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# Possibilities of Development of Municipal Waste Recycling and Incineration in Poland

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One of the basic rules in the field of waste management is the use of processes which are located as high as possible in the waste hierarchy, while taking into consideration the life cycle thinking. This also applies to municipal waste management. Waste prevention is at the top of the hierarchy. This is followed by: preparation for reuse, recycling and other recovery processes, including thermal treatment (incineration) of waste with energy recovery. The disposal of waste, which includes, among others, landfilling, is at the bottom of the hierarchy. Thus, the objective is to move up the hierarchy, which means moving away from waste disposal towards waste recovery.

## 1. Current state of municipal waste management in Poland

### 1.1. Legal status

The municipal waste management is regulated in the first place by:

- the Act of 13 September 1996 on maintaining cleanliness and order in gminas (Journal of Laws of 2013, item 1399, as amended),
  - the Act of 14 December 2012 on waste (Journal of Laws of 2013, item 21, as amended)
- and the ordinances issued on the basis of authorizations contained in these acts.

The general overhaul of the municipal waste management system took place on 1 July 2013. It involved putting the obligation on the municipalities to collect/receive and properly manage this waste, i.e. to transfer the so-called *ownership of waste* to municipalities. At the same time, the municipalities are obliged to achieve target levels, among others, in the preparation for reuse and recycling of municipal waste and reducing landfilling of biodegradable municipal waste. The laws also identify how to implement some of the obligations. For example, municipalities are obliged to hold

tenders for municipal waste collection from property owners or tenders for receiving and handling of such waste (basically, there is no possibility of in-house implementation of these obligations). In turn, when fulfilling the obligation to build, maintain and operate regional municipal waste treatment facilities, the municipalities can choose one of three options: public procurement, public-private partnerships or concessions for works or services.

Given the fact that municipal waste includes, among others, packaging waste, waste electrical and electronic equipment and waste batteries and accumulators, it should be noted that the management of these wastes is also governed by other rules, in particular:

- the Act of 13 June 2013 on packaging and packaging waste management (Journal of Laws item 888),
- the Act of 29 July 2005 on waste electrical and electronic equipment (Journal of Laws of 2013, item 1155 as amended),
- the Act of 24 April 2009 on batteries and accumulators (Journal of Laws of 2015, item 687)

and the ordinances issued on the basis of authorizations contained in these acts.

The landfill fee, which is one of the fees for the use of the environment that were introduced by the Act of 27 April 2001 – the Environment Protection Law (Journal of Laws of 2013, item 1232, as amended), is the financial instrument designed to reduce landfilling of municipal waste and moving waste management up the hierarchy.

## 1.2. National waste management plan

The National Waste Management Plan 2014 (Official Journal *Polish Monitor* of 2010 No. 101, item 1183) relates to waste generated in Poland, particularly municipal waste, hazardous waste, packaging waste, municipal sewage sludge, and waste imported into the country.

National Waste Management Plan covers:

- description of the current state of waste management,
- projected changes in waste generation and management,
- targets for waste management and providing deadlines for their achievement,
- waste management system,
- tasks, implementation of which will improve the situation of waste management,
- the type of projects and the timetable of their implementation,
- financial instruments for implementing the objectives of waste management,
- monitoring system and method for estimating the implementation of the objectives of waste management.

Analysing the state of waste management in Poland, stress was laid on identification of existing problems. Quality of statistical data, level of ecological awareness of the Polish society and the state of infrastructure of waste management belong to the main problems. Moreover, specific problems in particular area were identified.

Concerning municipal waste, including biodegradable, the following problems are being identified:

- insufficient number and processing capacity of facilities for the management of waste, including thermal and mechanical-biological treatment of mixed municipal waste,
- management of municipal waste during the so-called transitional period, i.e. during the period from the closing of landfills not complying with legal and technical requirements to the opening of the waste management plants,
- too slow progress in the development of separate collection of municipal waste, including hazardous waste occurring in a stream of mixed municipal waste,
- lack of legally defined requirements for mechanical-biological treatment of mixed municipal waste,
- lack of systems for collecting expired medicines from households, particularly in the areas not covered by thermal treatment of municipal waste.

As far as the management of packaging waste is concerned, the following problems were identified:

- the recovery and recycling levels achieved so were obtained owing to treatment of waste from business activity, including the commerce sector; unfortunately, it does not have any significant impact on a change in the municipal waste management,
- it is necessary to have this sector of waste management under control as far as reporting and the method for verifying the discharge of obligations are concerned,
- too low mass of packaging waste that is collected separately in households.

With regard to the management of waste batteries and accumulators the following problems were indicated:

- absence of facilities in the country for the management of the used alkaline batteries, securing the recycling efficiency at a minimum of 50 percent,
- existing installations in the country, performing recovery processes of lead-acid batteries and accumulators, have significant spare capacities,

and in case of waste electrical and electronic equipment:

- the collection target of four kg per person per year, from 1 January 2008, was not reached,
- part of waste electrical and electronic equipment, especially waste such as washing machines, refrigerators or freezers end up on scrap yards and are not properly managed and not subject to registration and notification,

- entrepreneurs not sending their reports to the Chief Inspector of Environment Protection or the making them in an unreliable way.

Far-reaching aim of establishing process of national waste management plan is reaching waste management system consistent with the principle of sustainable development, in which the principles of waste management are fully implemented. In particular the principle of dealing with waste in accordance with the waste hierarchy. Implementation of this objective will enable the achievement of other goals such as reducing landfilled waste, particularly biodegradable waste, reduce climate change caused by waste management or to increase participation of energy from renewable sources in the energy balance of the country, by replacing fossil fuel burning by energy recovery methods of waste containing biodegradable fractions.

Accordingly, with regard to the state's ecological policy, the following main objectives were adopted:

- maintaining the trend of decoupling growth in waste generation from economic growth of the country expressed in the GDP;
- increasing the share of the recovery, particularly recycling in relation to glass, metal, plastic, paper and paperboard, as well as energy recovery from waste in accordance with the requirements of environmental protection;
- reducing amount of waste going to landfills,
- eliminating practices of illegal waste landfills,
- creation and launch of a database of products, packaging and waste management.

There will be further changes in the law, arising from the need to transpose the EU law and from the need for changes identified in this plan.

For each group of waste (i.e. municipal waste, hazardous wastes and other wastes), more specific objectives were formulated.

Following objectives were adopted in municipal waste management:

- organising the system of collection of municipal waste covering all residents by 2015 at the latest,
- organising the system of separate collection of waste covering all residents by 2015 at the latest,
- reducing the amount of biodegradable municipal waste going to landfills, should not to be landfilled:
  - more than 50 percent in 2013,
  - more than 35 percent in 2020mass of these waste produced in 1995,
- reducing the mass of municipal waste landfilled to the max. 60 percent of waste generated by the end of 2014,

- preparation for reuse and recycling of waste materials, such as at least paper, metal, plastic and glass from households and possibly from other sources similar to households, at a minimum level of 50 percent of their mass by 2020.

With regard to the packaging waste, waste batteries and accumulators and waste electrical and electronic equipment the aim is to achieve targets indicated in directives and striving to make full use of capacity of treatment facilities for waste batteries and accumulators.

In accordance with the objectives set for the recovery and recycling, there is a need to maintain an appropriate system of separate collection and receiving at least the following fractions of municipal waste:

- green waste from gardens and parks,
- paper and paperboard (including packing, newspapers, magazines, etc..),
- glass packaging waste, divided into clear and colored glass,
- plastics and metals,
- waste batteries and accumulators,
- waste electrical and electronic equipment,
- expired pharmaceuticals,
- chemicals (paints, solvents, waste oils, etc.),
- furniture and other large size waste,
- construction and demolition waste.

In urban areas or regions, which are defined in voivodship waste management plans, as areas affected by the installations for thermal treatment of waste, expired pharmaceuticals, chemicals, contaminated paper and cardboard, can be collected as mixed municipal waste.

In rural areas, green waste can be handled in-house, including composting or in agricultural biogas installations, whereas in family housing areas, in the backyard composting.

According to the adopted system of waste management in the given municipality, the municipal council shall adopt rules of cleanliness and orderliness in the municipality, which will include the adopted system solutions, inter alia obligation for separate collection of the above fractions. Other fractions of municipal waste can be collected together as mixed municipal waste.

Separately collected waste must be accumulated and transported in such a manner as to avoid mixing.

The basis for waste management should be the waste management facilities (WMF), which include regional treatment plants for municipal waste with a capacity sufficient to receive and process waste from an area inhabited by a minimum 150 thousand residents that meet the technical criteria for best available technique, serving respective regions of waste management.

WMFs are obliged to ensure at least the following range of services:

- mechanical-biological or thermal treatment of mixed municipal waste and residues from the sorting,
- landfilling of processed mixed municipal waste,
- composting of green waste,
- sorting of the various fractions of municipal waste collected separately (optional),
- dismantling facility of bulk waste (optional),
- waste electrical and electronic equipment dismantling plant (optional).

In the case of agglomerations or regions covering more than 300 thousand residents, the preferred method of management of mixed municipal waste is their thermal treatment. Infectious medical and veterinary waste will be accepted in municipal waste incineration plants, after their initial deactivation. Within the frames of the regions designated in the voivodship waste management plans, municipalities have to jointly conduct the municipal waste management and ensure the construction and maintenance of waste management infrastructure, in particular waste management plants.

Voivodship plans indicate locations for the recovery and disposal of mixed municipal waste for the certain period, until the construction of regional waste management facilities is completed.

The attainment of goals adopted with regard to the management of packaging waste requires the implementation of the following actions:

- conducting legislative and control works in order to eliminate the grey market,
- expanding technical infrastructure in respect of the separate collection of packaging waste from households,
- expanding technical infrastructure for sorting and recycling of packaging waste,
- introducing instruments for the monitoring of packaging waste flows and the functioning of the system, including the creation of a national recycling register with a register of entrepreneurs that put packaged products on the market, entrepreneurs that put packaging on the market, entrepreneurs authorized to issue documents in confirmation of recycling and documents in confirmation of recovery other than recycling, and register of those document and of producer responsibility organisations (so called recovery organisations).

To achieve assumed goals in the area of waste batteries and accumulators, innovative technologies should be developed and implemented for treatment of waste batteries and accumulators, particularly alkaline, which ensures the effectiveness of recycling. One of the measures to achieve the objectives may also be bringing by the Chief Inspector of Environmental Protection opposition to transboundary movements of such waste, to ensure the implementation of legally binding obligations on the recovery and recycling targets set out in Community legislation.

Achieving assumed goals in the area of management of waste electrical and electronic equipment, requires:

- expanding or upgrading the technical infrastructure for the collection and processing of waste electrical and electronic equipment,
- reduction of the existence of the *grey market* in the economy, by legislative action and control.

In the National Waste Management Plan 2014 detailed tasks were also defined, which apart from legislative actions, include:

- creation and launch of a database of products, packaging and waste management,
- broadening of green public procurement,
- coordination and support of the implementation of scientific research in the field of waste management (*technologies with a reduced rate of waste generation, products with less environmental impact during their use and after its completion, the waste recycling technologies, the conditions of isolation of certain substances and materials, possible to consider them as products*),
- conducting a nationwide information and education campaign on waste management in households.

Based on the reports on the implementation of voivodship waste management plans, and information obtained from various ministries, assessment will be conducted regarding implementation of different tasks specified in the National Waste Management Plan 2014. Moreover, aims defined in the plan will be monitored. The source of data in the initial phase, will be data stored in existing databases, collected in the within administrative system and statistical surveys. After creation of database of products, packaging and waste management, it will become the main source of information. To determine the values of some indicators, data from the reports on the implementation of voivodship waste management plans will be used as well.

It is expected that the national waste management plan will be amended by the end of 2015.

### 1.3. Results

Table 1 shows the data of the Central Statistical Office (CSO) transferred to Eurostat and concerning the overall weight of the treated municipal waste and municipal waste mass treated using different methods in 2004 to 2013. The total mass of treated municipal waste corresponds to the mass of collected municipal waste. The decrease in the amount of waste observed in recent years can be caused by significant emigration and changes in material status of part of the population. In addition, the data in Table 1 show that the percentage of recycled waste is increasing, but the percentage of landfilled waste is still high.

No data is yet available for 2014 – the first year in which the new municipal waste management system was fully in force in Poland, and according to which the municipalities are responsible for collecting and managing municipal waste, in particular from households.

Table 1: Municipal waste management in Poland in 2004 to 2013 (according to CSO data submitted to Eurostat)

Year	Mass of treated municipal waste thousand Mg	Mass of municipal waste treated using different methods thousand Mg		
		Material recycling	Incineration	Landfilling
2004	9,715	243	44	9,194
2005	9,352	367	44	8,623
2006	9,877	487	45	8,987
2007	10,083	580	41	9,098
2008	10,036	895	40	8,716
2009	10,053	1,421	46	7,915
2010	10,040	1,783	39	7,428
2011	9,828	1,173	45	7,659
2012	9,581	1,244	51	7,158
2013	9,474	1,499	*766	5,979

\* Data on incineration for 2013 also include co-incineration of alternative fuels produced from municipal waste in cement plants, which in this case constitutes a dominant part, exceeding multiple times the incineration in the only Polish incineration plant with a capacity of approximately 40 thousand Mg/year.

Table 2 shows information on the morphological composition of municipal waste – according to the National Waste Management Plan 2014; Table 3 shows the existing capacity in the recycling and incineration of municipal waste as of the end of 2013. Even taking into account the fact that currently there are 6 municipal waste incineration plants being built with combined annual processing capacity of approximately 1 million Mg/year, and the cement plants could increase their processing capacity to 1.2 million Mg/year of high-calorie fractions of municipal waste, then comparing the data in Table 1 with the data in Tables 2 and 3, it can be concluded that there is a significant potential – not yet fully exploited – to develop recycling and incineration of municipal waste in Poland.

According to a report from the third OECD Environmental Performance Review of Poland, from 2000 to 2012, EUR 2.4 billion was invested in waste management. Enterprises, including municipal utilities, provided a large share of the financing. Poland's environmental funds and EU financial support also played important roles. This level of funding, however, was not sufficient to achieve national and EU targets. While there was a significant expansion of biological and mechanical treatment and composting, more than half of MSW is still landfilled.

Table 2: Morphological composition of municipal waste in Poland in 2008

No.	Fraction	Share of fraction in generated waste		
		%		
		in big cities*	in small towns**	in rural areas***
1.	paper and paperboard	19.1	9.7	5.0
2.	glass	10.0	10.2	10.0
3.	metals	2.6	1.5	2.4
4.	plastics	15.1	11.0	10.3
5.	multi-material waste	2.5	4.0	4.1
6.	kitchen and garden waste (bio-waste)	28.9	36.7	33.1
7.	mineral waste	3.2	2.8	6.0
8.	fraction of less than 10 mm	4.2	6.8	16.9
9.	textiles	2.3	4.0	2.1
10.	wood	0.2	0.3	0.7
11.	hazardous waste	0.8	0.6	0.8
12.	other categories	3.2	4.5	4.9
13.	bulky waste	2.6	2.6	1.3
14.	waste from green areas	5.3	5.3	2.5

\* – in cities with populations over 50 thousand residents (in 2008, 14.18 million people lived in such cities, i.e. 37.18 % of all Polish population)

\*\* – in town with populations below 50 thousand residents (in 2008, 9.11 million people lived in such towns, i.e. 23.89 % of all Polish population)

\*\*\* – in 2008, 14.58 million people lived in such areas, i.e. 38.93 % of all Polish population

Table 3: Existing estimated capacities with regard to recycling of selected fractions of waste and incineration of municipal waste as of the end of 2013

No.	Type of process	Existing capacity Mg
1.	Paper recycling in paper mills	about 2,100,000
2.	Recycling of ferrous metals in steelworks	about 8,000,000
3.	Recycling of glass packaging in glassworks	650,000 to 750,000
4.	Recycling of flat glass in glassworks	250,000 to 300,000
5.	Incineration of mixed municipal waste in incinerators	42,000
6.	Co-incineration of high-calorie fractions of municipal waste in cement plants	about 1,000,000

Further investment is needed to meet the 2020 targets, notably for the recycling and composting of MSW. Current plans also call for high levels of investment to build MSW incinerators. Given the large costs involved, it is vital to develop a coherent strategy for investment in this sector in which the cost and benefits of alternative approaches are carefully assessed and support is provided to municipalities. Implementation of the strategy should be carefully monitored and adjusted in the light of experience.

## 2. Potential for recycling and incineration of municipal waste

As indicated in the introduction, the main goal should be to manage waste primarily through recycling (both material and biological) or incineration with energy recovery, and the proportion of the mass of waste treated with each method should result from the

analysis, taking into account the criterion that waste management, including recycling, should be done in a sustainable manner, consistent with the increasingly propagated principles of circular economy. The target capacity in recycling and incineration was estimated with regard to the total amount of municipal waste generated and the desired level of recycling, using the assumption that ultimately non-recycled waste will be incinerated (in the transitional period the waste will be treated using mechanical and biological methods) – according to the European Commission’s proposal for 2020 and 2030. The results are shown in Table 4.

Table 4: Estimated target capacity for recycling and incineration of municipal waste

Amount of generated municipal waste	Required level of recycling	Necessary target capacity for recycling	Maximal allowable target capacity for incineration
million Mg	%	million Mg	million Mg
10	50	5.0	5.0
	70	7.0	3.0
12	50	6.0	6.0
	70	8.4	3.6
15	50	7.5	7.5
	70	10.5	4.5

Given the morphological composition of municipal waste and degree of contamination of waste, recycling at the level of 70 percent – with today’s technology – is unrealistic, if it is to be carried out in a sustainable manner, and the recycled materials are to be of high quality. Thus, a more realistic assumption is that recycling of municipal waste should reach 50 percent. Taking into account the activities in waste prevention, the amount of municipal waste generated should not exceed 12 million Mg. Therefore, approximately 6 million Mg of municipal should be recycled – using both material and biological recycling methods. This means that it is necessary to extend and increase the effectiveness of separate collection of municipal waste, including bio-waste as a separate fraction, which in turn means the need to transform the plants for mechanical and biological treatment of mixed municipal waste – the mechanical part transformed into waste separation facilities and biological part (depending on the type of installation for mechanical and biological waste treatment) into facilities for composting green waste or fermentation of bio-waste. As regards incineration of waste, due to the well-developed network of central heating systems in Poland, and the energy needs of the industry, the newly built incineration plants should act as electrical power and heating plants.

Nonetheless, planning new facilities it would be recommended to take into account recommendations included in the report from the third OECD Environmental Performance Review of Poland. In the field of waste and materials management there are following recommendations:

- strengthen efforts to improve resource productivity and reinforce implementation of the material productivity components of the Strategy for Innovative and Efficient Economy,

- update national and regional (voivodship) waste management plans, integrating a coherent investment approach for MSW treatment facilities that aims to meet EU targets for municipal waste recycling and reduce the share of biodegradable waste sent to landfill, and avoiding the development of incineration capacity that outstrips demand or competes with other forms of waste treatment; focus implementation of the National Waste Prevention Programme on priority waste streams,
- consider setting recycling targets for municipal waste at the level of waste regions or voivodships rather than municipalities,
- assess how greater use of economic instruments could support the more efficient achievement of waste management goals, enhance material productivity and support the financial sustainability of waste utilities, including by increasing landfill charges; strengthening the incentive effect of the tax on mineral extraction, including aggregates and introducing a tax on single-use carrier bags,
- expedite the completion of the National Database on Products, Packaging and Waste; adopt measures to improve the accuracy of waste data,
- reinforce efforts to improve public awareness of waste management and resource productivity issues,
- consider establishing a mechanism to support and oversee municipalities in providing efficient and effective waste management services (e.g. through tendering, project preparation and tariff setting); further support the strengthening of capacities in municipalities to promote compliance with waste management legislation and regulations,
- consider ways to strengthen the reliability and performance of environmental producer responsibility systems, including by requiring the certification of producer responsibility organisations and their adherence to an environmental management system (such as EMAS), and the adoption of common reporting formats,
- further develop national register of contaminated sites; provide funding for both remediation and the identification of degraded sites, prioritise sites for remediation on the basis of the risks they pose to human health and the environment.

### 3. Summary

In recent years, there have been positive changes in the field of waste management in Poland. However, taking into account the state of municipal waste management in other European Union countries, further progress is possible. Achieving higher levels of high-quality recycling requires, first of all, appropriate development of the system of separate collection of municipal waste, so that it is efficient and ensures the quality of the waste, as expected by the recycling industry. It should be noted that the paper, steel and glass industries have adequate capacities to process these recyclable materials. Even assuming more than 50 percent of target recycling level (this level should be achieved in a sustainable way), there is still the possibility of expanding the capacity with regard to incineration of municipal waste.

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