection, treatment and disposal of non-hazardous waste, but there was also an increase in the recovery of sorted materials. The collection, treatment and disposal of hazardous waste accounts for a smaller share of the sector's net sales revenue, and growth was also the smallest in these areas.



(38.11: 356 enterprises, 38.12: 38 enterprises, 38.21: 138 enterprises, 38.22: 46 enterprises, 38.32: 221 enterprises, total 799 enterprises)

Source: own elaboration based on OPTEN database

Figure 3. The development of the waste management sector's net sales for companies with 5 closed business years, 2014–2018

In the first three years between 2014 and 2018, the profitability indicators for waste collection, treatment and disposal were typically better than those for the recovery of sorted materials, but in the last two years the profitability indicators of the latter sector also increased. In 2018, 64% of companies in the sector were profitable (based on data from 973

companies). The proportion of profitable companies in the field of recovery of sorted materials was lower. Profitability indicators were calculated on the basis of aggregate data from 596 profitable SMEs and the results are shown in Table 4. It can be seen that profitability varies from class to class.

Table 4
Profitability characteristics of the waste management sector of Hungary

NACE class	Rate of profitable enterprises (%, 2018)	Operating profit/total assets (%, 2018)	Operating profit/net sales revenue (%, 2018)
38.11	69	8	7
38.12	81	14	11
38.21	62	12	10
38.22	69	2	13
38.32	54	11	6
Div. 38 total	64	-	-

Source: own calculations based on OPTEN database

Out of the top 50 companies in the waste management sector of Hungary concerning turnover, 24 operate in the collection of non-hazardous waste and 11 in the field of treatment and disposal of non-hazardous waste. This is because most of these companies are public utility companies. Eleven companies operate in recovery of sorted materials among the largest companies. The remaining four companies belong to the treatment and disposal of hazardous waste. Half of the top 12 companies operate in the field of recovery of sorted materials. These companies are: INTER-METAL Recycling Kft., MÜ-GU-Kft., Loacker Hulladékhasznosító Kft., ERECO Zrt., GEOSOL Kft., and Hamburger Recycling Hungary Kft.

PESTEL ANALYSIS OF THE INDUSTRY

The PESTEL analysis concerns six factors: political, economic, social, technological, environmental, and legal. In the following, we examine the selected sector along these lines.

POLITICAL AND LEGAL ENVIRONMENT

The waste sector is subject to strict European Union and domestic regulations. EU regulation is based on three main pillars:

- European Union legislation on waste – Waste Framework Directive 2008/98/EC,
- European Union legislation on waste management operations,

- European Union legislation on specific waste streams.

Waste management issues in the European Union are basically regulated by the European Commission Directive 2008/98/EC. The directive lays down measures to protect the environment and human health. It defines a number of relevant concepts, such as waste, hazardous waste, waste management, recovery, and recycling. Besides it determines the levels of the waste hierarchy, which are:

- prevention;
- preparing for re-use;
- recycling;
- other recovery, e.g. energy recovery;
- disposal.

It also led to tightening of regulations on companies by introducing the “polluter-pays principle” and the “extended producer responsibility”.

The polluter-pays principle has become a guiding principle at both European Union and international level. The point is that “the waste producer and the waste holder should manage the waste in a way that guarantees a high level of protection of the environment and human health” (Directive 2008/98/EC, p. 4). Extended producer responsibility is designed to promote the efficient use of resources in the design and manufacture of products, taking into account the full life cycle of products, including their repair, reuse, disassembly and recycling (Directive 2008/98/EC).

Observing trends in EU legislation, it is clear that the European Union has been introducing continuous tightening since the 2008 Directive (which itself introduced stricter principles). The legislation focuses mainly on reducing industrial emissions and

on hazardous substances used in electrical and electronic equipment and the treatment of waste from such equipment. The most relevant Hungarian regulations are closely related to the EU Directives.ⁱ

ECONOMIC ENVIRONMENT

For the analysis of the economic environment, we first reviewed research project funds available in the raw materials sector, in particular the waste sector, including Horizon 2020 resources at the European level and the opportunities provided by domestic structural funds and government resources.

The supported H2020 projects were filtered using the keywords “Raw material”, “Circular economy” and “SMEs”. This yielded a list of 51 projects to be examined. Of these, 11 were coordinated by Hungarian coordinator organizations (UNEXIM, InnoPellet, reNEW (2016), reNEW (2017-2019), OpenHeritage, BrailleJet, START2ACT, CFMEBR, ULTIMATE, ultimate, and OPTOFORCE) while the rest included a Hungarian participant. The project types are: Innovation (IA), Research & Innovation (RIA), Coordination & Support (CSA) and SME. The topics of the supported projects within the raw materials sector is extremely diverse; we did not find a focus area for Hungarian-related projects. Topics include highly automated deep mining, an international training centre for professionals in the raw materials sectors, mapping and developing new co-operation opportunities related to raw materials, an EU databank for secondary raw materials, circular economy, recycling in the textile industry, food waste, agricultural waste, waste heat recovery, industrial symbiosis in the construction value chain, wastewater treatment and sewage treatment. The requested grant in the examined projects ranges from EUR 0 to EUR 1,510,990 euro.

We did not find any indication of a funded Hungarian-related project that specifically supports start-ups, either in the waste management sector or in the circular economy. The reviewed projects can be linked to a total of 29 Hungarian organizations.ⁱⁱ

Reviewing the Hungarian funds, we highlighted the projects supported by the operational programmes KEHOP (Environmental and Energy Efficiency Operational Programme) and GINOP (Economic Development and Innovation Operational Programme). We also reviewed EFOP (Human Resources Development Operational Programme) projects, including projects dealing with the raw materials sector, e.g. Project EFOP-3.6.2-16-2017-00010 entitled “Sustainable Raw Materials Management Thematic Network - RING 2017”, but these focus primarily on the supply and education of researchers. Within KEHOP the following support schemes deal with the waste management sector:

- KEHOP-3.1.1-17 - Development of municipal waste collection, transport and pre-treatment systems;
- KEHOP-3.1.2-17 - Diversion of biodegradable waste from landfills;
- KEHOP-3.1.3-17 - Attitude formation toward waste prevention
- KEHOP-3.2.1-15 - Development of pre-treatment, recovery and disposal subsystems for municipal waste;
- KEHOP-3.2.2-15 - Systematic development of a network of municipal waste treatment facilities for phased projects.

Evaluating 40 projects, it can be said that these projects primarily serve to support state-owned companies and local governments, while primarily supporting the development of landfills instead of decreasing the quantity of waste or using it as secondary raw materials.

Within the GINOP projects, a number of projects focus on micro, small and medium-sized enterprise development; there is a sub-project related to start-ups (GINOP-2.1.5-15 - Building an innovation ecosystem (startup and spinoff) and supporting young people to become entrepreneurs appears as well (GINOP 5.2.2-14; GINOP 5.2.3.-16; GINOP 5.2.7.- 18). However, they are not sector-specific, so applicants compete strongly with other sectors for resources (<https://www.palyazat.gov.hu/>).

In addition to EU and national funds, there are a number of other opportunities to be found for start-ups, such as business angels or venture capitalists. However, it can also be said that most of them do not specialise specifically in the raw material sector or, within it, in the activities of the waste management sector, so new companies have to compete with companies in other sectors as well. However, encouraging examples can be found here, e.g. the Bonitas Investment Fund Manager (Bonitas Befektetési Alapkezelő) mentions the sustainable environment as a priority area, to which waste management is also linked (<https://bonitasktk.hu/befektetesi-politika/>). By the end of 2016, companies in the Water Supply, Sewage and Waste Management sectors had contracted approximately HUF 2.5 billion among the investments of JEREMIE venture capital funds (Equinox Consulting 2016). In the Széchenyi Capital Investment Fund (Széchenyi Tőkebefektetési Alap), we do not find a winning application specifically from the waste management sector, but they support two companies related to wastewater utilisation, which may mean a shift in the circular economy (Biopolus Technológiák Zrt., Cyclator Kft.) (www.szechenyi.szta.hu/befekteteseink/?fwppaged=2). Hiventures' portfolio includes Plantoon Technologies Ltd, which develops bio-plastic composting technology

(www.hiventures.hu/portfolionk?o=10).

Internationally, Chivas Venture (<https://www.chivas.com/en-EN/the-venture>) is specialised in revitalising the circular economy, supporting a number of start-ups from reducing food waste to recycling used tires.

Low-interest, state-subsidized loan programmes are available for SMEs, e.g. Growth Loan Program Refinancing loans disbursed under the “Hajrá” Programme (Növekedési Hitelprogram Hajrá keretében folyósított refinanszírozási hitelek) or Széchenyi Card Programme. However, the conditions of these are not necessarily suitable for start-up companies. For example, one condition may be at least two closed business years, during which the company cannot be unprofitable.

The preparation of the Hungarian Waste Management Strategy is in progress. The aims are to increase the economic policy role of the sector and to support the achievement of sustainability goals and the transition to a circular economy (A Nemzeti Hulladékgazdálkodási Stratégia kimunkálásához kapcsolódó tanulmányra ad megbízást az ÉMI (2020, April 9). This is also important because shareholders in the waste management sector expect more public support to fully exploit the potential of waste recovery. (Héjja 2020)

SOCIAL ENVIRONMENT

Two levels of the waste management hierarchy, prevention and re-use, are greatly influenced by consumer behaviour in society. The people have a big impact on the production processes, as their consumption habits generate the production processes. If we could achieve significant changes in the demands of the population, it would also change the production processes (the supply side). That is why it is important to give higher priority to the formation of a social opinion on waste, which is still in its infancy in Hungary. Increase in public awareness through awareness-raising programs and initiatives could be the basis for prevention.

Unfortunately, there is still much controversy in this area. For example: a number of good programmes are being launched to change children's attitudes, such as drawing competitions (e.g. “My Environmentally Conscious School” drawing competition, Ministry of Innovation and Technology) and idea competitions (“Be creative from waste!” Ministry of Innovation and Technology; “Become a reuse ambassador”, Bay Zoltán Research Institute), while at the same time selective waste collection is not fully established in Hungarian schools. A large number of websites and information materials are being produced to shape public attitudes, while prices of goods do not reflect decision-makers’ preferences for waste reduction and do not orient consumers towards more sustainable consumption. Currently a clear, central

strategy in the areas of information, awareness-raising and education is lacking.

Reuse, in which case the given product or packaging can be reused for the same purpose as it was originally manufactured for, without any modification, is a good solution to avoid waste. This extends the time of use and saves the product from disposal. A website dealing with possibilities of creating products from waste (<http://kornyezetbarat.hulladekboltermek.hu>) collects a lot of examples and best practices in connection with reuse opportunities. The examples listed below are summarised based on the collection of the website mentioned above. The most well-known example of this for the Hungarian population was returnable (deposit) glass. Unfortunately, manufacturers today are making their products unique by making the world of glass increasingly diverse, making it impossible to economically recycle and reuse glass. In other areas, however, we are witnessing the emergence of new practices. There are already examples of recycling centres that are becoming more widespread in Western European countries in our region. CERREC (Central Europe Repair & Re-use Centers and Networks) has set up re-use centers on an experimental basis. There are several of these in Hungary, such as the two Attitude Shaping and Reuse Centers in Budapest, the Miskolc Reuse Center and the Kaposvár Reuse Center. The essence of the business model is that the population can place their used, redundant, but still usable objects, tools and equipment for free in the centres, which sell them for a symbolic amount. At present, however, there is no re-use center in Hungary for consumer goods collected during industrial, commercial, service and office disposal, and electronic items cannot be placed in these centres.

Another good example of reuse is the many auction portals and classifieds websites (Vatera, TeszVesz, Jófogás, etc.), which do a lot to extend the life of products by linking the demand and supply side. Also recycling stores (replacement of defective parts, repair shops) are included, including second-hand stores, charity shops and commission stores, and online second-hand stores, of which there are many examples in the country. Finally, we should mention public initiatives, which are typically organised on social media (thematic give-and-take groups on Facebook) or in the form of traditional fairs, such as exchange fairs (books, clothes, antiquities). In the case of these initiatives, quality control and renovation activities are largely lacking; the modern reuse business has not yet developed in Hungary.

TECHNOLOGICAL ENVIRONMENT

An advanced technological environment plays an important role in the development of the sector. The demand for state-of-the-art technologies is emerging

at all levels of the waste pyramid, both within the sector and at the level of related industries.

Stricter environmental standards set increasingly ambitious energy efficiency, emission reduction and waste reduction targets for both products and production methods. Greater use of secondary raw materials in production processes is desirable. The need for processing long-lasting, repairable, modular, low-emission, energy-saving, etc. products is becoming ever more apparent. All this requires continuous technological development from manufacturers.

In the case of recycling the waste (or by-product) is recycled as a secondary raw material for use in the

production processes. There is a need for modern technologies on the part of both the sectors that use recycled waste and the waste management sector. Sectors that sell and use secondary raw materials need to recognize the potential of the circular economy and industrial symbiosis. The waste management sector, as a kind of accelerator, is involved in the process of efficient collection, sorting and preparation. Waste collection systems, sorting, cleaning, shredding, and preparation all require different technologies for different wastes. Table 5 collects the quantity and share of recyclable waste categories and also gives possibilities how they can be recycled.

Table 5
The amount of recyclable waste (2016) and its recyclability opportunities in Hungary

Recyclable wastes	Quantity (tonnes)* 2016	Share (%)	Recyclability opportunities **
Metal wastes, ferrous	1 338 015	47.9	Steel industry, production of steel products
Metal wastes, non-ferrous	125 720	4.5	Metallurgy, manufacture of metal cans
Metal wastes, mixed	23 949	0.9	Metallurgy, manufacture of metal cans
Glass wastes	131 618	4.7	Glass production, glass products, packaging
Paper and cardboard wastes	713 579	25.6	Manufacture of paper and paper products
Rubber wastes	54 113	1.9	Rubber sheets, automotive products, road foundation, energy recovery in a cement plant
Plastic wastes	221 334	7.9	plastic product, packaging, film production, textile production, as fuel in cement industry, thermal power plant
Wood wastes	159 293	5.7	Production of furniture
Textile wastes	23 190	0.8	Textile industry, cloths, carpet
Recyclable wastes total	2 790 811	100.0	

Sources: *Eurostat, **Hungarian Waste Management Federation

Energy recovery includes waste incineration and cement plant recovery. Waste incineration as a fuel is mainly found in cement plants to reduce the production costs of cement. Waste incineration in waste incineration plants are used for production of heat and/or electricity. Most incinerators produce combined heat and power (CHP). Central and Eastern European countries lag significantly behind Western Europe in the number of incinerators and in their performance. Modern flue gas purification technologies and processes can ensure that emissions from incinerators are well below the very strict EU limit values. Even so, serious disadvantages of this solution are the air pollution caused by incineration, the loss of secondary raw materials, and other social problems (Bánhidly 2019).

Landfilling is widespread due to its short-term cheapness and simplicity. There are 74 landfills operating in Hungary that meet EU standards. In some cases, landfill gas (biogas) generated in landfills can be used for heat and electricity

generation (for example it is used in district heating in Miskolc)

(<http://kornyezetbarat.hulladekboltermek.hu/hulladek/hulladekhierarchia/>).

According to Eurostat data for 2016, in Hungary waste treatment activities occur in the following distribution: disposal - landfill 34.2%, disposal - incineration 0.6%, energy recovery 7.4%, recycling 54.1%, refilling 3.7%.

ENVIRONMENTAL FACTORS

Efficient waste management plays a key role in the fight against climate change and in other issues of environmental protection. Through recycling, waste is converted into secondary raw materials and returned to industrial production, thus the use of primary raw materials is reduced. Due to this process significant reductions can be achieved in energy consumption, CO₂ emissions, air pollution, water pollution, and water consumption compared to the

production from primary raw materials. For the results available in the field of metal recycling see EuRIC Circular Metals Strategy 2021.

CONCLUSIONS

Today's trends and changes in consumer habits pose a major challenge to the waste sector. In this article, by analysing the situation in Hungary, we established the following:

- Statistics show that the waste sector is a very significant sector in terms of turnover and employment data in the Hungarian raw material sector.
- Taking into consideration all levels of the waste hierarchy (prevention, reuse, recycling, energy recovery, landfilling), the performance and importance of the sector is higher than estimations from official statistics, as many innovations and achievements related to waste

management/recycling in the user sectors are reported under other NACE codes.

- The role of the waste sector in industrial value chains has been defined as a kind of intermediary, which through the collection, treatment and processing of waste contributes to the generation of secondary raw materials that can be sold to industries and thus help to achieve a circular economy.
- The preparation of the Hungarian Waste Management Strategy is in progress. Its objectives – to increase the role of the sector in economic policy and to support the achievement of sustainability goals and the transition to a circular economy – will further increase the future potential of waste management and this role will appear (and already appears, to some extent) in support systems and in the creation of business opportunities.

REFERENCES

- AID, G., EKLUND, M., ANDERBERG, S., BAAS, L. (2017). Expanding roles for the Swedish waste management sector in inter-organizational resource management. *Resources, Conservation and Recycling*, 124, 85–97. <https://doi.org/10.1016/j.resconrec.2017.04.007>
- BÁNHIDY, JÁNOS. (2019). Az energetikai hulladékhasznosítás szerepe a körforgásos gazdaságban (The role of energy waste recovery in the circular economy). Don't Waste It. Retrieved from <https://www.dontwasteit.hu/2019/12/09/az-energetikai-hulladekhasznositas-szerepe-a-korforgasos-gazdasagban/> on May 12, 2020.
- Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Retrieved from <https://eur-lex.europa.eu/legal-content/HU/TXT/HTML/?uri=CELEX:32008L0098&from=EN> on May 12, 2020.
- EQUINOX CONSULTING (2016). Kockázati-tőke-programok eddigi eredményeinek értékelése. (Evaluation of the results of venture capital programs). Report commissioned by the Prime Minister's Office. <https://www.palyazat.gov.hu/download.php?objectId=71217>
- EUROPEAN COMMISSION (2017a). Study on the Review of the List of Critical Raw Materials. Criticality Assessments. Retrieved from <https://op.europa.eu/en/publication-detail/-/publication/08fdb5f-9766-11e7-b92d-01aa75ed71a1> on May 12, 2020.
- EUROPEAN COMMISSION (2017b). Study on the Review of the list of Critical Raw Materials. Critical Raw Materials Factsheets. Retrieved from <https://op.europa.eu/en/publication-detail/-/publication/7345e3e8-98fc-11e7-b92d-01aa75ed71a1/language-en> on May 12, 2020.
- EUROPEAN COMMISSION (2017c). Study on the Review of the list of Critical Raw Materials. Non-critical Raw Materials Factsheets. Retrieved from <https://op.europa.eu/en/publication-detail/-/publication/6f1e28a7-98fb-11e7-b92d-01aa75ed71a1/language-en> on May 12, 2020.
- EUROPEAN COMMISSION (2020)- Study on the EU's list of Critical Raw Materials – Final Report (2020). Retrieved from <https://ec.europa.eu/docsroom/documents/42883/attachments/1/translations/en/renditions/native> on May 12, 2020.
- HÉJJA, E. (2020). A fémhulladék-hasznosítás környezeti és gazdasági előnyei – Végleges formában az EuRIC új brosrúja (Environmental and economic benefits of scrap metal recovery - Final new EuRIC brochure). Retrieved from <https://www.zipmagazin.hu/a-femhulladek-hasznositas-kornyezeti-es-gazdasagi-elonyei-vegleges-formaban-az-euric-uj-brosuraja>
- HORVÁTH, Á. & BEREZSK, Á. (2019). Az ipari szimbiózis szerepe a fenntartható erőforrásgazdálkodásban (Role of the industrial symbiosis in the sustainable corporate resource management). *Észak-Magyarországi Stratégiai Füzetek XVI*(3), 99–109. <https://doi.org/10.32976/stratfuz.2019.10>

- HUNGARIAN WASTE MANAGEMENT FEDERATION, EU-S JOGSZABÁLYOK (EU Regulations). Retrieved from <https://www.hosz.org/jogszabalyok> on May 12, 2020.
- MATHUR, N., DENG, S., SINGH, S., YIH, Y. & SUTHERLAND, J.W. (2019): Evaluating the environmental benefits of implementing Industrial Symbiosis to used electric vehicle batteries. *Procedia CIRP*, 80, 661-666. <https://doi.org/10.1016/j.procir.2019.01.074>
- MATHUR, N, SINGH, S. & SUTHERLAND, J.W. (2020). Promoting a circular economy in the solar photovoltaic industry using life cycle symbiosis. *Resources, Conservation and Recycling*, 155, April 2020, 104649. <https://doi.org/10.1016/j.resconrec.2019.104649>
- NACE Rev. 2 - Statistical classification of economic activities in the European Community. Eurostat Methodologies and working paper. Retrieved from <https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF> on May 12, 2020.
- EURIC CIRCULAR METALS STRATEGY 2021 Retrieved from <https://www.euric-aisbl.eu/position-papers/item/525-euric-circular-metals-strategy-2> on June 20, 2021.
- A Nemzeti Hulladékgazdálkodási Stratégia kimunkálásához kapcsolódó tanulmányra ad megbízást az ÉMI (2020, April 9). <https://www.dontwasteit.hu/2020/04/09/a-nemzeti-hulladeggazdalkodasi-strategia-kimunkalasahoz-kapcsolodo-tanulmanyra-ad-megbizast-az-emi/>

DATABASES

Central Statistical Office of Hungary (KSH) databases

CORDIS - EU research projects under Horizon 2020 (2014-2020) - <https://data.europa.eu/euodp/en/data/dataset/cordisH2020projects> - H2020 Projects and H2020 Project Publications tables

Eurostat databases

GUESS databases

Horizon 2020 Environment and resources data hub - <https://sc5.easme-web.eu/?mode=7#>

OPTEN databases

^{i i} Hungarian Waste Management Federation, <https://www.hosz.org/jogszabalyok>

ⁱⁱ CORDIS - EU research projects under Horizon 2020 (2014-2020) - <https://data.europa.eu/euodp/en/data/dataset/cordisH2020projects> - H2020 Projects and H2020 Project Publications tables; Horizon 2020 Environment and resources data hub - <https://sc5.easme-web.eu/?mode=7#> - filtered to Hungarian data

